Psychobiological and Contextual Influences on Treatment Expectations

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ABSTRACT

Background: Treatment expectations have a significant impact on health interventions and play a pivotal role in placebo and nocebo effects. In the current analysis, we investigated the influence of psycho-biological and contextual factors on treatment expectations in placebo- and nocebo-related intervention studies.

Methods: Data from seven experimental and clinical studies was pooled (n = 173 participants with chronic pain, psoriasis or depression, n = 420 healthy participants). Treatment expectations as well as chronic stress, somatosensory amplification, trait depressive and anxiety symptoms were assessed via self-report. As a measure of hypothalamic-pituitary-adrenal axis functioning, the cortisol awakening response (CAR) was calculated from saliva samples.

Results: Patients in clinical studies reported higher improvement expectations (OR [95% CI] 5.27 [1.20, 23.2]) and side effect expectations (OR [95% CI] = 7.68 [2.16, 27.3]) compared to healthy participants in experimental settings. In the clinical samples, higher levels of stress were associated with higher levels of worsening expectations (OR [95%CI] = 1.88 [1.02, 3.44]). Additionally, previous experience with the intervention was associated with lower side effect expectations (OR [95% CI] = 0.28 [0.11, 0.70]), while somatosensory amplification was associated with higher side effect expectations (OR [95%CI] = 1.28 [1.04, 1.58]). The CAR was not associated with any treatment expectation.

Conclusion: This large-scale analysis identified key correlates of treatment expectations while simultaneously finding no support for an association with the CAR. Clinical samples reported higher improvement and side effect expectations, suggesting that intervention relevance and meaning shape expectations and highlighting the importance of contextual factors in modulating expectations.

Keywords: Treatment expectation; Treatment experience; Cortisol; Treatment setting; Placebo; Nocebo

BACKGROUND

Medical and psychological treatments do not operate in isolation from the context in which they are delivered (Gibbons et al., 2009; Meyer et al., 2022; Rief et al., 2026). Beyond the pharmacological or therapeutic components of an intervention, patients' expectations about treatment outcomes can substantially influence clinical responses (Bingel, 2020; Burke et al., 2026; Enck et al., 2013). These effects are particularly evident in placebo and nocebo research, where positive and negative expectations have been shown to shape symptom experiences and treatment outcomes across a wide range of conditions (Bingel, 2020; Schedlowski et al., 2015; Zilcha-Mano et al., 2019). Specifically, positive expectations are associated with a more favorable treatment outcome, while negative expectations can contribute to symptom worsening or the occurrence of side effects (Faasse et al., 2025; Faasse & Petrie, 2013; Smith et al., 2019). Thus, treatment expectations represent potential targets for interventions that could improve treatment outcomes across diverse health conditions (Basedow, Zerth, et al., 2023; Kube et al., 2018; Laferton et al., 2025; Zerth et al., 2025). Importantly, such treatment expectations are multidimensional constructs, encompassing expectations about symptom improvements, symptom worsening, and the occurrence of side effects (Borgmann et al., 2024; Laferton et al., 2017; Shedden-Mora et al., 2023).

As treatment expectations and their influence on health outcomes remain an understudied subject, it is crucial to understand how they interact with interventions and participant characteristics such as psychological traits, biological factors, learning histories and clinical status. So far, research has shown that expectations are shaped by several treatment-related factors, such as written and verbal information (Carlino et al., 2015), prior experiences (Basedow, Fischer, et al., 2023), or social observational learning (Bajcar & Bąbel, 2024). As these factors shape treatment expectation, a relevant question is whether treatment expectation formation differs between experimental studies with healthy participants without

prior experiences and clinical conditions and clinical intervention studies in which patients have obvious treatment needs. This might be plausible because of individual relevance of the treatment for the personal well-being (Hutchinson & Moerman, 2018) and desire for relief (Price et al., 1999). Furthermore, patients participating in clinical intervention studies have often experienced the same or similar interventions beforehand (Bevan et al., 1993; Devine et al., 2013) and are influenced by these experiences with regard to the formation of their expectations (Basedow, Zerth, et al., 2023; Colloca et al., 2020). These findings are particularly relevant for potential clinical applications, as a better understanding of how patients develop treatment expectations is crucial for designing interventions that effectively optimize beneficial expectations (Blasi et al., 2001; Kube et al., 2018; Peerdeman et al., 2016).

In addition to treatment-related factors and relevance of clinical status outlined above, a specific expectation is also shaped by person-level variables such as psychological traits or biological factors (Bingel, 2020). Previous research has suggested that trait negative affect (e.g., anxiety and depression), chronic stress, and somatosensory amplification, i.e., the tendency to attend more closely to bodily sensations, play a particularly important role in the formation of negative expectations and the development of nocebo effects (Basedow, Zerth, et al., 2023; Doering et al., 2015; A. Fischer et al., 2026; Roderigo et al., 2017; Schäfer et al., 2023).

Regarding biological factors, previous research has focused almost exclusively on the role of neural mechanisms and their role in placebo and nocebo effects (Raghuraman & Colloca, 2025; Spisak et al., 2026). However, seeing as the peripheral nervous system plays an important role in psychological functioning (Packard et al., 2016), the exploration of the reactivity of the hypothalamic-pituitary-adrenal (HPA) axis as measured by salivary cortisol and the cortisol awakening response (CAR) might be a relevant target for exploratory research

(Clow et al., 2010; Pruessner et al., 1997; Wüst et al., 2000). Beyond serving as a marker of physiological preparedness, the CAR is associated with a number of health outcomes, such as depressive symptoms among others (Adinoff et al., 2005; Binder et al., 2009; S. Fischer et al., 2017). This may be particularly relevant in the context of treatment expectations, as several expectation-related psychological constructs, including trait negative affect, chronic stress, and somatization, have been linked to altered HPA axis functioning (Junghanns et al., 2007; Rapcencu et al., 2017; Rief et al., 2010; Ventura-Juncá et al., 2014). Consequently, the CAR might be a relevant measure to explore interindividual differences in the formation of treatment expectations. While first studies suggest that a reduced cortisol response to an acute stressor is associated with stronger positive treatment expectations (Pulopulos et al., 2020; Salzmann et al., 2018), it remains unknown whether HPA-axis reactivity and the accompanying physiological preparedness, independent of any intervention, contribute to the formation of specific treatment expectations. Establishing such a biological trait marker of treatment expectations would not only advance our understanding of the biological mechanisms involved in expectation formation but could also identify novel targets for interventions designed to influence treatment expectations.

To advance these goals the Collaborative Research Centre (CRC) 'Treatment Expectation' (CRC/TRR289) (https://treatment-expectation.de/) was created in 2020 and instigated a large number of placebo- and nocebo-focused basic experimental research studies in healthy participants and intervention studies in diverse clinical samples (e.g., depression, chronic pain or psoriasis samples). Here we analyze seven studies of the CRC/TRR 289, covering experimental approaches in healthy participants and interventional studies in clinical samples. Specifically, our aim was to explore how expectations regarding symptom improvement, symptom worsening and side effects differed between study samples (healthy participants vs.

clinical samples) and were associated with trait negative affect, chronic stress and somatosensory amplification as well as HPA axis reactivity and previous experiences. By identifying factors associated with treatment expectations, we aim to inform strategies for reducing negative expectations and promoting positive expectations, ultimately supporting patient-centered care and future placebo and nocebo research.

