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Do Individuals With Endometriosis Display Interpretation and Memory Recall Biases Compared With Pain-Free Controls? A Cross-Sectional Study

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ABSTRACT

Chronic pain significantly impacts many individuals with endometriosis, yet cognitive biases—specifically interpretation bias (IB) and memory recall bias (MRB)—remain underexplored in this context. This study examined IB and MRB in individuals with endometriosis compared with pain-free controls and explored their associations with pain outcomes. A total of 160 participants (90 with endometriosis; 70 pain-free controls) completed online tasks assessing IB (via ambiguous scenarios), MRB (using a surprise free-recall task), and self-reported pain measures. Individuals with endometriosis demonstrated a significantly reduced tendency to interpret ambiguous information in a neutral manner compared with pain-free controls, but no differences in MRB. Within the endometriosis cohort, IB and MRB were modestly correlated, although neither bias was significantly associated with pain outcomes once anxiety and depression were controlled for. These findings suggest that while altered IB is a distinguishing cognitive feature of endometriosis, its influence on pain experience appears indirect and may be shaped by affective factors.

1 | Introduction

Endometriosis is a chronic, often debilitating gynaecological disorder characterised by the growth of endometrial-like tissue outside the uterine cavity. This ectopic tissue can implant on a range of pelvic organs, including the ovaries, fallopian tubes, bladder and rectum (Saunders and Horne 2021). Affecting an estimated 1 in 10 women of reproductive age globally (Maddern et al. 2020), endometriosis is marked by symptoms such as chronic pelvic pain, dysmenorrhoea (painful menstrual cramps) (Martire et al. 2023), dyspareunia (pain during sexual intercourse) (Privitera et al. 2023), dysuria (painful urination) (Fleischer et al. 2024), dyschezia (painful defecation) (Ferrero et al. 2020) and infertility (Kalfas et al. 2022). These symptoms can severely impact daily life, significantly impairing relationships, sexual health and overall quality of life (Facchin et al. 2021; van Stein et al. 2023).

Despite its widespread prevalence, the aetiology and pathogenesis of endometriosis remain poorly understood, with an average diagnostic delay of ~10 years from the onset of symptoms (Carey et al. 2014). According to the National Health Service England, endometriosis is a difficult condition to diagnose as symptoms vary and mimic other disorders such as inflammatory bowel syndrome, painful bladder syndrome, and pelvic inflammatory disease (National Health Service 2024).

Given the limited success of conventional treatment approaches, achieving adequate pain relief remains a significant challenge in endometriosis (Samami et al. 2023). Consequently, increasing focus is being given to psychological factors that may influence the aetiology and persistence of endometriosis-related pain. Recent research suggests that cognitive biases, including interpretation bias (IB; Schoth and Liossi 2016; Todd et al. 2025) and memory recall bias (MRB),

may play a significant role in shaping pain perception (van Aken et al. 2017). In the context of pain, IB refers to the tendency to interpret ambiguous information in a negative or pain-related manner, while MRB involves the selective recall of pain/illness-related information.

Studies have demonstrated that individuals with both acute pain (Gaffiero et al. 2022; Heathcote et al. 2016) and chronic pain associated conditions such as chronic headache are more likely to interpret ambiguous stimuli as pain related (Schoth et al. 2018). In the case of endometriosis specifically, a study by Todd et al. (2023) revealed that IB was notably associated with greater fear of disease progression, even when statistically controlling for age and pain severity. Negative IB was linked to higher levels of fear of disease progression, suggesting that individuals with a tendency to interpret ambiguous situations negatively are more anxious about the future of their condition. Notably, anxiety is known to exacerbate chronic pain (Asmundson 2014). Pickup et al. (2023) further showed that individuals with endometriosis were not only more likely to interpret ambiguous words as threatening compared with healthy controls, but that IB was associated with increased pain interference. Taken together, this evidence suggests IB as a psychological factor influencing pain interference and quality of life in endometriosis.

