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How do people with fibromyalgia interpret ambiguous cues in empathy-related healthcare scenarios?

Short-running title: Interpretation bias in fibromyalgia

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Abstract

Empathic communication is essential for high-quality healthcare, yet patients must often interpret subtle and ambiguous interpersonal cues during healthcare encounters. In such contexts, prior experiences and cognitive-affective processes may shape interpretation in biased ways. In Fibromyalgia Syndrome (FMS), a frequently stigmatised and 'invisible' condition, such biases may influence how patients perceive unclear messages from healthcare professionals. While interpretation bias for pain-related information has been explored, bias in interpreting social-emotional information has not. This study investigated interpretations of ambiguous social-emotional cues from healthcare professionals in individuals with FMS (*n* = 65), compared with those who have other chronic pain conditions (*n* = 51) and pain-free controls (*n* = 77). Participants completed a novel scenario-based task assessing the perceived likelihood of positive, neutral, and negative interpretations of ambiguous clinical situations. Validated self-report measures of psychological distress and perceived clinical empathy were also administered. Results showed that individuals with FMS were significantly more likely to endorse negative interpretations and less likely to endorse positive ones, relative to both comparison groups, even after controlling for depression, anxiety, and stress. The FMS group also reported greater psychological distress and lower perceived empathy. Moreover, negative interpretation bias was associated with greater distress and lower perceived clinical empathy, while positive bias showed the opposite pattern. These findings suggest that individuals with FMS interpret ambiguous healthcare communication through a distinct cognitive-affective lens. This highlights that patient–provider interactions are not experienced uniformly across chronic pain populations, and that interpretative biases should be considered to improve healthcare communication.

Perspective*:* We explored how individuals with fibromyalgia (compared to other chronic pain and pain-free groups) interpret empathy-related ambiguous cues from healthcare professionals. Controlling for psychological distress, the fibromyalgia group showed stronger negative interpretation biases than both comparison groups. Understanding these socio-cognitive patterns may help improve communication and empathy in fibromyalgia care.

Key words*:* Fibromyalgia Syndrome, Chronic Pain, Interpretation Bias, Healthcare Interactions, Empathy

Introduction

Empathy is widely recognised as a cornerstone of high-quality healthcare, associated with improved patient satisfaction, trust, and health outcomes [1,2]. While typically conceptualised as a clinician trait or behaviour, patients' perceptions of empathy may also be shaped by underlying cognitive and emotional processes. One such process is interpretation bias — the tendency to consistently resolve ambiguity in a certain (e.g., negative) manner. Negative interpretation biases can hinder emotional regulation, particularly during heightened stress or pain [3]. In healthcare contexts, where communication is often emotionally nuanced or ambiguous, these biases may influence how patients perceive clinicians' messages [4].

Chronic pain may amplify these processes, in part due to frequent experiences of illness invalidation, in which patients feel that their symptoms or suffering are dismissed or disbelieved [5]. Invalidation is associated with poorer functioning, greater psychological distress [6], and reduced trust in healthcare professionals, while also intensifying perceptions of stigma [7]. These issues are particularly pronounced in Fibromyalgia Syndrome (FMS), a complex chronic pain condition affecting 2%–8% of the global population [8]. FMS is characterised by widespread musculoskeletal pain and impairments in physical, affective, and cognitive functioning [9], often leading to a reduced quality of life [10]. In the absence of visible symptoms and objective biomarkers [11], FMS is frequently described as an "invisible" illness, contributing to clinical uncertainty and greater stigma than other chronic pain conditions [12]. These social and perceptual dynamics may shape not only symptom experience but also how patients interpret healthcare interactions.

Empathic clinician communication has been shown to reduce psychological distress and pain intensity in FMS [1,13]. However, many FMS patients report feeling misunderstood or dismissed by healthcare providers [14], perceptions that may reflect and reinforce pre-existing negative interpretation biases. Given the heightened stigma surrounding FMS, patients may be particularly prone to interpreting ambiguous clinician cues as invalidating or lacking empathy, yet this remains underinvestigated.

Research on interpretation biases in chronic pain has largely focused on pain- or illness-related scenarios, commonly assessed using Likelihood Ratings Tasks. These present ambiguous everyday scenarios followed by negative and benign resolutions, asking participants to rate their likelihood. For example, in the scenario: *“You drop a kitchen knife on the floor. It … your foot,”* the resolutions are: *(a) cuts; (b) misses* [15]. Adults with chronic pain more often endorse negative interpretations than pain-free individuals [16], and these biases are linked to greater pain interference [17]. Earlier task versions for adolescents revealed similar biases for bodily threat and also social cues [18,19], though results in social domains remain inconsistent [20]. Critically, interpretation biases for socio-affective cues in healthcare contexts in people with FMS remain unstudied despite their clinical relevance.

Accordingly, this pre-registered study investigated whether people with FMS are more likely to interpret ambiguous clinician cues negatively than pain-free individuals or — given the additional challenges faced by people with FMS — those with non-FMS chronic pain conditions. Correlations between interpretation biases, perceived clinical empathy, and distress were also examined. Participants completed a novel task featuring healthcare-related scenarios and rated the likelihood of negative, neutral, and positive interpretations. We hypothesised that participants with FMS would exhibit greater negative interpretation bias than comparison groups. To focus on pain specifically, we controlled for anxiety, depression, and stress, which are highly prevalent in people with chronic pain — particularly FMS [21] — and are underpinned by cognitive and affective biases [22–24]. Understanding how individuals with FMS interpret unclear messages from healthcare professionals may provide important insights into optimising clinical communication.