METHODS

Procedure

The analyses reported herein are part of the central scientific project (Z02) of the CRC/TRR 289 and are based on data from seven studies investigating treatment expectation and placebo and nocebo effects conducted at three study sites including n = 593 participants between June, 2020 and April, 2024. All included studies focused on psychological and/or pharmacological interventions involving either closed or open-label placebo and nocebo conditions and participants were included across all experimental conditions. Three studies included clinical samples (i.e., chronic back pain, depression and psoriasis) in interventional studies while four studies investigated treatment expectations in experimental settings in healthy participants, see Table 1. As such, the included study populations were classified as clinical or healthy samples. Complete participant level data was available to the authors and was analyzed independently of previously published study-level results. As part of the harmonized design across the CRC projects, all studies assessed treatment expectations before any medical or experimental intervention but after receiving initial information about the treatment itself, including details about the upcoming experiment/intervention. Additionally, chronic stress, somatosensory amplification and trait negative affect were assessed at the beginning of each study.

Saliva samples were collected by participants themselves (see below for details). All studies were conducted in accordance with the Declaration of Helsinki and all participants gave informed consent for their participation. All studies were approved by the local ethics boards and the current analysis was approved by the Ethics Review Board of the Medical Faculty of the University Duisburg-Essen (protocol number 23-11384-BO).

Table 1. Details regarding the analyzed studies.

Project	Study design	Study cohort	Clinical or experimental intervention for which expectation was measured
Study 1 (Aulenkamp et al., 2026)	Experimental	Healthy volunteers N=109	Infusion of placebo naloxone that might increase pain
Study 2 (Baker et al., 2022; Mostauli et al., 2025)	Experimental	Healthy volunteers N=107	Placebo nasal spray (“oxytocin”)
Study 3 (Chuang et al., 2025)	Experimental	Healthy volunteers N=306	Pharmacological mood manipulation (sulpiride 400 mg vs. placebo)
Study 4 (Schmidt et al., 2025)	Experimental	Healthy volunteers N=117	Pharmacological treatment of sickness symptoms (ibuprofen vs. placebo)
Study 5 (Hölsken et al., 2021)	Clinical	Patients (Psoriasis) N=120	Pharmacological psoriasis treatment (secukinumab)
Study 6 (Stuhlreyer et al., 2022)	Clinical	Patients (Chronic back pain) N=65	Pharmacological treatment of chronic back pain (metamizole vs. open-label placebo)
Study 7 (Henrich et al., 2023)	Clinical	Patients (Depression) (N=164)	Placebo pharmacological (buscopan) or psychological (emotional writing task) treatment of depression symptoms

Materials

Sociodemographic information. Age and self-identified gender were recorded during the first study visit of participants.

Treatment expectations. Self-reported expectations were recorded with the German version of the Generic rating scale for previous treatment Experiences, treatment Expectations, and treatment Effects (GEEE) (Rief et al., 2021). Participants rated how strongly they expected the treatment or intervention to lead to an improvement of symptoms, a worsening of symptoms, or side effects ("How much improvement [worsening; complaints / side effects] do you expect from the treatment?") related to the treatment condition on an eleven-point Likert scale (from 0 "no expectation at all" to 10 "highest possible expectation"). The scale can be adapted to any given treatment, with primary outcome variables and treatment modalities tailored to the needs of the study and has been validated in heterogeneous samples (Henrich et al., 2026; Wilhelm et al., 2026). Responses were analyzed as ordinal variables, consistent with recommendations for ordinal response data (Kero & Lee, 2016). Participants also indicated if they had previous experience with the intervention, which was included as a binary independent variable (previous experience vs. no previous experience). The GEEE was collected in line with other psychometric questionnaires during the first day of each study.

Chronic stress. The German version of the perceived stress scale (PSS) (Klein et al., 2016) contains ten items (e.g., "In the last month, how often have you been upset because of something that happened unexpectedly?") rated on a scale from 0 ("never") to 4 ("very often") resulting in a maximum total score of 40.

Somatosensory amplification. The German version of the somatosensory amplification scale (SSAS) (Barsky et al., 1990; Doering et al., 2015) assesses the tendency of participants to amplify somatosensory symptoms. The scale contains ten items (e.g., "When someone else coughs, it makes me cough too") answered on a scale of 1 ("not true at all") to 5 ("completely

true"), with a resulting total score range of 10-50, with higher scores representing a stronger tendency to focus on bodily signals.

Trait anxiety and depressive symptoms. The trait scales of the German version of the state-trait anxiety-depression inventory (STADI) (Renner et al., 2018) were used to assess trait depression and anxiety in participants. The STADI scales consist of 20 items related to trait affect (e.g., "I enjoy life"), scored on a scale of 1 ("not at all") to 4 ("almost always"). The 20 items map onto two summarizing scores ("anxiety" and "depression", 10 items per subscale, range: 10-40), which were analyzed here as distinct facets of trait negative affect.

Cortisol awakening response

Saliva samples for the assessment of the CAR were self-collected by the study participants on two consecutive mornings. In line with the CAR expert consensus guidelines (Stalder et al., 2016, 2022), saliva was collected immediately after awakening (t = 0 min; S1) as well as 30 min (S2) and 45 min (S3) after S1, using commercial collection devices (Salivette Cortisol, Sarstedt, Nuembrecht, Germany). To maximize protocol compliance and sampling accuracy participants used a smartphone application (*SalivApp*, Rocket Apes, Essen, Germany) that was developed within the CRC/TRR 289. To provide saliva samples, participants were instructed to gently move the swab in their mouth for 1 min without chewing. After saliva collection, samples were stored in the participant's refrigerator and brought to the laboratory at the next study visit. Saliva was recovered by centrifugation (1000 g, 2 min, 4°C) and stored at -20°C until testing.

Salivary cortisol concentrations were analyzed by enzyme-linked immunosorbent assay (Cortisol Saliva ELISA, IBL International, Hamburg, Germany) according to the manufacturer's instructions. Cross-reactivity of the anti-cortisol antibody with other relevant steroids was 8.5% (11-deoxycortisol), 2.6% (cortisone), 1.0% (corticosterone), and <0.1% (estrone,

estradiol, estriol, progesterone, testosterone). Inter- and intra-assay coefficients of variation were <10%. All samples of an individual participant were analyzed in the same run.

As measures of HPA axis activity, we report the average salivary cortisol concentration at the time of awakening (S1) across the two sample days and the area under the curve (AUC) with respect to increase (AUC_I) as suggested by the consensus guidelines (Stalder et al., 2016, 2022). The AUC_I was calculated according to Pruessner et al. (2003) by averaging the values for each of the three sampling time points (S1, S2, S3) from both mornings.

Statistical Analyses

All analyses were conducted in RStudio 2023.12.1 (RStudio Team, 2020).

Pre-Processing and data merging

All psychometric data was collected in Limesurvey (Limesurvey GmbH., n.d.) with each study implementing their own survey but all questionnaires being automatically scored through a centrally managed scoring procedure. Data were anonymized through the ALLIAS software (Englert et al., 2023) which also allowed linking the anonymized psychometric data to the cortisol data saved on another server. For each included study the relevant variables were selected and merged in a single combined dataset, serving as the baseline for the current analysis. This overall dataset consisted of data from *n* = 988 participants. Case-wise deletion was applied to the overall dataset removing cases based on missing psychometric or saliva sample data, implausible values in any of the psychometric or demographic (e.g., age below 18) variables, implausible values in the cortisol data (i.e., S1, S2 or S3 < 1, AUC_I > 2000) or collection of the saliva samples outside of a 4-week window in relation to psychometric data collection. After removing n = 165 cases with partially missing data, n = 47 implausible values, n = 57 cases with improper saliva sampling, and n = 126 cases where the saliva sampling date was missing because of an app-related error, the case-wise deletion procedure left a total

sample of *n* = 593 participants. All continuous independent variables were z-standardized study-wise after descriptive statistics based on the raw values had been calculated.

Descriptive statistics

All descriptive statistics were calculated separately for each included study and Variance inflation factor values indicated no collinearity across the z- standardized variables (all VIF < 2.5).