While evidence for MRB in chronic pain remains inconclusive, early research suggested that individuals with chronic pain tend to recall more pain/illness-related information compared with healthy controls (Pincus and Newman 2001). However, a recent systematic review and meta-analysis by Schoth et al. (2020) found no notable differences in MRB between individuals with chronic pain and healthy controls. These mixed findings highlight the need for further investigation of MRB in chronic pain-related conditions. Moreover, according to the Integrated Functional Contextual Framework (IFCF) proposed by Van Ryckeghem et al. (2019), cognitive biases do not operate in isolation but interact dynamically to influence how pain is perceived, processed, and managed. Importantly, it is argued that these interactions can amplify pain-related distress and contribute to the persistence of chronic pain.

Considering the above, the current study is the first to examine MRB in individuals with endometriosis, while also examining IB and their combined effect on pain perception. Considering the findings of previous research, we hypothesised that: (i) Individuals with endometriosis will exhibit a stronger IB towards pain-related information than pain-free controls (PFC); (ii) there will be a difference in the number of pain-related solutions recalled (MRB) between the endometriosis cohort and PFCs; and (iii) there will be a relationship between pain outcomes, IB and MRB in the endometriosis cohort.

2 | Materials and Methods

2.1 | Design

The present study used an online between-subjects experimental design. The independent variable was the participant cohort (endometriosis vs. PFC) and the dependent variables were the IB and MRB index scores. A priori power analysis was conducted using G*Power. A medium effect size ($d = 0.50$) was selected based on meta-analytic evidence showing a moderate pooled effect ($g \approx 0.60$) for IB in chronic pain populations (Schoth and Liossi 2016) and was therefore considered a conservative and empirically grounded estimate for the present study. Using this effect size, an independent-samples t-test with $\alpha = 0.05$ and 80% power required a minimum total sample of 128 participants ($n = 64$ per group). The final sample of 160 participants exceeded this requirement, providing adequate statistical power.

2.2 | Recruitment

Recruitment materials consisted of a digital poster and accompanying participant information sheet titled 'exploring the effects of pain on cognition'. The invitation briefly described the project as part of a Master's dissertation in Health Psychology examining the effects of pain on cognition and invited women diagnosed with endometriosis and women without pain or medical conditions to participate. The materials outlined study procedures, duration, and voluntary participation but did not include information relating to hypotheses to minimise potential bias. Recruitment took place via organic sharing on social media platforms (e.g., Facebook, Reddit, Instagram, LinkedIn), and no paid or targeted advertising was used.

2.3 | Participants

A total of 160 participants were recruited. Of these, 90 participants with a self-reported diagnosis of endometriosis comprised the endometriosis cohort (age range = 18–55 years; $M \pm SD = 33.66 \pm 10.31$), and 70 participants comprised the PFC cohort (age range = 22–63 years; $M \pm SD = 35.89 \pm 12.54$).

Eligibility criteria for both cohorts were: (i) female sex; (ii) ≥ 18 years of age; and (iii) fluency in English. To qualify for the endometriosis cohort, participants were required to report a formal diagnosis of endometriosis. For the pain-free control cohort, participants were required to report no current physical health conditions and no ongoing or chronic pain lasting 12 weeks or longer. Participants who experienced occasional or transient pain episodes (e.g., headaches, menstrual cramps, minor injuries) were not excluded, as such experiences are common in otherwise pain-free populations.

Participants were recruited through online platforms, including Facebook, Reddit, and Instagram. No financial incentives were provided.

2.4 | Demographic Questionnaire

All participants completed a demographic questionnaire that gathered information on age, ethnicity, and educational level. Participants in both cohorts were also asked to provide details on (i) duration of pain symptoms; (ii) any comorbid mental health conditions. Those in the endometriosis cohort were additionally asked to specify (iii) the length of time they have experienced endometriosis-related symptoms; and (iv) any current medications they receive.