Methods

Design

This pre-registered study (https://osf.io/7t6h2/?view_only=237ca66002e3463695952066555af1cb) employed a mixed factorial design. The between-subjects factor was Group, comprising individuals with fibromyalgia, individuals with chronic pain conditions other than fibromyalgia, and pain-free comparison participants. The within-subjects factor was Rating Type, with three levels: negative, neutral, and positive interpretations. The primary outcome was the likelihood rating of each interpretation type. We controlled for symptoms of depression, anxiety, and stress to account for their influence on group differences in interpretation bias. Associations between interpretation bias scores and these mental health symptoms, relevant demographic variables, and perceived clinical empathy were examined both within and across the three groups.

Participants

Initially, only individuals with fibromyalgia syndrome (FMS) and pain-free controls (PFC) were recruited. Subsequently, as part of an exploratory extension, a third group was added consisting of individuals with chronic pain conditions other than FMS (henceforth OCP). The results of the interpretation bias task for the original two groups are presented in Figure S1 of the Supplementary Materials to comply with the pre-registration. Ethical approval was granted by the Liverpool John Moores University Research Ethics Committee prior to participant recruitment (UREC reference number: 24/PSY/077).

Participants were recruited via the online platform Prolific (https://www.prolific.com/). All participants were pre-screened on Prolific and were required to meet the following eligibility criteria: aged 18 years or older, fluent in English, and residing in the United Kingdom. Group-specific inclusion criteria were applied as follows: the FMS group included individuals who self-reported a fibromyalgia diagnosis or were in the process of receiving a clinical diagnosis and also met the ACR criteria, assessed using the Widespread Pain Index (WPI) and Symptom Severity Scale (SSS) [25]. The OCP group comprised individuals who self-reported a diagnosis of chronic pain conditions other than FMS (e.g., chronic low back pain, chronic migraines, and neuropathic pain), with the absence of FMS symptoms confirmed via the WPI and SSS. The PFC group comprised participants reporting no history of chronic or acute pain or related health conditions at the time of participation. As Prolific did not offer a specific pre-screening question for fibromyalgia — only for chronic pain — further screening was conducted within the study survey to ensure accurate group allocation.

A simulation-based power analysis was conducted in R to estimate the required sample size. In the absence of prior studies employing similar methodology, power was set at 80% to detect a medium effect size (Cohen's d = 0.5). A total of 1,000 simulations were run using linear mixed-effects models, which included fixed effects for group, condition, their interaction, and scenario number, as well as random intercepts for participant ID. The results indicated that a sample of 120 to 128 participants was needed to detect main effects and interactions at the conventional alpha level (α = .05). Based on this estimate, the initial recruitment target was 60 participants per group[a]. To account for potential ineligibility, attrition, or incomplete data, we opened the study to 80 participants per group. This ensured the final sample would meet the required number of complete responses.

Materials and Measures

Interpretation Bias Task

This task assessed interpretation biases in response to ambiguous, empathy-related cues that might arise within healthcare interactions. It comprised 15 brief vignettes, each describing a scenario during a clinical appointment that could be interpreted in various ways. Each vignette was followed by three possible endings, reflecting positive, neutral, or negative interpretations. Participants were instructed to imagine themselves in the described situation

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[a] This calculation was conducted prior to the study's extension to include a third group — individuals with other chronic pain conditions — for whom we also aimed to recruit 60 participants. We ultimately obtained data from 51 participants in this group, following the exclusion of incomplete responses and ineligible participants.

and rate the likelihood of endorsing each interpretation on a continuous scale from 0 (not at all likely) to 100 (extremely likely).

The task was adapted from established vignette-based measures that assess interpretation biases in ambiguous situations, such as the Adolescent Interpretations of Bodily Threat [18]. However, rather than focusing on bodily threat/pain or general social situations, the present task examined ambiguous interactions specifically within healthcare settings. Scenarios were carefully designed to avoid explicit cues that might direct participants towards a particular interpretation, thereby allowing them to draw their own conclusions based on their reasoning, personal beliefs, and prior experiences.

To ensure ecological validity, sensitivity, and relevance to the target population, the scenarios were co-developed with five individuals with lived experience of chronic pain, including one with fibromyalgia. These contributors openly shared their healthcare experiences, which informed the development of realistic and meaningful scenarios. To maintain scientific rigor and minimise bias, the final scenario content and response options were carefully refined in collaboration with experts in pain research. The contributors also piloted the online survey to ensure the materials were clear, appropriate, and accessible before data collection. Examples of scenarios with their corresponding interpretations are shown in Table 1, and the complete set of scenarios is available at: https://doi.org/10.24377/LJMU.d.00000239.

The overall Interpretation Bias Task score demonstrated excellent internal consistency, Cronbach's α = .90. Internal consistency was also examined separately for each interpretation type: Positive (α = .80) and Negative (α = .83) were good, while Neutral (α = .67) was moderate. Convergent validity was further assessed through correlations with the clinician empathy scores (reported in the Results section *Bivariate correlation analysis* below).

Demographic and Screening Questionnaires

All participants provided basic demographic information (e.g., age, gender, ethnicity) and relevant medical details (e.g., chronic pain diagnosis, symptoms duration). Additionally, individual differences were assessed through questions about self-reported neurodivergence (e.g., ADHD, Autism, dyslexia, dyspraxia, etc.) and mental health difficulties (e.g., depression, anxiety, bipolar disorder, etc.). Both variables were assessed using predefined response options: formally diagnosed, awaiting diagnosis, experiencing symptoms without a diagnosis, self-identification without seeking diagnosis, or no symptoms/traits. As an exploratory variable, participants were asked whether close family or friends worked in healthcare, given the potential influence on perceived clinical empathy.