Characteristics of cortisol awakening response

Repeated measures ANCOVA was performed to investigate the development of the cortisol response across all three timepoints (S1, S2, S3) in interaction with the setting variable (clinical vs. healthy sample). Additionally, we calculated Pearson correlation coefficients between the cortisol measures (S1 and AUC_i), treatment expectation outcomes and psychological trait variables.

Modelling treatment expectations

As GEEE outcomes were treated as ordinal, we applied mixed ordinal regression with a cumulative link model and logit link (Agresti, 2010; Winship & Mare, 1984). One model per treatment expectation domain (improvement, worsening, side effect expectations) was calculated with a fixed interaction effect of study setting (clinical vs. healthy) with each psychological variables (PSS, STADI Depression, STADI Anxiety, SSAS), biological variables (S1 & AUC_i) and previous experience, as well as a fixed additive effect of demographics (age, gender) and a random intercept allowing variation of outcomes across studies. As a form of sensitivity analysis, we calculated the abovementioned models separately in the clinical and the healthy subsample of studies, resulting in three models total for each treatment expectation outcome (full sample model, clinical sample model, healthy participant model). Regression coefficients were transformed into odds ratios (= $e^{coefficient}$) to be interpreted as

effect sizes with very small (OR = 1 - 1.67 & OR = 0.6-1), small (OR = 1.68 – 3.46 & OR = 0.29 – 0.59), medium (OR = 3.47 – 6.70 & OR = 0.15 – 0.28) and large (OR > 6.70 & OR < 0.15) effects (Chen et al., 2010). Model fit was assessed via McFaddens' R^2 (McFadden, 1974) with values of > 0.2 representing excellent model fit. The level of significance was set at $p < .05$.

RESULTS

Descriptive measures

A total of *n* = 593 participants were included in the analysis, with n = 173 from the clinical sample and n = 420 healthy participants. Participants were on average 28.9 years old (SD = 10.9), and were nearly equally distributed between male and female gender (*n* = 263 (44.4%) male, *n* = 330 (55.6%) female). See Table 2 for complete descriptive statistics displayed separately per study. The GEEE expectation outcomes showed distinct distributions across projects with a pronounced zero-inflation specifically for worsening expectation, see Supplemental Figure 1 & Supplemental Table 1.

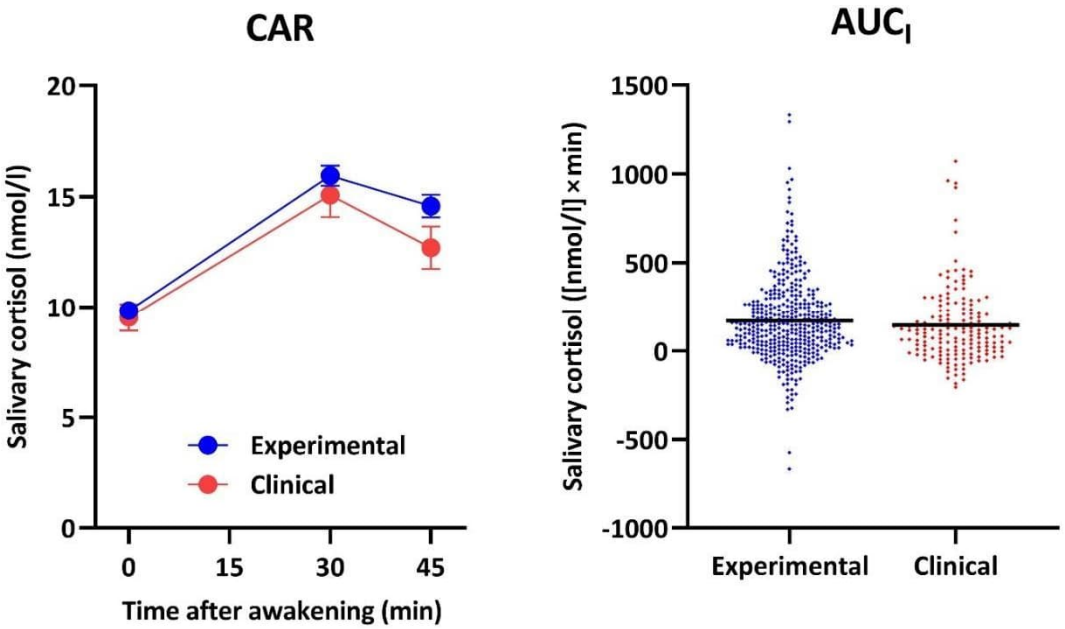
Table 2. Mean (standard deviation) and frequency statistics per study.

	Study 1 (N = 46)	Study 2 (N = 81)	Study 3 (N = 211)	Study 4 (N = 82)	Study 5 (N = 73)	Study 6 (N = 23)	Study 7 (N = 77)	Clinical sample (n = 173)	Healthy participants (n = 420)
Age	24.7 (3.4)	26.4 (4.3)	24.2 (3.4)	25.7 (4.4)	47.4 (15.0)	42.8 (14.3)	28.3 (9.7)	38.3 (15.6)	25.0 (3.9)
Gender - *Male*	N = 17 (37.0%)	N = 37 (45.7%)	N = 102 (48.3%)	N = 33 (40.2%)	N = 45 (61.6%)	N = 6 (26.1%)	N = 23 (29.8%)	74 (42.8%)	189 (45%)
Gender - *Female*	N = 29 (63.0%)	N = 44 (54.3%)	N = 109 (51.7%)	N = 49 (59.8%)	N = 28 (38.4%)	N = 17 (73.9%)	N = 54 (70.2%)	99 (57.2%)	231 (55%)
PSS	14.8 (5.3)	16.3 (6.2)	16.1 (5.2)	12.7 (5.9)	15.4 (6.0)	21.6 (4.9)	25.7 (4.4)	20.9 (7.0)	15.3 (5.7)
SSAS	27.9 (5.0)	28.1 (5.6)	27.8 (5.9)	25.0 (5.3)	25.6 (5.3)	32.5 (5.3)	27.9 (6.1)	27.6 (6.0)	27.3 (5.7)
STADI depression	15.9 (4.4)	17.3 (4.9)	17.7 (4.2)	15.2 (4.2)	20.2 (5.2)	21.5 (6.9)	29.2 (4.3)	24.4 (6.7)	16.9 (4.5)
STADI anxiety	17.2 (4.6)	18.5 (4.9)	18.5 (4.3)	16.6 (4.3)	19.1 (4.9)	20.4 (5.3)	27.3 (5.6)	22.9 (6.5)	18.0 (4.5)
Cortisol S1	11.0 (6.2)	9.4 (6.3)	10.2 (6.2)	8.8 (5.3)	7.8 (5.0)	12.4 (15.1)	10.3 (6.9)	9.5 (8.0)	9.8 (6.1)
Cortisol AUC_I	175.4 (251.3	104.4 (179.1)	206.1 (260.6)	144.4 (189.7)	116.0 (214.0)	186.2 (333.0)	161.2 (211.8)	145.5 (232.1)	171.1 (235.6)
Previous experience - *Yes*	9 (19.6%)	0 (0%)	0 (0%)	61 (74.3%)	73 (100%)	23 (100%)	28 (36.4%)	124 (71.7%)	70 (16.7%)

Cortisol awakening response

Temporal dynamics of the changes in salivary cortisol concentration during the first 45 min after awakening (mean ± SEM) are shown in Figure 1. Results show the expected, significant rise in cortisol during the post-awakening period of 45 minutes ($F(2,1182) = 149.8$, $p < .001$). The experimental and clinical samples did not differ in the CAR ($F(1,591) = 1.85$, $p = .17$) or the AUC_I ($t(325.0) = -1.22$, $p = .22$). Cortisol measures (S1 and AUC_i) showed a small intercorrelation ($r = -.18$) and were not correlated significantly with any psychological trait variable or with treatment expectation outcomes, see Supplemental Figure 2.