2.5 | Recent Pain Experiences Questionnaire (RPEQ)

All participants completed the RPEQ. This is a modified version of the Brief Pain Inventory (Cleeland and Ryan 1994) to assess subjective pain experiences over the past 3 months, consistent with previous research (Heathcote et al. 2016; Gaffiero et al. 2022). The RPEQ comprises four items assessing: (i) average pain intensity; (ii) worst pain intensity; (iii) pain interference with daily activities; and (iv) pain frequency. The first three items are rated on an 11-point scale ranging from 0 ('*no pain*') to 10 ('*pain as bad as you can imagine*'). The pain interference item used anchors of 0 ('*I don't miss out on any activities*') and 10 ('*I miss out on all activities*'). Pain frequency is rated on a 6-point scale ranging from 1 ('On less than 1 day each month') to 6 ('*Every day*'); intermediate points (2–5) are intentionally unlabelled to represent gradations between these two extremes, consistent with Heathcote et al. (2016). Higher scores indicate greater pain intensity, higher interference, and more frequent pain. In the present sample, internal consistency was excellent ($\alpha = 0.90$), with corrected item–total correlations ranging from 0.742 to 0.829, indicating that all items contributed adequately to the overall scale reliability.

2.6 | Pelvic Pain Impact Questionnaire (PPIQ)

For both cohorts, to assess the impact of pelvic pain on various aspects of life, the 10-item PPIQ was administered (Chalmers et al. 2019). Participants rated each item on a 5-point Likert scale ranging from 0 ('*not at all*') to 4 ('*a great deal*'). Participants were asked to reflect on how pelvic pain influenced their functioning over the past month. The PPIQ includes eight scored items and two supplemental, non-scored items. The eight scored items evaluate how pelvic pain affects energy levels, mood, sleep, gastrointestinal functioning, ability to sit, ability to engage in daily activities and exercise, and ability to wear certain clothing. The two supplemental, non-scored items address menstruation and intimacy. The total score range is 0–32, with higher scores indicating a greater impact of pelvic pain on daily life. The PPIQ has demonstrated strong psychometric properties, including high utility, high test–retest reliability and excellent reliability across a range of pelvic pain conditions (Al-Abbadey et al. 2019; Chalmers et al. 2019). In the present sample, internal consistency was excellent ($\alpha = 0.93$), with corrected item–total correlations ranging from 0.501 to 0.839, indicating that all items contributed adequately to the overall scale reliability.

2.7 | Experimental Tasks

2.7.1 | Measuring IB via the Ambiguous Scenarios Task

All participants completed a computerised ambiguous scenarios task, a method commonly used to assess IB in pain research (Chan et al. 2020; Gaffiero et al. 2022; Heathcote et al. 2016). In this task, participants were presented with 18 ambiguous scenarios that can be interpreted in either a pain- or non-pain-related manner. For example, one scenario reads: 'A ball hits you in the face. You look in the mirror and see your face is covered in...' where a pain-related interpretation would be 'blood', and a non-pain-related interpretation would be 'mud'. The task of the participant is to type the first word(s) that come to mind in response to each scenario. In addition, this task included 14 filler scenarios (i.e., scenarios that could not be interpreted in a pain-related manner) to avoid priming effects and reduce demand characteristics. An example of a filler scenario is: 'You get distracted and when you return you realise you forgot to boil the...' with non-pain-related responses such as 'kettle', 'water' and 'pasta'. Participants followed the same instructions for the filler scenarios, typing the first word(s) that came to mind. Following a practice trial, participants then completed the 32 experimental trials, with stimuli presented in Arial font (size 11) in the centre of their computer screen. The order of both ambiguous and filler scenarios was randomised to minimise any potential order effects.