Participants in the pain groups completed validated self-report tools to assess symptoms of fibromyalgia [26]. These included the Widespread Pain Index (WPI) and the Symptom Severity Scale (SSS), which form part of the 2016 American College of Rheumatology (ACR) diagnostic criteria for fibromyalgia [27]. The WPI employs the Michigan Body Map [28] to evaluate chronic pain across 19 prespecified body areas (score range: 0–19), while the SSS measures the severity of associated symptoms including fatigue, cognitive difficulties, and headaches (score range: 0–12). In the current sample, internal consistency was good for the WPI ($\alpha = 0.88$), the SSS ($\alpha = 0.75$), and the combined WPI + SSS composite score ($\alpha = 0.89$). Participants were classified as meeting the criteria for fibromyalgia if they scored either WPI ≥ 7 and SSS ≥ 5, or WPI = 4-6 and SSS ≥ 9, in accordance with ACR guidelines. Notably, in a comparison with rheumatoid arthritis patients, the 2010 ACR criteria have demonstrated 100% sensitivity and 81% specificity [29], supporting the use of the WPI and SSS for accurate identification of FMS patients. Individuals who completed the OCP-targeted survey were also assessed with the WPI and SSS and were only included in the OCP group if they did not meet the ACR criteria for fibromyalgia.

To characterise individuals with chronic pain conditions other than fibromyalgia, participants in the OCP group completed a structured set of questions regarding their pain history and medical diagnoses. Specifically, these participants were asked whether they had received a diagnosis for any of the listed conditions, which were aligned with the chronic pain taxonomy of the International Classification of Diseases (ICD-11) [30]. The list included both chronic primary pain conditions (e.g., complex regional pain syndrome) and chronic secondary pain conditions (e.g., chronic neuropathic pain), ensuring a comprehensive assessment of pain types. Fibromyalgia, also classified as a chronic primary pain condition in the ICD-11, was included as an option; selecting it automatically ended the survey to ensure accurate classification of the clinical groups.

Symptoms of Depression, Anxiety, and Stress

The Depression Anxiety Stress Scales (DASS-21) [31] were used to evaluate emotional states of depression, anxiety, and stress. This 21-item instrument is a short-form version of the original 42-item scale and has demonstrated excellent internal consistency in previous research (α = .95). In the current sample, Cronbach's alpha values indicated good reliability: α = .95 for Depression, α = .87 for Anxiety, and α = .90 for Stress. The DASS-21 has been widely used to measure mental health symptomology in both general and clinical populations, including chronic pain patients [32]. Participants rated each statement based on how much it applied to them over the past week, using a 4-point Likert scale, ranging from 0 ("Never - Did not apply to me at all") to 3 ("Almost Always - Applied to me very much, or most of the time"). Subscale scores were computed by summing responses to the relevant 7 items and multiplying the result by 2, yielding scores from 0 to 42 for each subscale. Higher scores indicating greater levels of depression, anxiety, and stress. These subscale scores were used as covariates in the analyses (see *Plan of Data Analysis*).

Perceptions of Clinical Empathy

To assess participants' self-reported perceptions of empathy from clinicians, two validated self-report measures were adapted for reference to general healthcare interactions[b]. The Jefferson Scale of Patient Perceptions of Physician Empathy (JSPPPE) [33] is a widely used instrument designed to capture patients' perceptions of physician empathy. It has demonstrated high reliability across diverse clinical populations, including individuals with chronic pain conditions, such as fibromyalgia [1]. In the current study, participants rated five statements on a 7-point Likert scale (1 = *strongly disagree*, 7 = *strongly agree*), with higher scores indicating greater perceived empathy. To ensure broader applicability, items were slightly reworded to refer to healthcare professionals in general rather than a specific physician. For instance, the original item *"Dr. (name of the physician) asks about what is happening in my daily life"* was adapted to "*In general, healthcare professionals ask about what is happening in my daily life".* The internal consistency of the adapted JSPPPE in this sample was excellent (Cronbach's $\alpha = 0.93$).

The second measure employed was the Consultation and Relational Empathy (CARE) measure [34], which evaluates how patients perceive the interpersonal quality of their healthcare interactions. It is considered the leading tool for assessing physician empathy from the patient's perspective, due to its strong reliability, internal consistency, and validity across a range of clinical settings and populations [35,36]. Although the original questionnaire evaluates perceptions of empathic communication after a specific consultation with the practitioner, instructions in the present study were adapted to make participants reflect on general experiences with healthcare providers. Instructions started with the stem, *"In your clinical appointments, how would you rate healthcare professionals in general at..."* followed by the original 10 CARE items. Sample items include "making you feel at ease" and "really listening", each followed by a brief explanatory phrase in brackets. Participants rated each

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[b] The pre-registration specified that individual difference variables would include the Empathic Concern (IRI-EC) and Perspective Taking (IRI-PT) subscales from the Interpersonal Reactivity Index (Davis, 1983). However, these measures were ultimately excluded from the final study protocol, as they were not sufficiently relevant given our focus on perceived empathy from others rather than self-reported empathy. Additionally, their removal helped reduce participant burden.

item on a 5-point scale (1 = *poor*, 5 = *excellent*), with higher scores reflecting greater perceived empathy. The adapted CARE measure also demonstrated excellent internal consistency in this sample (Cronbach's $\alpha = 0.96$).

Procedure

Participants were recruited via the online platform Prolific, which hosts a large pool of individuals registered to take part in research studies. Upon registration, users complete a general screening questionnaire that includes an item regarding the presence or absence of chronic pain. Three separate study advertisements were posted on the platform, each targeting a specific group; for example, only individuals who had reported experiencing chronic pain were able to access the survey designated for the pain groups. The recruitment materials stated that the research focused on how people interpret healthcare scenarios.