Figure 1. Cortisol awakening response (CAR).



Note: Changes in salivary cortisol concentration during the post-awakening phase and distribution of the area under the curve with respect to increase (AUC_I). Data are shown as mean ± SEM.

Expectations of symptom improvement

The full sample regression model for improvement expectations showed low fit (McFaddens' $R^2 = .018$), with between-study heterogeneity explaining 17% of the variance in improvement expectations. Participants in the clinical study setting reported higher levels of improvement expectation scores compared to participants in the experimental setting (OR [95%CI] = 5.27

[1.20, 23.2], p = .03). Additionally, an increase of one standard deviation in age was associated with a very small increase in improvement expectation scores in the full sample (OR [95%CI] = 1.53 [1.22, 1.91], p < .001) as well as the clinical sample (OR [95%CI] = 1.53 [1.19, 1.96], p < .001), see Figure 2. Neither previous experience, gender, any trait or cortisol variable, nor any of the interaction effects were significant in the full-sample or sub-sample models, see Supplemental Tables 2 & 3 for all coefficients and odds ratios across models.

Expectations of symptom worsening

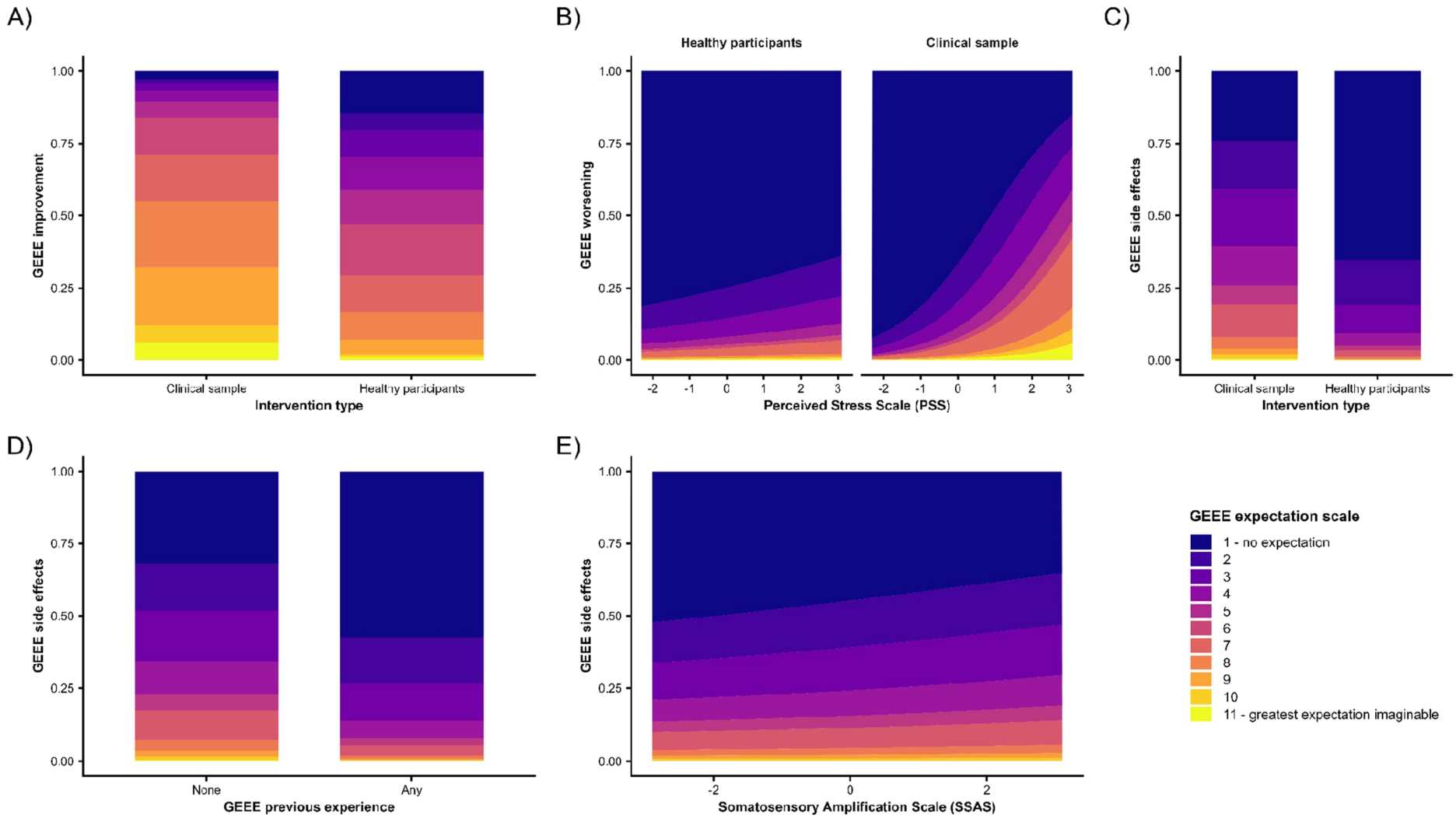
The full-sample regression model for worsening expectations showed low fit (McFaddens' R^2 = .026) and only 2% of variance being explained by between-study heterogeneity. Only one small interaction effect emerged in the full-sample, namely that a positive relationship between chronic stress and worsening expectations was more pronounced in clinical compared to healthy samples (OR [95%CI] = 1.88 [1.02, 3.44], p = .04). This finding was supported by sub-sample analyses showing that chronic stress was related to stronger worsening expectations (OR [95%CI] = 2.41 [1.42, 4.08], p = .001) only in the clinical sample. Apart from the interaction effect, no variable showed a significant association with worsening expectations in the full sample. In addition to the stress effect in the clinical sample, age (OR [95%CI] = 0.68 [0.50, 0.94], p = .02) and gender (OR [95%CI] = 0.42 [0.19, 0.90], p = .02) were also associated with lower levels of worsening expectations. In contrast, previous experience was associated with weakened worsening expectations in the healthy sample only (OR [95%CI] = 0.29 [0.11, 0.77], p = .01).

Expectations of side effects occurrence

The full-sample regression model for side effect expectations showed low fit (McFaddens' R^2 = .029) with 11% of variance being related to between-study heterogeneity. Similarly to

improvement expectations, the clinical sample reported higher levels of side effect expectations compared to healthy participants (OR [95%CI] = 7.68 [2.16, 27.3], p = .002). Furthermore, having any previous experience with the intervention was associated with a moderate decrease in side effect expectations (OR [95%CI] = 0.28 [0.11, 0.70], p = .006) and higher levels of somatosensory amplification were weakly associated with stronger side effect expectations (OR [95%CI] = 1.28 [1.04, 1.58], p = .02). The moderate effect of previous experience was confirmed in the clinical (OR [95%CI] = 0.26 [0.11, 0.63], p = .003) as well as the healthy subsample (OR [95%CI] = 0.24 [0.09, 0.60], p = .002). Additionally, gender was associated with a decrease of side effect expectations in the clinical samples only (OR [95%CI] = 0.45 [0.24, 0.84], p = .01). No other effects, including associations with cortisol variables, were significant in the full-sample or sub-sample analyses, however awakening cortisol showed a marginal association with side effect expectations in healthy participants (OR [95%CI] = 0.80 [0.63, 1.00], p = .05).

353 Figure 2. Statistically significant marginal effects on the likelihood of reporting improvement, worsening and side effect expectations.