The IB task was scored using the pre-defined coding scheme developed by Gaffiero et al. (2022), which categorises each possible word completion for the 18 ambiguous word association scenarios as *pain-related* or *non-pain-related*. Each participant's typed responses were automatically matched against this coding list. Completions reflecting pain-related content (e.g., *hurt*, *ache*, *injury*) were coded as *pain-related*, whereas those reflecting non-pain contexts (e.g., *exercise*, *stretch*, *movement*) were coded as *non-pain-related*. An IB index score was then calculated by subtracting the total number of non-pain-related completions from the number of pain-related completions. More positive scores therefore indicated a stronger bias towards pain-related interpretations, whereas more negative scores indicated a bias towards non-pain-related interpretations. This objective, pre-defined approach ensured replicable scoring without the need for independent rater judgement.

2.7.2 | Measuring MRB via the Surprise-Free Recall Task

To explore MRB, a surprise-free recall task was used. The surprise-free recall task is commonly employed in pain-related research (Schoth et al. 2019, 2018). In this task, participants are given 3 min to recall as many solutions as possible from the ambiguous or filler scenarios presented earlier in the ambiguous scenarios task. Participants are instructed to type these words into a text box, focusing on any interpretations that came to mind when completing the ambiguous scenarios task, regardless of whether they were pain or non-pain related. No further instructions were given to guide responding. The task was conducted without any warning to capture natural, unprompted recall.

2.8 | Procedure

This online experimental task was administered using Qualtrics XM software (Provo, UT; version February–May 2024). The study adhered to the British Psychological Society Code of Human Research Ethics and the BPS Ethics Guidelines for Internet-Mediated Research. Additionally, it received approval from the University of Derby, College of Health, Psychological and Social Care Research Ethics Committee (approval no. ETH2324-1475). As part of this ethics application, a full overview of the study design and planned analyses was submitted and reviewed, which served the same function as preregistration and therefore a separate preregistration was not

undertaken. All participants provided informed consent before completing the demographic questionnaire. Participants then proceeded with the ambiguous scenarios task, followed by the PPIQ and RPEQ. Finally, participants took part in the surprise-free recall task to assess memory retention of their scenario responses. Upon completion, participants were fully debriefed and thanked for their participation. The average time to complete the study was 15 min.

2.9 | Data Preparation

To analyse the data, IB and MRB index scores were calculated. The IB index score was derived by subtracting the number of non-pain-related interpretations from the number of pain-related interpretations (i.e., IB pain—IB neutral). Similarly, the MRB index score was determined by subtracting the number of non-pain-related words correctly recalled from the number of pain-related words correctly recalled (i.e., MRB pain—MRB neutral). A positive value for either index score indicates a bias towards pain-related information, a value of 0 suggests no bias, and a negative value indicates a bias towards neutral information.

2.10 | Analytic Strategy

All hypotheses were developed a priori based on previous literature. Specifically, a directional hypothesis was adopted for IB due to consistent evidence of enhanced threat- or pain-related interpretation among individuals with chronic pain (e.g., Schoth and Liossi 2016; Todd et al. 2023). In contrast, a non-directional hypothesis was adopted for MRB because findings regarding MRB in chronic pain populations remain mixed and inconclusive (Schoth et al. 2020).

Hypothesis 1 posited that individuals with endometriosis would exhibit a stronger IB towards pain-related information compared with PFCs. Hypothesis 2 posited that there would be a difference in the number of pain-related solutions recalled (MRB) between the endometriosis and PFC cohorts, but no specific directionality was predicted. These hypotheses were tested using independent samples *t*-tests to compare the IB and MRB indices between the cohorts. Hypothesis 3 proposed a non-directional relationship between pain outcomes, IB, and MRB within the endometriosis cohort. Pearson's correlations were conducted to examine associations between pain outcomes, IB scores (reflecting the extent of pain-related interpretations), and MRB scores (reflecting the proportion of pain-related information recalled). Data were analysed using SPSS (version 29; IBM Corp.).