Eligible participants were directed to a survey hosted on QuestionPro. The survey began with a participant information sheet and an electronic consent form. Only those who provided informed consent were able to proceed. All participants completed the questionnaires assessing their demographic information, self-reported mental health difficulties, and pain experiences. Measures of fibromyalgia symptoms (WPI and SSS) were administered exclusively to participants in the chronic pain groups.

Participants then completed the interpretation bias task, in which they rated the likelihood of interpreting ambiguous healthcare scenarios in positive, neutral, or negative ways. To minimise order effects, the presentation of scenarios and interpretation options was fully randomised across participants. Next, they completed the DASS-21 to report symptoms of depression, anxiety, and stress. Finally, perceptions of clinical empathy based on prior healthcare experiences were assessed using two adapted self-report measures: the JSPPPE and the CARE measure. The entire survey took 15-20 minutes to complete. Participants were compensated £3.00 via the Prolific platform, according to the estimated

20-minute study length and aligning with Prolific's recommended reward rate of £9.00 per hour.

Plan of Data Analysis

The data analytic plan was pre-registered on January 2025 (https://osf.io/7t6h2/?view_only=237ca66002e3463695952066555af1cb). All statistical analyses were conducted in R studio, Version 1.3.1093. Descriptive statistics were reported for all demographic variables (e.g., age, gender, ethnicity), sample characteristics (e.g., neurodivergence, mental health difficulties, pain-related variables), and validated questionnaires (e.g., DASS-21, CARE, JSPPPE). The original pre-registration was based on two groups (FMS and PFC, as mentioned above), but all main analytic decisions and settings were retained when adding the third group (OCP) to the analyses.

Data normality was assessed using the Shapiro-Wilk test, and homogeneity of variance via Levene's test. Group comparisons across all three groups were conducted using chi-square tests for categorical variables (e.g., ethnicity). For continuous variables, one-way ANOVA with Tukey post hoc tests were used when assumptions were met (e.g., CARE scores); otherwise, Kruskal-Wallis tests were applied, followed by Dunn's test with Šidák correction for pairwise comparisons. Effect sizes were reported using Epsilon squared (Kruskal-Wallis), and Cohen's *d* or *f* for t-tests and ANOVAs, respectively. Critical p-values were set at $p <$ .05.

To test our main hypothesis and examine the effects of Group and Rating Type on interpretation ratings, a linear mixed-effects model was used, accounting for the nested structure of the data (i.e., repeated measures within participants and within scenarios). The outcome variable was interpretation rating (0–100), with Group (FMS, OCP, PFC), Rating Type (negative, neutral, positive), and their interaction (Group × Rating Type) as predictor variables. The PFC group and neutral interpretation type served as reference categories in the analysis. The model included random intercepts for participant ID, and fixed effects for Group, Rating Type, their interaction, and scenario number.

Significant effects were followed up with pairwise comparisons for the main effect of Rating Type and planned contrasts to compare the estimated marginal means for the interaction effect, comparing groups for each level of Rating Type. To control for mood-related symptoms, subscale scores from the DASS-21 were included as covariates. Therefore, we sought to account for the influence of psychological distress on participants' cognitive and emotional interpretation biases.

Additionally, we conducted Spearman's rank-order correlations to examine associations between continuous demographic variables (e.g., age), questionnaire scores (DASS-21, CARE, JSPPPE), and rating outcomes (positive, neutral, and negative interpretations). Correlations were performed across the full sample as well as within each group (FMS, OCP, and PFC).

Results

Descriptive Statistics and Sample Characteristics

A total of 224 survey responses were collected and reimbursed. Of these, ten participants responding to the FMS-targeted survey were excluded for being in the process of obtaining a formal FMS diagnosis but not meeting the ACR criteria. Another individual was excluded for not having a formal diagnosis despite meeting the ACR criteria. In the OCP group, nineteen participants were excluded: one for pain duration under three months (not considered chronic pain), one who was awaiting an FMS diagnosis but did not meet the ACR criteria, and seventeen who met the ACR criteria without a formal FMS diagnosis. In the PFC group, one participant was excluded due to self-reported suspicion of FMS.

Further details on pain groups are provided in the Supplementary Materials, with participant inclusion/exclusion and group assignment summarised in Table S1, SSS scores by symptom severity category shown in Table S2, and subgroups of chronic pain conditions other than FMS in Table S3. The final sample included *N* = 193 participants, categorised into three groups: fibromyalgia group (*n* = 65), other chronic pain group (*n* = 51), and pain-free group (*n* = 77). Descriptive statistics for demographic, exploratory, and clinical characteristics by group are presented in Table 2.

A Kruskal-Wallis test revealed a significant difference in age across groups, $\chi^2(2) = 18.66$, p < .001. Subsequent Dunn's post-hoc tests with Šidák correction showed that the OCP group was significantly older than both the FMS ($Z = 3.00$, $p = .008$) and PFC groups ($Z = 4.27$, $p < .001$), whereas no significant age difference was observed between the FMS and PFC groups ($Z = 1.25$, $p = .509$). In contrast, gender ($\chi^2(2) = 3.32$, $p = .190$), ethnic background ($\chi^2(6) = 7.97$, $p = .240$), and the presence of close people working as healthcare professionals ($\chi^2(2) = 0.20$, $p = .907$) did not significantly differ across the three groups.

In line with previous literature, significant group differences were observed in self-reported psychological difficulties. Pain-free individuals reported significantly lower rates of mental health conditions than both pain groups, $\chi^2(2) = 41.94$, $p < .001$. Pairwise comparisons with Šidák correction revealed significantly higher rates in FMS and OCP compared to controls (both $p < .001$), while the difference between FMS and OCP did not reach statistical significance ($p = .201$).