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Note: All displayed effects are statistically significant at $p < .05$. A) Difference in predicted probabilities of each GEEE improvement expectation category between clinical samples and healthy participants. B) Interaction between the effect of stress (PSS) and sample group on predicted probabilities of each GEEE worsening expectation category. C) Difference in predicted probabilities of each GEEE side effect expectation category between clinical samples and healthy participants. D) Difference in predicted probabilities of each GEEE side effect expectation category for none and any previous experience. E) Relationship between predicted probabilities of each GEEE side effect expectation category and somatosensory amplification (SSAS). *GEEE* - Generic rating scale for previous treatment experiences, treatment expectations, and treatment effects. *PSS* – Perceived Stress Scale. *SSAS* – Somatosensory Amplification Scale. To calculate marginal effects, the GEEE scale was transformed from 0-10 to 1-11.

DISCUSSION

In this large-scale analysis, we investigated the association of psychological and biological factors with different dimensions of treatment expectations in patients and healthy participants. We pooled data from seven experimental and clinical studies, aiming to identify correlates of treatment expectations that hold across different study contexts. Across expectation dimensions, study sample (healthy vs. clinical) emerged as an important factor. Relative to healthy participants, individuals in the clinical samples showed elevated improvement expectations and side effect expectations, whereas no clear differences emerged for worsening expectations. The only significant interaction effect showed that chronic stress was associated with stronger symptom worsening expectations in clinical samples but not in healthy participants. In addition, prior experience with an intervention was associated with lower side-effect expectations. Besides the effect of setting, only somatosensory amplification was associated with side effect expectations, while other psychological variables and the CAR were not significantly associated with any expectation outcomes.

Negative affective traits, i.e., somatosensory amplification and chronic stress, were associated with an increase in side effect and worsening expectations, respectively. These results are in line with previous finding that have reported trait associations specifically with negative treatment expectations (Basedow, Zerth, et al., 2023; A. Fischer et al., 2026; Kern et al., 2020) as well as research showing that these traits are not significantly associated with placebo effects (and consequently improvement expectations) (Kang et al., 2022). These results suggest a possible diverging mechanistic route for the influence of traits on expectations and subsequent placebo and nocebo effects. While improvement expectation-mediated placebo effects might be largely context and state dependent (Geers et al., 2021), nocebo effects,

mediated by negative treatment expectations, might be more consistently affected by stable negative affective traits.

Our analysis provided no evidence for an association between baseline treatment expectations, other psychological trait variables and the CAR. One possible explanation is that the CAR and its underlying biological processes may be more relevant to other biopsychosocial treatment mechanisms and outcomes than to treatment expectations themselves, in line with research showing a heterogeneous effect profile for the CAR (Ariño-Braña et al. 2025; Engel et al. 2022; Chida & Steptoe, 2009; Ring, 2025). Additionally, previous research has shown that the effects of cortisol on treatment expectations might be more prominent if they are aligned in a temporal context (Pulopulos et al., 2020; Salzmann et al., 2018). Thus, the CAR might influence treatment expectations in an acute state-like fashion, but not in its form as a trait marker. Alternatively, the considerable heterogeneity of the pooled studies may have attenuated or masked more specific associations that are detectable only within particular populations, interventions, or study contexts. For example, the awakening cortisol levels were marginally associated with side effect expectations (p = .05) in the experimental setting sample. Thus, associations between cortisol-related measures, treatment expectations and potential expectation effects on health outcomes might be detected in larger homogeneous samples.

Our results further suggest that the relevance of an intervention plays a more important role for treatment expectations than other psychological or biological traits. As expected, patient samples exhibited stronger improvement expectations than healthy participants. This difference may reflect patients' greater desire for symptom relief as well as the increased personal relevance of medical interventions in clinical populations (Colloca et al., 2020). Because interventions are likely to be perceived as more meaningful by patients participating

in a clinical study than by healthy individuals in an experimental setting, these findings are consistent with the notion that placebo and nocebo effects are strongly shaped by the perceived personal relevance of the treatment context (Hutchinson & Moerman, 2018). Interestingly, the clinical sample was not only associated with higher improvement expectations but also higher side effect expectations. Thus, a higher personal relevance of an intervention or stronger meaning response, might not only influence improvement expectations, but also increase the incidence of nocebo responses and detrimental outcomes via an influence on side effect expectations (Faasse et al., 2019; A. Fischer et al., 2026). However, the co-occurrence of high levels of improvement and side effect expectations might also reflect a “no-pain, no-gain” attitude by participants, believing that effective treatments need to produce side effects as well (Meyrose et al., 2024; Schenk et al., 2024). Our results also indicate that experimental research on the effects of treatment expectations might not easily generalize to clinical contexts, as the underlying expectations in these two contexts differ significantly. To strengthen the translational impact of expectation research, future studies should more frequently employ experimental approaches in clinical populations, where treatment expectations operate in the context of actual illness and treatment needs. Further, experimental research in clinical populations could better shed light on the role of previous experience, especially in the context of longitudinal and repeated measurements.

These results are also in line with previous research showing that treatment experiences are potent determinants particularly of negative treatment expectations (Henrich et al., 2026; Zerth et al., 2025; Zunhammer et al., 2017). Based on our findings a possible psychological mechanism underlying this effect seems to be a change in uncertainty of expectations, or rather a change in having any expectations at all. Participants without any previous experiences were more likely to report various levels of side effect expectations, reflecting

higher uncertainty and more variance across participants. Clinical providers should be aware that patients entering a treatment for the first time (i.e., without previous experience) might start treatment with more pronounced negative expectations and thus a higher susceptibility to nocebo effects, highlighting the need for appropriate and effective communication in treatment settings (Bingel & For the Placebo Competence Team, 2014; Bingel & Wiech, 2024; Burke et al., 2026; Kube & Rief, 2026; Rief & Wilhelm, 2024).

Limitations

Our analysis comprised data from seven heterogeneous projects involving different populations and interventions, all of which assessed treatment expectations using a harmonized set of measures. Although this approach enhances generalizability and allows for the identification of overarching associations with psychological traits, it also introduces substantial variability in the variables of interest. On the one hand, this heterogeneity may have contributed to the absence of significant trait effects by obscuring more specific associations that are present only within particular subgroups of the dataset. On the other hand, it strengthens the robustness and generalizability of the observed associations, as these effects emerged consistently across diverse study contexts. In relation to study heterogeneity, our clinical sample itself also consisted of patients with different diagnoses (chronic back pain, psoriasis, depression). Arguably, these distinct disorders relate differently to the investigated psychological and biological factors and thus more specific effects of the CAR or psychological traits on treatment expectations might have been overshadowed by pooling the different patient groups.

Furthermore, treatment expectations were assessed via the GEEE, which is a single-item-per-domain instrument that might be particularly sensitive to individual interpretations of

concepts such as improvement, worsening, and side effects. While the GEEE allows for administration across diverse settings, the meaning attached to these dimensions is likely to vary considerably between contexts. Thus, participants across different studies may have based their responses on different underlying concepts, thereby introducing an unintended level of heterogeneity in the assessment of treatment expectations.

Conclusion

This large-scale, multimodal analysis spanning clinical and experimental studies investigated the association of psycho-biological individual traits and contextual factors with expectations of symptom improvement, symptom worsening and side effects. While we found no effect of the CAR on treatment expectations, we demonstrate that in studies of clinically-relevant interventions there is a higher likelihood of strong expectations of symptom improvement and treatment-related side effects. Additionally, encountering an intervention for the first time as well as high levels of somatosensory amplification go hand in hand with stronger negative treatment expectations. Our findings suggest a diverging role of psycho-biological traits on positive and negative treatment expectation effects. Specifically, somatosensory amplification and chronic stress seem to specifically increase the strength of negative expectations and thus subsequent nocebo effects. These results highlight the need for effective and expectation-considerate communication in clinical contexts, especially with first-time patients. Finally, these findings suggest that effectively influencing placebo and nocebo effects will depend less on the identification of relevant individual-level traits and more on the harnessing of contextual factors such as familiarity and uncertainty surrounding treatments.

DECLARATIONS

COMPETING INTERESTS

W.R. declares to have received honoraria from Boehringer Ingelheim for workshops on Post Covid.