3 | Results

3.1 | Demographics

3.1.1 | Endometriosis Cohort

The majority of individuals in the endometriosis cohort were of White British ethnicity (93.4%). A large proportion also reported Irish nationality (76.7%), reflecting regional/dual national identity rather than separate ethnic categorisation. Most participants had a postgraduate qualification (39.05%). The average time living with endometriosis reported was 6.85 ± 7.22 years (mean ± SD). With respect to mental health diagnoses, 59% reported suffering from a mental health disorder; this included both anxiety and depression (38.9%), only anxiety (11.1%), and only depression (9.0%). The remaining participants reported no mental health diagnoses (41%). In the last 3 months, on a scale of 1–10, average pain intensity was 6.04 ± 2.28, average worst pain intensity was 8.32 ± 2.01, and average pain interference was 6.49 ± 2.48. Finally, on a scale of 1–6, average pain frequency was 4.46 ± 1.49 (mean ± SD).

3.1.2 | Pain-Free Control Cohort

Individuals in the PFC cohort ($n = 70$) tended to be White British (57.1%) or Iranian (41.32%), had an undergraduate qualification (48%), and 68.6% reported no mental health diagnoses. The remaining 31.4% reported anxiety and depression (21.4%), anxiety (2.9%), and depression (7.1%). In the last 3 months, average pain intensity was 3.37 ± 2.33, average worst pain intensity was 4.81 ± 3.20, average pain interference was 3.05 ± 2.66, and finally, average pain frequency was 2.47 ± 1.34.

3.2 | Age, Pain Outcomes, IB and MRB Scores Between the Endometriosis and Pain-Free Control Cohorts

Independent samples *t*-tests were conducted to compare age, average pain intensity, worst pain intensity, pain interference, pain frequency, and PPIQ scores between the endometriosis and PFC cohorts. No significant difference was observed in age, $t(158) = -1.234$, SE = 1.807, $p = 0.110$, $d = -0.197$. Significant differences were observed in average pain intensity, $t(158) = 7.291$, SE = 0.366, $p < 0.001$, $d = 1.162$, worst pain intensity, $t(158) = 8.028$, SE = 0.437, $p < 0.001$, $d = 1.352$, pain interference, $t(158) = 8.417$, SE = 0.407, $p < 0.001$, $d = 2.56$, pain frequency, $t(158) = 8.724$, SE = 0.227, $p < 0.001$, $d = 1.43$, and PPIQ scores, $t(158) = 8.981$, SE = 1.30, $p < 0.001$, $d = 1.48$. In all cases where significant differences were observed, effect sizes were very large, evidencing consistent and large differences in pain reporting. For mean ± SD please see Table 1 below.

3.3 | Comparing IB and MRB Index Between the Endometriosis and Pain-Free Control Cohorts

To test Hypotheses 1 and 2 an independent samples design was used to examine the IB index and MRB index in the endometriosis and PFC cohorts. Data were analysed using independent samples *t*-tests with cohort as the independent variable and IB and MRB index as the dependent variables. A significant difference was observed in IB index, $t(158) = 2.658$, $p = 0.004$, $d = 0.424$, with the endometriosis cohort exhibiting a weaker bias towards neutral information (mean ± SD, −0.98 ± 6.08) compared with PFCs (mean ± SD, −3.41 ± 5.30). No significant differences were observed in MRB index, $t(158) = -0.849$, $p = 0.198$, $d = -0.135$.

3.4 | Associations Between Pain-Related Outcomes, IB and MRB in Endometriosis

To test Hypothesis 3, which examined the relationships between IB, MRB, and pain outcomes within the endometriosis cohort, Pearson's correlation coefficients were calculated. The analysis included IB and MRB index scores, as well as all pain-related variables of: average pain intensity, worst pain intensity, pain interference, pain frequency, and duration of pain. Table 2 presents the full correlation matrix for these variables.

A small but significant positive correlation was observed between IB and MRB index scores ($r = 0.181$, $p = 0.04$), indicating that participants who made more pain-related interpretations also tended to recall more pain-related information. A further small positive correlation was observed between IB and pain interference ($r = 0.169$, $p = 0.055$), suggesting a trend whereby individuals with stronger pain-related IBs reported greater interference from pain in daily activities, although this relationship did not reach statistical significance. No other relationships between IB, MRB, and pain outcomes were significant or approached significance (all p values > 0.05).