Depression, Anxiety, and Stress

As presented in Table 3, significant differences were observed in DASS-21 scores across groups, with participants in the FMS group exhibiting higher levels of distress. Large group effects were observed for depression ($\chi^2(2) = 63.90$, $p < .001$, $\varepsilon^2 = 0.33$), anxiety ($\chi^2(2) = 70.16$, $p < .001$, $\varepsilon^2 = 0.36$), and stress ($\chi^2(2) = 59.81$, $p < .001$, $\varepsilon^2 = 0.30$). Dunn's post-hoc tests revealed that FMS participants had significantly higher scores than both OCP and PFC groups (all $p < .001$). Additionally, the OCP group scored higher than the PFC group for depression (*p* < .001), anxiety (*p* < .001), and stress (*p* = .004). A detailed breakdown of the severity levels for each subscale is provided in Table S4 of the Supplementary Materials.

Interpretation Bias Ratings

Results from the linear mixed-effects models analysis, controlling for symptoms of depression, anxiety, and stress (DASS-21 subscales)[c], revealed a significant main effect of Rating Type (all *p* < .001) but no significant main effect of Group (all *p* > .05). In particular, negative interpretations were rated as significantly less likely (*Estimate* = -18.82, *p* < .001), while positive interpretations were rated significantly more likely (*Estimate* = 6.87, *p* < .001) compared to neutral interpretations. Importantly, a significant Group × Rating Type interaction emerged for negative ratings (*Estimate* = 8.74, *p* < .001; see Figure 1).

Pairwise contrasts by Rating Type revealed that participants with FMS rated the likelihood of negative interpretations significantly higher than both pain-free controls (*Estimate* = 6.65 *p* < .001) and those with other chronic pain conditions (*Estimate* = 3.96, *p* = .023), supporting our hypothesis that individuals with FMS exhibit a greater negative interpretation bias, even when controlling for mental health symptoms. Additionally, for positive interpretations, the FMS group provided significantly lower ratings than both the PFC group (*Estimate* = -4.11, *p* = .014) and the OCP group (*Estimate* = -6.66, *p* < .001). No significant group differences were found for neutral interpretations. Comparisons between OCP and FMS (*p* = .40), FMS and PFC (*p* = .39), and OCP and PFC (*p* = 1.00) were all non-significant, indicating similar responses across groups for neutral ratings. Overall, these findings suggest a fibromyalgia-specific interpretation bias, marked by a greater tendency to perceive ambiguous healthcare interactions more negatively and less positively.

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[c] Given age differences between groups, age was also included as a covariate in the linear mixed-effects model. When controlling for age, all significant effects reported remained unchanged. As age was not a significant predictor, results are presented according to the original pre-registered model without age included.

Model fit statistics indicated that the mixed-effects model explained a small amount of variance in the data. The marginal R^2 (variance explained by fixed effects) was 0.158, while the conditional R^2 (variance explained by both fixed and random effects) was 0.170.

Self-Reported Perception of Clinical Empathy

Group differences in perceived empathy, as measured by the JSPPPE, were not statistically significant, $\chi^2(2) = 4.73$, $p = .096$, However, a significant group difference was found for CARE scores ($F(2,190) = 3.29$, $p = .04$). Post hoc Dunn's tests indicated that this difference was driven by significantly lower CARE scores in the FMS group compared to pain-free controls ($p = .031$), suggesting a reduced perception of empathy in general healthcare settings. However, no significant differences were observed between FMS and OCP ($p = .58$) or between OCP and pain-free controls ($p = .37$). Effect sizes for both JSPPPE ($\varepsilon^2 = 0.01$) and CARE ($\eta^2 = 0.03$, *Cohen's f* = 0.19) were small.

Correlations Between Interpretation Bias Ratings and Self-Reported Perceived Clinical Empathy

Correlations between continuous demographic variables, questionnaire scores, and outcome variables were examined within and across the three groups. Figure 2 shows the Spearman Correlation Matrix for the full sample, while correlation matrices for each group are presented in Supplementary Fig. S2a-c.

Significant associations were observed between both measures of perceived clinical empathy (CARE and JSPPPE) and interpretation bias across all groups. CARE and JSPPPE were strongly positively correlated ($r = .74$ across groups, mirrored in individual groups; see Supplementary Materials). Higher perceived clinical empathy was associated with a more positive interpretation bias. Specifically, JSPPPE scores showed a moderate positive correlation with positive ratings ($r = .51$), with CARE showing a slightly weaker association ($r = .44$). Additionally, negative ratings were moderately inversely correlated with empathy scores (CARE: $r = -.45$; JSPPPE: $r = -.51$), indicating that individuals with a more negative bias tend to perceive less empathy in clinical interactions.

Discussion

This study examined how individuals with FMS interpret ambiguous healthcare communication and how these interpretations relate to perceived empathy and psychological distress. As hypothesised, participants with FMS were more likely to endorse negative and less likely to endorse positive interpretations of socio-affective ambiguous cues from clinicians, relative to both pain-free individuals and those with other chronic pain conditions. No group differences emerged for neutral interpretations.

By comparing interpretation patterns across pain groups, we examined whether these biases are unique to FMS or reflect broader challenges in chronic pain care. Accumulating studies have documented the prevalence of stigma in individuals with chronic pain, particularly in those with lack of a clear pathophysiology or medical evidence such as FMS [37,38]. While communication barriers are common in healthcare for chronic pain in general [39,40], our results suggest that individuals with FMS may approach clinical interactions with more negative expectations. Moreover, such negative interpretation biases may also shape how individuals with FMS perceive stigma and empathy in clinical encounters, which might further contribute to strained therapeutic relationships [12].