L.A.B. declares to have received honoraria from Clenia Littenheid AG for a presentation on addiction treatments. Additionally, LAB receives royalties from Hogrefe for book sales.

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The other authors declare no potentially competing interests.

CONTRIBUTIONS

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DATA AVAILABILITY

As the analyzed data is part of an ongoing DFG Collaborative Research Centre, data publication is not possible at this point in time. At the end of the funding period of the TRR289 all collected data will be made publicly available.

ETHICAL STANDARDS

The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

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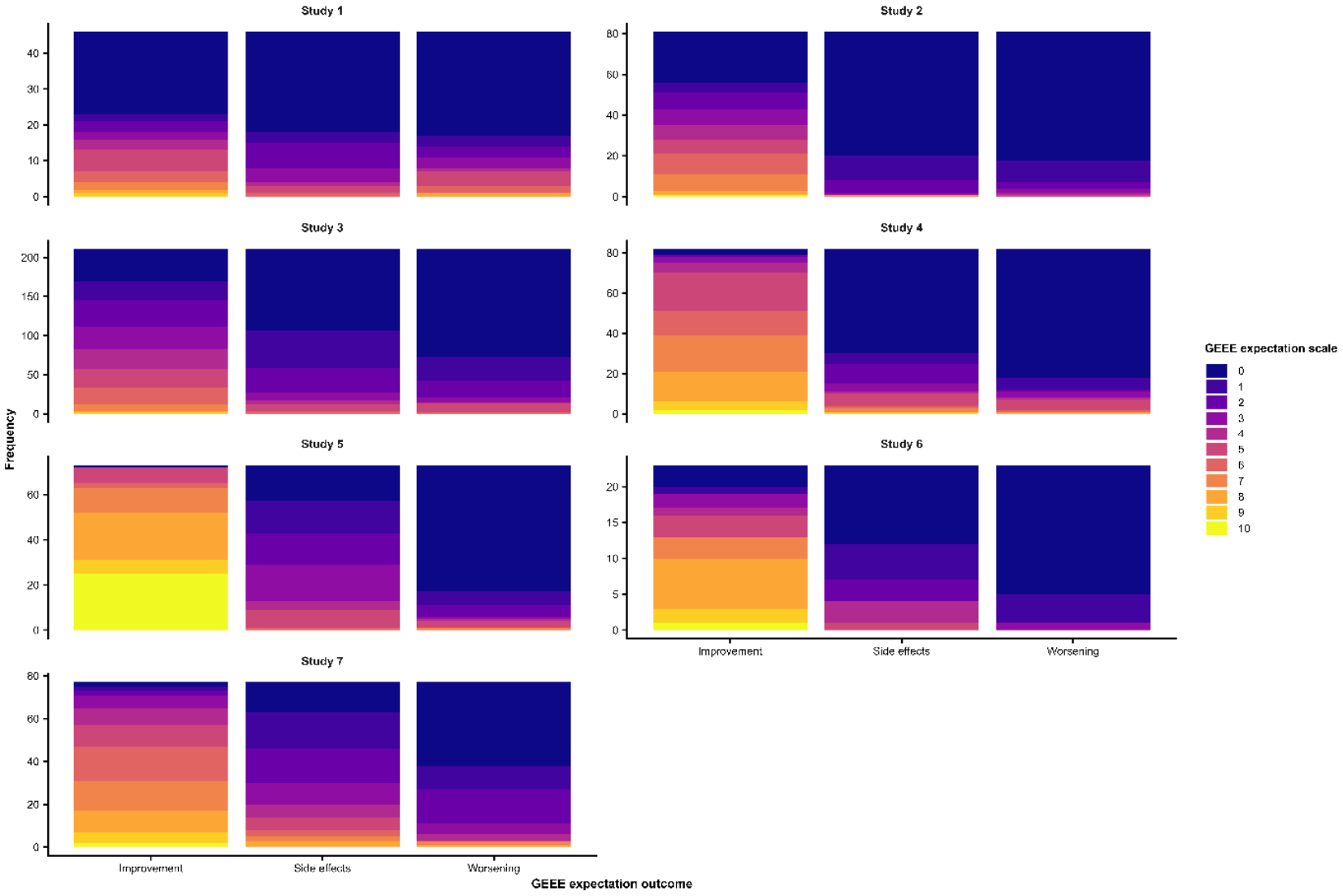
SUPPLEMENT

Supplemental Table 1. Distribution of GEEE outcome levels across studies.

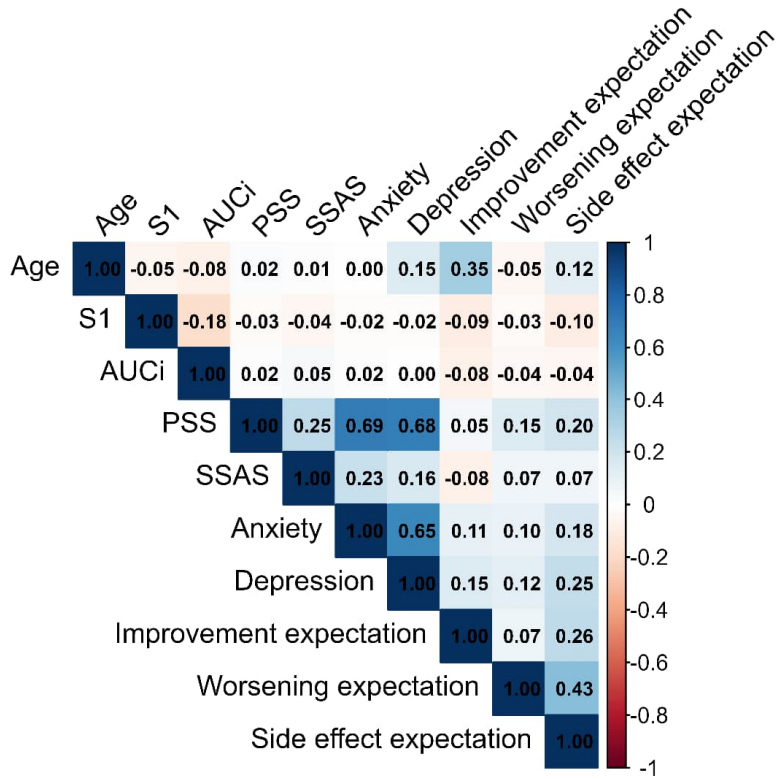
GEEE Item	Response category	Study 1 (N = 46)	Study 2 (N = 81)	Study 3 (N = 211)	Study 4 (N = 82)	Study 5 (N = 73)	Study 6 (N = 23)	Study 7 (N = 77)	Clinical sample (n = 173)	Healthy participants (n = 420)
Improvement	0	23 (50.0 %)	25 (30.9 %)	42 (19.9 %)	3 (3.7 %)	1 (1.4 %)	3 (13.0 %)	2 (2.6 %)	6 (3.4%)	93 (22.1%)
	1	2 (4.3 %)	5 (6.2 %)	23 (10.9 %)	0 (0.0 %)	0 (0.0 %)	1 (4.3 %)	2 (2.6 %)	3 (1.7%)	30 (7.1%)
	2	3 (6.5 %)	8 (9.9 %)	34 (16.1 %)	1 (1.2 %)	0 (0.0 %)	0 (0.0 %)	2 (2.6 %)	2 (1.2%)	46 (11.0%)
	3	2 (4.3 %)	8 (9.9 %)	30 (14.2 %)	3 (3.7 %)	0 (0.0 %)	2 (8.7 %)	6 (7.8 %)	8 (4.6%)	43 (10.2%)
	4	3 (6.5 %)	7 (8.6 %)	25 (11.8 %)	5 (6.1 %)	0 (0.0 %)	1 (4.3 %)	8 (10.4 %)	9 (5.2%)	40 (9.5%)
	5	6 (13.0 %)	7 (8.6 %)	24 (11.4 %)	19 (23.2 %)	7 (9.6 %)	3 (13.0 %)	10 (13.0 %)	20 (11.6%)	56 (13.3%)
	6	3 (6.5 %)	10 (12.3 %)	21 (10.0 %)	12 (14.6 %)	2 (2.7 %)	0 (0.0 %)	16 (20.8 %)	18 (10.4%)	46 (11.0%)
	7	2 (4.3 %)	8 (9.9 %)	8 (3.8 %)	18 (22.0 %)	11 (15.1 %)	3 (13.0 %)	14 (18.2 %)	28 (16.2%)	36 (8.6%)
	8	1 (2.2 %)	2 (2.5 %)	2 (0.9 %)	15 (18.3 %)	21 (28.8 %)	7 (30.4 %)	10 (13.0 %)	38 (22.0%)	20 (4.8%)
	9	1 (2.2 %)	0 (0.0 %)	2 (0.9 %)	4 (4.9 %)	6 (8.2 %)	2 (8.7 %)	5 (6.5 %)	13 (7.5%)	7 (1.7%)
	10	0 (0.0 %)	1 (1.2 %)	0 (0.0 %)	2 (2.4 %)	25 (34.2 %)	1 (4.3 %)	2 (2.6 %)	28 (16.2%)	3 (0.7%)
Side Effects	0	28 (60.9 %)	61 (75.3 %)	105 (49.8 %)	52 (63.4 %)	16 (21.9 %)	11 (47.8 %)	14 (18.2 %)	41 (23.7%)	246 (58.6%)
	1	3 (6.5 %)	12 (14.8 %)	47 (22.3 %)	5 (6.1 %)	14 (19.2 %)	5 (21.7 %)	17 (22.1 %)	36 (20.8%)	67 (16.0%)
	2	7 (15.2 %)	6 (7.4 %)	32 (15.2 %)	10 (12.2 %)	14 (19.2 %)	3 (13.0 %)	16 (20.8 %)	33 (19.1%)	55 (13.1%)