To examine whether relationships between IB, MRB index and pain interference were influenced by mental health comorbidity, partial correlations were conducted controlling for self-reported anxiety and depression. The previously significant association between IB and MRB index scores was reduced to trend level ($r = 0.176$, $p = 0.051$), suggesting that anxiety and depression may partly account for this relationship. In contrast, the association between IB and pain interference was already non-significant and weakened further when controlling for anxiety and depression ($r = 0.123$, $p = 0.127$), indicating no independent relationship between IB and pain interference once affective symptoms were considered.

TABLE 1 | Age pain outcomes, IB and MRB score between the endometriosis cohort and the pain-free control cohort.

	Endometriosis ($n = 90$), mean ± SD	Pain-free control ($n = 70$), mean ± SD
Age, years	33.66 ± 10.32	35.89 ± 12.54
Average pain intensity, score	6.04 ± 2.28	3.37 ± 2.33
Worst pain intensity, score	8.32 ± 2.01	4.81 ± 3.20
Pain interference, score	6.49 ± 2.48	3.05 ± 2.66
Pain frequency, score	4.46 ± 1.49	2.47 ± 1.34
PPIQ, score	21.97 ± 7.02	10.26 ± 8.98
IB index	−0.98 ± 6.08	−3.41 ± 5.30
MRB index	2.70 ± 1.79	2.94 ± 1.80

Abbreviations: IB, interpretation bias; MRB, memory recall bias; N/A, not applicable; PFC, pain-free control; PPIQ, Pelvic Pain Impact Questionnaire.

4 | Discussion

To the best of our knowledge, the present study is the first to examine both IB and MRB in individuals with endometriosis

TABLE 2 | Pearson's correlations between pain-related outcomes, IB, MRB and years in pain in the endometriosis cohort ($n = 90$).

	IB index	MB index	Pain intensity	Worst pain intensity	Pain interference	Pain frequency	Pain duration	PPIQ
IB index	1	—	—	—	—	—	—	—
MB index	−0.181*	1	—	—	—	—	—	—
Pain intensity	−0.039	−0.005	1	—	—	—	—	—
Worst pain intensity	0.034	−0.129	0.614**	1	—	—	—	—
Pain interference	0.169	0.082	0.524**	0.541**	1	—	—	—
Pain frequency	−0.005	0.098	0.523**	0.454**	0.541**	1	—	—
Pain duration	−0.102	−0.074	−0.086	−0.086	−0.001	−0.081	1	—
PPIQ	−0.018	0.082	0.660**	0.421**	0.376**	0.336**	−0.211*	1

Abbreviations: IB, interpretation bias; MRB, memory recall bias; PPIQ, Pelvic Pain Impact Questionnaire.
*$p < 0.05$.
**$p < 0.001$.

compared with PFCs. Three clear findings emerged. First, individuals with endometriosis showed a significantly stronger tendency to interpret ambiguous information in a non-neutral manner, indicating elevated IB in this population. Second, no group differences were observed for MRB, suggesting that endometriosis was not associated with enhanced (short-term) recall of pain-related information. Third, within the endometriosis cohort, IB and MRB were modestly correlated, but neither bias demonstrated significant associations with pain severity, frequency, or interference once anxiety and depression were accounted for. Together, these results indicate that while IB appears reliably elevated in endometriosis, its link with pain outcomes is indirect and likely influenced by affective factors.