Although our OCP group encompassed heterogeneous profiles, many non-FMS chronic pain conditions — such as rheumatoid arthritis — have well-defined symptoms and pathophysiology, which may reduce stigmatisation [41]. In contrast, FMS is often characterised by contested diagnostic legitimacy, making it particularly vulnerable to being misunderstood or not fully recognised in medical settings [42]. This invisibility, coupled with stigma, may increase susceptibility to misinterpretations and heighten distress during clinical encounters. Such factors can reinforce anticipatory biases, prompting patients to interpret ambiguity as critical, invalidating, or lacking empathy.

Consistent with this idea, participants with FMS reported lower perceived empathy in general healthcare (CARE scale) than pain-free controls, though not relative to OCPs. Reduced empathy may be more broadly present in pain populations, albeit more pronounced in FMS. Interestingly, group differences did not emerge on the JSPPPE, perhaps because it focuses on perceived empathy within a consultation-specific context, lacking sensitivity to broader stigma-related dynamics. In contrast, the CARE scale — emphasising relational and emotional aspects — may better reflect cumulative effects of long-term healthcare interactions in FMS. This discrepancy highlights the need for empathy measures that capture the impact of stigma and legitimacy concerns in patient-provider relationships.

Participants with FMS reported higher emotional distress than both comparison groups. Importantly, interpretation biases persisted even after controlling for depression, anxiety, and stress, that is, symptoms commonly elevated in chronic pain populations [21,43]. These findings align with evidence that individuals with FMS process emotional and cognitive information differently [44,45], potentially linked to alterations in neural pathways involved in pain regulation [46]. Neuroimaging studies in FMS patients have revealed differences in functional connectivity within the pain network [47], along with altered activation in critical regions for pain modulation, social cognition, and emotional processing, such as the anterior cingulate cortex and insula [48,49].

Correlation analyses further highlighted the interplay between interpretation bias, perceived clinical empathy, and psychological distress. Within and across all groups, positive interpretations were correlated with higher perceived empathy, while negative interpretations were associated with lower empathy. This suggests a reciprocal relationship: individuals predisposed to negative interpretations may perceive less empathy regardless of the provider's intentions, while perceived lack of empathy may reinforce or even trigger interpretative biases, particularly in patients with prior unsatisfactory healthcare experiences. Negative interpretation bias was also linked to greater distress (DASS-21 subscales), supporting that such biases may contribute to or reflect underlying emotional difficulties. This is consistent with models of cognitive-affective interaction in chronic illness, in which appraisal processes — such as stress or threat perception — interact with coping responses and social feedback, potentially sustaining negative affective and behavioural cycles [50,51].

Overall, our findings highlight that patient-provider interactions are not experienced uniformly across chronic pain populations. While relational and systemic barriers are common in pain care, individuals with FMS may approach clinical encounters with distinct interpretative patterns shaped by experiences of stigma and uncertainty. Addressing these cognitive-affective biases — through provider training, empathic communication, and targeted psychological interventions — may be key for improving therapeutic alliances and outcomes.

Limitations

Several limitations warrant consideration. First, the cross-sectional design prevents causal inference: it remains unclear whether negative interpretation bias reduces perceptions of empathy, whether diminished empathy perceived fosters such a bias, or whether both processes reflect broader contextual or psychosocial mechanisms associated with FMS. Additional factors such as prior healthcare trauma, provider communication style, and sociocultural beliefs about pain may also influence interpretative styles and should be explored in future research. Assessing perceived stigma may further elucidate how social dynamics shape patient interpretations of clinician behaviour, particularly in conditions that are frequently misunderstood or delegitimised. While our focus on FMS highlights how condition-specific challenges contribute to interpretation biases, individual differences and contextual factors likely influence these processes beyond diagnostic categories and warrant further investigation.

Second, the study focused on interpretation bias but did not explore other important cognitive-affective mechanisms like attentional bias or attentional control. These processes have been implicated in the onset and maintenance of chronic pain and may interact with interpretation biases [52]. Future research could adopt a more comprehensive framework to better understand how these processes jointly shape the perception of healthcare experiences.

Lastly, although we used self-reported diagnoses, validated FMS measures, and applied ICD-11 criteria for OCP, these methods may not fully eliminate overlap between fibromyalgia and other chronic pain conditions. Moreover, rates of neurodivergence were higher in the pain groups, but we did not examine its potential influence on interpretation bias or perceived empathy; this represents an important direction for future research. In addition, sex and gender were not distinguished, and a sex- and gender-based analysis was not incorporated. Given the well-established gendered dynamics of pain perception and healthcare delivery, future studies would benefit from adopting an intersectional framework to better capture the complex interplay between gender, chronic pain, and cognitive-affective bias.

Implications and Future Directions

A notable strength of this study is the use of a novel, co-produced measure of interpretation bias in patient-provider interactions. Incorporating lived experience enhanced the measure's relevance and real-world applicability [53], which reflects the growing commitment to meaningful patient and public involvement in pain research. The measure demonstrated good convergent validity with established clinical empathy questionnaires (JSPPPE and CARE) and is publicly available to enable further psychometric evaluation. Additional methodological safeguards included statistically controlling for depression, anxiety, and stress to examine FMS-specific interpretation biases beyond distress, and pre-registering the analytic strategy to strengthen the transparency and reproducibility.

While we focused on FMS, similar stigma-related dynamics may also affect other "invisible" pain conditions, such as irritable bowel syndrome [54] or endometriosis [55]. Future research should investigate whether distinct interpretation biases and perceptions of empathy emerge within specific conditions. This would help to clarify whether the observed effects are FMS-specific or reflect broader challenges related to stigma in poorly understood pain disorders.