GEEE Item	Response category	Study 1 (N = 46)	Study 2 (N = 81)	Study 3 (N = 211)	Study 4 (N = 82)	Study 5 (N = 73)	Study 6 (N = 23)	Study 7 (N = 77)	Clinical sample (n = 173)	Healthy participants (n = 420)
	3	4 (8.7 %)	1 (1.2 %)	10 (4.7 %)	4 (4.9 %)	16 (21.9 %)	0 (0.0 %)	10 (13.0 %)	26 (15.0%)	19 (4.5%)
	4	1 (2.2 %)	0 (0.0 %)	5 (2.4 %)	1 (1.2 %)	4 (5.5 %)	3 (13.0 %)	6 (7.8 %)	13 (7.5%)	7 (1.7%)
	5	2 (4.3 %)	0 (0.0 %)	8 (3.8 %)	6 (7.3 %)	8 (11.0 %)	1 (4.3 %)	6 (7.8 %)	17 (9.8%)	16 (3.8%)
	6	1 (2.2 %)	0 (0.0 %)	4 (1.9 %)	1 (1.2 %)	1 (1.4 %)	0 (0.0 %)	3 (3.9 %)	4 (2.3%)	6 (1.4%)
	7	0 (0.0 %)	1 (1.2 %)	0 (0.0 %)	2 (2.4 %)	0 (0.0 %)	0 (0.0 %)	2 (2.6 %)	2 (1.2%)	3 (0.7%)
	8	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	3 (3.9 %)	3 (1.7%)	0 (0.0 %)
	9	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	1 (1.2 %)	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	1 (0.2%)
Worsening	0	29 (63.0 %)	63 (77.8 %)	138 (65.4 %)	64 (78.0 %)	56 (76.7 %)	18 (78.3 %)	39 (50.6 %)	113 (65.3%)	294 (70.0%)
	1	3 (6.5 %)	11 (13.6 %)	31 (14.7 %)	6 (7.3 %)	6 (8.2 %)	4 (17.4 %)	11 (14.3 %)	21 (12.1%)	51 (12.1%)
	2	3 (6.5 %)	3 (3.7 %)	21 (10.0 %)	1 (1.2 %)	5 (6.8 %)	0 (0.0 %)	16 (20.8 %)	21 (12.1%)	28 (6.7%)
	3	3 (6.5 %)	2 (2.5 %)	6 (2.8 %)	3 (3.7 %)	1 (1.4 %)	1 (4.3 %)	5 (6.5 %)	7 (4.0%)	14 (3.3%)
	4	1 (2.2 %)	1 (1.2 %)	2 (0.9 %)	1 (1.2 %)	1 (1.4 %)	0 (0.0 %)	3 (3.9 %)	4 (2.3%)	5 (1.2%)
	5	4 (8.7 %)	1 (1.2 %)	11 (5.2 %)	5 (6.1 %)	3 (4.1 %)	0 (0.0 %)	0 (0.0 %)	3 (1.7%)	21 (5.0%)
	6	2 (4.3 %)	0 (0.0 %)	2 (0.9 %)	1 (1.2 %)	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	5 (1.2%)
	7	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	1 (1.4 %)	0 (0.0 %)	2 (2.6 %)	3 (1.7%)	0 (0.0 %)
	8	1 (2.2 %)	0 (0.0 %)	0 (0.0 %)	1 (1.2 %)	0 (0.0 %)	0 (0.0 %)	1 (1.3 %)	1 (0.5%)	2 (0.5%)

Supplemental Figure 1. Distribution of each GEEE outcome (improvement, worsening, & side effect expectations) across all analyzed studies.



Supplemental Figure 2. Pearson correlation coefficients for all continuous independent and dependent variables.



Note: S1, awakening cortisol; AUC_i, cortisol awakening response; PSS, perceived stress scale; SSAS, somatosensory amplification scale

Supplemental Table 2. Results from three mixed-cumulative-link models with improvement expectations, worsening expectations and side effect expectations as dependent variables.

Independent variables	Coefficient (SE)	Odds ratio [95% CI]	z-value	p-value
GEEE improvement expectation (Mc Fadden R^2 = .018; Random intercept (1|Study) ICC = .17)				
Setting (experimental [reference] vs. clinical)	1.66 (0.76)	5.27 [1.20, 23.2]	2.2	.03
Experience (none [reference] vs. any)	0.46 (0.38)	1.59 [0.75, 3.37]	1.21	.23
Awakening cortisol (S1)	-0.11 (0.10)	0.90 [0.74, 1.09]	-1.12	.26
CAR (AUC_I)	-0.05 (0.09)	0.95 [0.79, 1.14]	-0.56	.58
Somatization (SSAS)	-0.12 (0.09)	0.89 [0.74, 1.07]	-1.28	.20
Trait stress (PSS)	0.03 (0.14)	1.03 [0.79, 1.36]	0.24	.81
Trait depression (STADI)	0.02 (0.16)	1.02 [0.75, 1.39]	0.13	.90
Trait anxiety (STADI)	0.09 (0.15)	1.09 [0.82, 1.45]	0.59	.56
Age	0.42 (0.11)	1.53 [1.22, 1.91]	3.71	<.001
Gender (male [reference] vs. female)	-0.02 (0.16)	0.98 [0.71, 1.34]	-0.13	.89
Setting * experience	0.33 (0.57)	1.39 [0.45, 4.25]	0.57	.57
Setting * Awakening cortisol	0.02 (0.15)	1.02 [0.76, 1.38]	0.15	.88
Setting * CAR	-0.11 (0.18)	0.89 [0.63, 1.28]	-0.61	.54
Setting * Somatization	0.22 (0,18)	1.24 [0.88, 1.75]	1.23	.21
Setting * Trait stress	-0.34 (0.27)	0.71 [0.42, 1.20]	-1.28	.20
Setting * Trait depression	-0.35 (0.25)	0.68 [0.41, 1.13]	-1.38	.17
Setting * Trait anxiety	0.28 (0.24)	1.06 [0.65, 1.74]	1.18	.24
GEEE worsening expectation (Mc Fadden R^2 = .026; Random intercept (1|Study) ICC = .02)				
Setting	0.32 (0.52)	1.38 [0.50, 3.80]	0.62	.53
Experience	-0.87 (0.47)	0.42 [0.17, 1.06]	-1.84	.06
Awakening cortisol	-0.004 (0.12)	1.0 [0.78, 1.26]	-0.04	.97
CAR	-0.11 (0.11)	0.90 [0.72, 1.12]	-0.93	.35
Somatization	0.18 (0.12)	1.19 [0.95, 1.49]	1.52	.13
Trait stress	0.17 (0.17)	1.19 [0.85, 1.66]	1.01	.31
Trait depression	0.08 (0.19)	1.08 [0.75, 1.56]	0.41	.68
Trait anxiety	-0.06 (0.18)	0.94 [0.67, 1.33]	-0.34	.73
Age	-0.19 (0.14)	0.83 [0.63, 1.09]	-1.35	.18
Gender	-0.26 (0.20)	0.77 [0.52, 1.13]	-1.34	.18
Setting * experience	0.21 (0.65)	1.23 [0.34, 4.42]	0.32	.75
Setting * Awakening cortisol	-0.15 (0.21)	0.86 [0.56, 1.30]	-0.72	.47
Setting * CAR	-0.01 (0.24)	0.99 [0.62, 1.57]	-0.04	.97