Regarding Hypothesis 1, the finding that individuals with endometriosis demonstrated a significantly stronger tendency to interpret ambiguous scenarios in a non-neutral, illness-relevant manner aligns well with previous research exploring IB in endometriosis populations. For example, Todd et al. (2023) demonstrated that a negative IB was associated with higher levels of fear of disease progression, suggesting that individuals with endometriosis who interpret ambiguous information negatively are more likely to experience heightened anxiety about the future course of their condition. Furthermore, Todd et al. (2023) reported fear of disease progression mediated the relationship between IB and pain interference. In other words, individuals who were more likely to interpret ambiguous information negatively also reported greater fear about their condition worsening. This heightened fear, in turn, intensified the extent to which pain disrupted their daily lives. Thus, negative IBs may indirectly amplify pain interference by increasing fear and vigilance towards illness-related threats. Similarly, Pickup et al. (2023) reported that individuals with endometriosis were more inclined to make health-threat interpretations and found that IB was directly associated with greater pain interference. Taken together, the findings of Todd et al. (2023), Pickup et al. (2023), and the present study converge to suggest that individuals with endometriosis exhibit a consistent pattern of altered, non-neutral IB, which may become pain-relevant in the prescence of heightened affective threat.

In addition to the above, the findings of the present study emphasise the utility of diverse experimental paradigms for measuring IB. Schoth and Liossi (2017) reviewed several approaches, including tasks involving ambiguous words, images, and ambiguous scenarios. Todd et al. (2023) and Pickup et al. (2023) both employed word association tasks, where participants interpreted single ambiguous words such as '*needle*' in either a benign ('*sew*') or health-threatening ('*injection*') manner. By contrast, the present study used an ambiguous scenarios task with stimuli validated by Heathcote et al. (2016) and Gaffiero et al. (2022). Although these scenarios were originally developed in non-clinical populations and were not tailored to the lived experiences of endometriosis, the current findings demonstrate their sensitivity and validity in detecting IB within this population. Nonetheless, the development of an endometriosis-specific stimulus set—incorporating language, imagery, and contextual cues relevant to this condition—would represent a valuable methodological advancement. Such stimuli could capture endometriosis-specific cognitive themes, enhance ecological validity, and better determine how threat processing manifests within endometriosis-related pain.

In respect to Hypothesis 2, no significant differences were observed in the number of pain-related solutions recalled between the endometriosis and PFC cohorts. This finding aligns with the broader MRB literature in chronic pain, which has yielded mixed results (Schoth et al. 2020). It suggests that although individuals with endometriosis interpret ambiguous information in a more pain-related manner, they do not necessarily recall pain-related material more readily than PFCs. This divergence between IB and MRB implies that these cognitive processes may operate through distinct mechanisms. While IB reflects relatively automatic threat appraisals, memory recall may be shaped by more controlled or affectively moderated processes, such as emotional regulation or attentional allocation. Thus, pain-related IB may heighten momentary vigilance to threat cues, but it does not necessarily translate into stronger short-term recall of pain-related information.

Several mechanisms may help explain this pattern. One possibility is emotional avoidance—a coping strategy in which individuals downregulate or suppress distressing material to reduce immediate emotional discomfort. Emotional avoidance is well documented in chronic pain (McCracken and Keogh 2009) and appears prevalent in women with endometriosis, who often report avoidant coping styles associated with anxiety and depression (Eriksen et al. 2008). Supporting this, Zarbo et al. (2022) found that individuals with endometriosis-related pain were more likely to repress or suppress unwanted thoughts and emotions. Such avoidance could manifest as selective attention away from pain-related cues or as reduced encoding of distressing information, resulting in lower recall of pain-related content. Alternatively, the Attentional Cost Hypothesis (Grisart et al. 2007) provides a cognitive explanation: the persistent demands of managing endometriosis-related pains may consume limited attentional resources, impairing encoding and consolidation processes required for later recall. Indeed, this interpretation is consistent with the cognitive-affective model of the interruptive function of pain (Eccleston and Crombez 1999), which proposes that pain captures attention at the expense of broader cognitive processing.