Although the distinct challenges faced by those with FMS may warrant tailored clinical support, these findings hold broader relevance for healthcare professionals in chronic pain care. Clinicians across specialties should remain mindful of the stigma and invalidation that often shape how such conditions are perceived and managed. Raising clinician awareness that such biases shape how communication is perceived may be an important step towards improving healthcare interactions. Rather than placing responsibility on patients, healthcare systems should embed empathic communication principles more explicitly and earlier across health disciplines [56]. As empathy training is inconsistently integrated into medical education [57], fostering this awareness could help clinicians better recognise the cognitive-affective factors influencing patient experiences and respond with clearer, more overtly validating communication.

These findings may also inform the development of communication-focused or psychosocial interventions for people with FMS. Established approaches such as cognitive-behavioural therapy [58,59] and bias modification techniques [17,60] could be adapted to help address both clinical and relational needs in FMS management.

As a UK-based study, findings may reflect context-specific challenges associated with the UK healthcare system. Factors such as appointment frequency and continuity, communication style, and cultural norms surrounding empathy expression may differ across health systems. Additionally, our Prolific sample, which is only UK-based and largely white, limits the generalisability of the findings to more diverse populations. Future research should examine how these factors influence interpretation bias and perceived empathy in diverse healthcare settings. Cross-cultural comparisons could disentangle system-level effects from more general cognitive-affective mechanisms underpinning the perception of patient–provider interactions.

Conclusion

This study demonstrates that individuals with FMS are more likely to interpret ambiguous healthcare communication negatively and less likely to endorse positive interpretations than both pain-free individuals and those with non-FMS chronic pain conditions, even when controlling for depression, anxiety, and stress. These biases were closely linked to lower self-reported perceived clinical empathy and greater emotional distress.

Disclosures

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The authors declare they have no conflicts of interest.

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Authorship Contributions

Maria Planes Alias: Conceptualisation, Methodology, Software, Formal analysis, Investigation, Data curation, Writing – Original Draft, Writing – Review and editing, Visualisation, Project administration; **David J Moore**: Conceptualisation, Methodology, Writing – Review & Editing, Supervision; **Nicholas Fallon**: Writing – Review & Editing, Supervision; **Katie Herron**: Writing – Review & Editing, Supervision; **Charlotte Krahé**:

Conceptualisation, Methodology, Validation, Writing – Review & Editing, Supervision, Project administration.

Data Availability

Supplementary data accompanying this article are available online at www.jpain.org and www.sciencedirect.com. This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/).

No published datasets were used in this study. The complete set of scenarios generated for this research is publicly available via DOI: https://doi.org/10.24377/LJMU.d.00000239. Other data supporting the findings of this study are available from the corresponding author upon reasonable request.

Figure Legends

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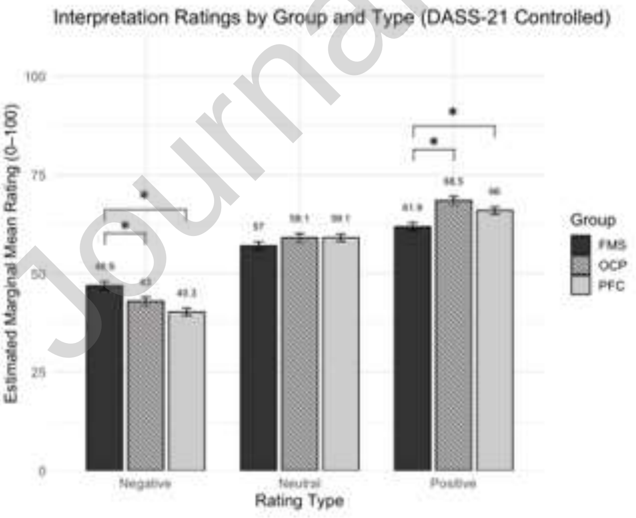

Figure 1. Bar plot showing estimated marginal mean ratings across scenarios by group and rating type (negative, neutral, positive). Error bars indicate ±1 standard error (SE). Ratings were analysed using linear mixed-effects models, controlling for depression, anxiety, and stress symptoms (DASS-21 subscales). Higher scores reflect greater endorsement of the respective interpretation type (positive, neutral, or negative). Group labels: FMS =

fibromyalgia, OCP = other chronic pain, PFC = pain-free controls. Asterisks (*) denote significant between-group differences.

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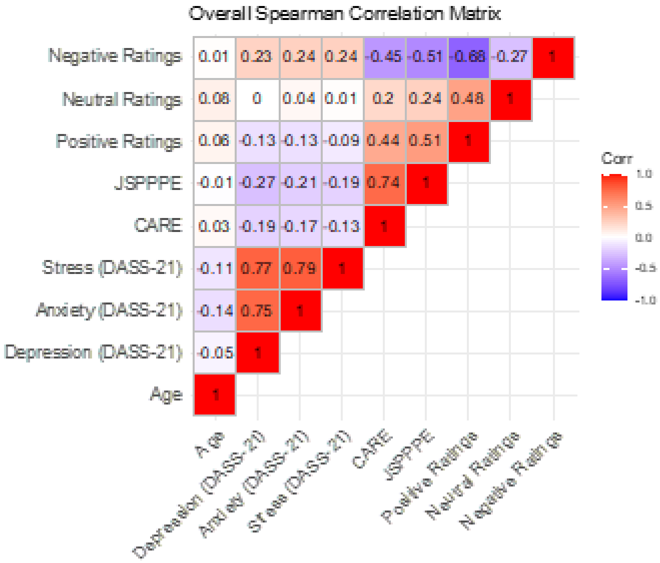

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Figure 2. Correlation Matrix of Continuous Variables Across All Groups. Negative, Neutral and Positive Ratings refer to the likelihood ratings of each interpretation option from the Interpretation Bias Task scenarios. CARE = Consultation and Relational Empathy; JSPPPE = Jefferson Scale of Patient Perceptions of Physician Empathy. Correlation strength is interpreted as follows: |*r*| ≥ .70 = strong, .40 ≤ |*r*| < .70 = moderate, |*r*| < .40 = weak or negligible. No missing data were reported for any variable across all groups (*N* = 193).