Setting * Somatization	-0.12 (0.20)	0.89 [0.60, 1.31]	-0.60	.55
Setting * Trait stress	0.63 (0.31)	1.88 [1.02, 3.44]	2.04	.04
Setting * Trait depression	-0.20 (0.29)	0.82 [0.46, 1.46]	-0.67	.50
Setting * Trait anxiety	-0.29 (0.29)	0.75 [0.43, 1.32]	-1.00	.32
GEEE side effect expectation (Mc Fadden R^2 = .029; Random intercept (1|Study) ICC = .11)				
Setting	2.04 (0.65)	7.68 [2.16, 27.3]	3.16	.002
Experience	-1.26 (0.46)	0.28 [0.11, 0.70]	-2.73	.006
Awakening cortisol	-0.22 (0.12)	0.80 [0.64, 1.02]	-1.83	.07
CAR	-0.14 (0.11)	0.87 [0.70, 1.08]	-1.28	.20
Somatization	0.25 (0.11)	1.28 [1.04, 1.58]	2.34	.02
Trait stress	0.13 (0.16)	1.14 [0.83, 1.55]	0.81	.42
Trait depression	0.21 (0.18)	1.23 [0.87, 1.74]	1.16	.25
Trait anxiety	-0.07 (0.17)	0.93 [0.67, 1.30]	-0.41	.69
Age	-0.05 (0.11)	0.95 [0.77, 1.18]	-0.46	.65
Gender	-0.21 (0.18)	0.81 [0.57, 1.14]	-1.20	.23
Setting * experience	-0.12 (0.61)	0.89 [0.27, 2.94]]	-0.19	.85
Setting * Awakening cortisol	0.27 (0.17)	1.31 [0.95, 1.82]	1.63	.10
Setting * CAR	0.16 (0.18)	1.17 [0.83, 1.66]	0.88	.38
Setting * Somatization	-0.22 (0.18)	0.81 [0.57, 1.14]	-1.21	.23
Setting * Trait stress	0.25 (0.26)	1.29 [0.77, 2.16]	0.96	.34
Setting * Trait depression	-0.38 (0.26)	0.68 [0.41, 1.13]	-1.49	.14
Setting * Trait anxiety	0.06 (0.26)	1.06 [0.65, 1.74]	0.25	.81

Note: bold, significant at $p < .05$; *GEEE*, Generic rating scale for previous treatment Experiences, treatment Expectations, and treatment Effects; *SSAS*, Somatosensory Amplification Scale; *PSS*, Perceived Stress Scale; *STADI*, State-Trait Anxiety-Depression Inventory

Supplemental Table 3. Results from six (three in clinical sample, three in experimental sample) mixed-cumulative-link models with improvement expectations, worsening expectations and side effect expectations as dependent variables.

	Clinical sample (n = 173)		Experimental sample (n = 420)	
Independent variables	Odds ratio [95% CI]	p-value	Odds ratio [95% CI]	p-value
	Improvement expectation			
Experience	2.07 [0.91, 4.72]	.08	1.57 [0.73, 3.40]	.25
Awakening cortisol	0.90 [0.71, 1.14]	.39	0.90 [0.74, 1.09]	.29
CAR	0.85 [0.62, 1.16]	.29	0.96 [0.80, 1.15]	.65
Somatization	1.06 [0.79, 1.43]	.69	0.89 [0.74, 1.07]	.23
Trait stress	0.72 [0.46, 1.13]	.15	1.04 [0.78, 1.37]	.79
Trait depression	0.74 [0.51, 1.09]	.13	1.03 [0.75, 1.41]	.87
Trait anxiety	1.43 [0.98, 2.09]	.06	1.09 [0.81, 1.45]	.58
Age	1.53 [1.19, 1.96]	< .001	1.43 [0.85, 2.38]	.17
Gender	1.02 [0.56, 1.87]	.95	0.94 [0.65, 1.37]	.76
Random intercept (1|Study) ICC	.073		.221	
Mc Fadden R^2	.042		.004	
	Worsening expectation			
Experience	0.58 [0.25, 1.35]	.20	0.29 [0.11, 0.77]	.01
Awakening cortisol	0.84 [0.59, 1.19]	.31	0.98 [0.77, 1.24]	.84
CAR	0.95 [0.62, 1.45]	.81	0.87 [0.69, 1.08]	.21
Somatization	1.10 [0.80, 1.52]	.56	1.14 [0.91, 1.44]	.25
Trait stress	2.41 [1.42, 4.08]	.001	1.17 [0.84, 1.64]	.36
Trait depression	0.83 [0.53, 1.30]	.42	1.05 [0.72, 1.52]	.81
Trait anxiety	0.75 [0.48, 1.16]	.19	1.00 [0.70, 1.43]	.99
Age	0.68 [0.50, 0.94]	.02	1.66 [0.89, 3.10]	.11
Gender	0.42 [0.19, 0.90]	.02	1.01 [0.64, 1.60]	.96
Random intercept (1|Study) ICC	.000		.062	
Mc Fadden R^2	.071		.017	
	Side effect expectation			
Experience	0.26 [0.11, 0.63]	.003	0.24 [0.09, 0.60]	.002
Awakening cortisol	1.06 [0.84, 1.35]	.60	0.80 [0.63, 1.00]	.05
CAR	1.08 [0.80, 1.45]	.61	0.84 [0.67, 1.04]	.10
Somatization	1.09 [0.81, 1.46]	.59	1.22 [0.99, 1.51]	.06
Trait stress	1.56 [0.99, 2.44]	.05	1.12 [0.82, 1.53]	.47

Trait depression	0.75 [0.51, 1.11]	.15	1.19 [0.84, 1.69]	.34
Trait anxiety	1.04 [0.71, 1.51]	.85	0.97 [0.69, 1.35]	.84
Age	0.89 [0.69, 1.11]	.28	1.60 [0.88, 2.90]	.12
Gender	0.45 [0.24, 0.84]	.01	1.09 [0.71, 1.66]	.70
Random intercept (1|Study) ICC	.075		.145	
Mc Fadden R^2	.040		.024	

Note: bold, significant at $p < .05$