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Table 1. *Example Scenarios from the Interpretation Bias Task with Corresponding Positive, Neutral, and Negative Interpretations*

SCENARIO SAMPLE	VALENCED INTERPRETATIONS
You have been dealing with symptoms for some time and have taken it upon yourself to research what might be causing them. During a healthcare appointment, you explain your experiences in detail. Afterwards, the doctor says, "It's clear you've done a lot of research. What do you think might be going on based on what you've learned?" How likely is it that you feel the doctor is…	*Positive*: engaging with your perspective *Neutral:* asking for information *Negative:* challenging your ideas
You have a telephone appointment with a doctor to discuss your test results after a long wait. After reviewing the results, the doctor quickly explains the situation using complex medical terms. When you ask for clarification, the doctor repeats the information in similar technical language, but you notice a subtle change in their tone of voice. How likely is it that you think the doctor is…	*Positive*: trying to communicate more clearly *Neutral:* staying professional *Negative:* becoming impatient

NOTE. The valence labels (*positive*, *neutral*, *negative*) were not shown in the task. The order of scenarios and interpretation options was randomised for each participant. Scenarios were co-developed with individuals with lived experience of chronic pain, based on key themes from consultation sessions.

Table 2. *Descriptive Statistics for Demographic and Sample Characteristics.*

VARIABLE	*FMS GROUP (N = 65)*	*OCP GROUP (N = 51)*	*PFC GROUP (N = 77)*

		M(SD)	*M(SD)*	*M(SD)*
Age		44.1 (12.1)	51.9 (13.2)	41.6 (13.6)
		Frequency (%)	*Frequency (%)*	*Frequency (%)*
Gender	Female	46 (70.8%)	35 (68.6%)	44 (57.1%)
	Male	19 (29.2%)	16 (31.4%)	33 (42.9%)
Ethnic Background	White	60 (92.3%)	45 (88.2%)	63 (81.8%)
	Asian	4 (6.2%)	2 (3.9%)	4 (5.2%)
	Black	1 (1.5%)	4 (7.8%)	8 (10.4%)
	Mixed / Multiple	0 (0%)	0 (0%)	2 (2.6%)
Neurodivergent	No	36 (57.1%)	33 (67.3%)	68 (89.5%)
	Yes	27 (42.9%)	16 (32.7%)	8 (10.5%)
Mental health issues	No	19 (32.8%)	26 (53.1%)	66 (86.8%)
	Yes	39 (67.2%)	23 (46.9%)	10 (13.2%)
Close people working in healthcare	No	52 (80%)	42 (82.4%)	61 (79.2%)
	Yes	13 (20%)	9 (17.6%)	16 (20.8%)
Reported diagnosis of FMS	Yes	53 (81.54%)	-	-
	Awaiting	12 (18.46%)	-	-
	No	-	51 (100%)	-
		M(SD)	*M(SD)*	*M(SD)*
Measures of FMS symptoms	SSS total score	8.95 (1.72)	5.59 (2.61)	-
	WPI total score	8.83 (5.25)	3.15 (1.82)	-

NOTE. M = mean; SD = standard deviation; FMS = Fibromyalgia Syndrome; OCP = Other Chronic Pain; PFC = Pain-Free Control. No data were missing for demographic variables (age, gender, and ethnicity) or for the exploratory variable regarding participants' close contacts in healthcare, across all groups. However, 5 participants selected "Prefer not to say" for neurodivergence-related questions. Additionally, ten responses were missing for mental health difficulties. Due to technical issues with the online survey platform, body map data from the WPI questionnaire were missing for 17 participants in the FMS group and 11 participants in the OCP group. Percentages always sum to 100% as they are relative to the total number of responses for each variable.

Table 3. *Mean scores for the DASS-21 Subscales, the Measures of Perceived Clinical Empathy, and Interpretation Ratings by Groups*

VARIABLE	*FMS GROUP (N = 65)*	*OCP GROUP (N = 51)*	*PFC GROUP (N = 77)*

		M(SD)	*M(SD)*	*M(SD)*
DASS-21 Subscales	Depression	19.2 (11.5)	11.8 (11.1)	4.96 (6.58)
	Anxiety	14.6 (8.95)	7.41 (7.73)	2.83 (3.96)
	Stress	20.2 (9.25)	12.5 (8.42)	7.53 (6.47)
Perceptions of Empathy in General Healthcare	JSPPPE	18.4 (7.81)	20.2 (7.72)	21.5 (6.22)
	CARE	29.5 (10.9)	31.4 (10.7)	33.8 (8.8)
Scenario Rating Type	Negative	47.60 (31.01)	42.85 (31.44)	39.79 (27.80)
	Neutral	57.68 (28.05)	58.98 (28.75)	58.61 (25.98)
	Positive	62.53 (26.73)	68.40 (26.48)	65.48 (23.92)

NOTE. JSPPPE = Jefferson Scale of Patient Perceptions of Physician Empathy; CARE = Consultation and Relational Empathy. No missing data were reported for any variable across all groups. Interpretation ratings reflect the average score (0–100) across all scenarios for each interpretation type: negative, neutral, and positive. Higher scores reflect greater endorsement of the respective interpretation type. Scenario rating values reported in the table are raw means, whereas the values shown in the corresponding plot represent marginal means.

Highlights

- Novel task reveals interpretation bias associated with fibromyalgia.
- Fibromyalgia is linked to more negative interpretations of healthcare scenarios.
- Interpretation bias correlates with distress and perceived clinical empathy.
- Interpretation biases still evident when controlling for psychological distress.