Considering Hypothesis 3, only partial support was observed. To expand, a small but significant positive association was observed between IB and MRB, but no significant associations were observed between IB, MRB and any pain outcomes. The IB and MRB finding indicates that individuals with endometriosis who made more pain-related interpretations also tended to recall more pain-related information. This suggests a modest degree of coherence between interpretive and mnemonic processing of pain-related information. However, no significant associations emerged between either bias measure and pain outcomes, aside from a trend-level correlation between IB and pain interference that did not remain significant once anxiety and depression were controlled for. Hence, these results suggest that while IB and MRB are modestly inter-related, their direct relationship to pain severity or impact appears limited and may be influenced by anxiety and depression rather than representing an independent maintaining mechanism.

Taken together, these findings highlight the complexity of cognitive-affective processes in endometriosis. While IB appears heightened and linked to MRB, neither bias directly predicted pain outcomes. This pattern adds weight to the idea that biases are dynamic. Indeed, it is well known that affective disposition towards anxiety and depression influences cognitive processing (Quigley et al. 2022; Mathews et al. 1997). Therefore, understanding how affect, cognition, and attentional control interact in processes of pain may be more informative than focusing on single biases in isolation. Future work should employ longitudinal and experimental approaches to determine whether targeting IB or emotional avoidance yields clinical benefit in individuals with endometriosis.

4.1 | Limitations and Future Research Directions

The current study has certain limitations. Firstly, it could be argued that the scenarios used in the ambiguous scenarios tasks were not specifically tailored to elicit interpretations uniquely relevant to individuals with endometriosis, which may have reduced the salience of pain-related solutions in this context. As previously stated, future research could attempt to develop an endometriosis-specific stimulus set for use in ambiguous scenario IB paradigms, which would increase ecological validity.

Secondly, attentional bias was not measured. Without directly assessing attentional bias, it remains unclear how attentional prioritisation of pain-related stimuli may have influenced the observed relationships between IB, MRB and pain outcomes. Incorporating attentional bias measures in future research, such as through in-person experimental paradigms employing eye-tracking technology (Gaffiero et al. 2019), would provide deeper insights into how these biases interact and contribute to the complex cognitive and emotional mechanisms underlying chronic pain in endometriosis.

Thirdly, participants were included based on a self-reported diagnosis of endometriosis. While medical verification was not feasible in this study, which introduces potential variability in diagnostic accuracy, steps were taken to enhance the reliability of self-reported data. Specifically, the inclusion of the PPIQ enabled participants to systematically report their symptoms and the impact of pelvic pain on their quality of life. The PPIQ is a validated tool designed to capture clinically relevant indicators of endometriosis-related pain; thus, its use enhances the credibility of self-reported diagnoses by providing structured, symptom-based data.

Finally, physical health comorbidity data were not collected for either cohort. Although participants in the control group were screened to exclude any current physical health conditions, comorbidities are common among individuals with endometriosis and may influence pain-related cognition. Future research should therefore record and statistically control for physical health comorbidities to clarify the unique contribution of endometriosis to cognitive bias patterns. When controlling for self-reported anxiety and depression, associations between IB and MRB were reduced to trend level, and relationships with pain interference were no longer significant. This suggests that affect-related factors may partially underlie the observed cognitive bias patterns. Future studies should therefore include validated continuous measures of anxiety and depression.

5 | Conclusion

In conclusion, the present study represents the first to measure IB and MRB in endometriosis and PFC cohorts. Our findings suggest that individuals with endometriosis are more likely to exhibit a reduced bias towards neutral interpretations of ambiguous information, with no evidence of a MRB favoring pain-related information. Moreover, whilst IB and MRB were associated, no relationships were observed between these two biases and pain outcomes. We suggest that understanding IB in clinical populations may help inform approaches to mitigating emotional distress and improving pain management in individuals with endometriosis. Future studies should expand on the present study by incorporating measures of attentional bias, which could further clarify the role of cognitive and affective processes in shaping chronic pain experiences in endometriosis.

Author Contributions

Sophia Nematollahi: conceptualization, investigation, writing – original draft, methodology, validation, visualization, writing – review and editing, formal analysis, project administration. **Frances A. Maratos:** writing – review and editing, supervision, validation, visualization. **Daniel Gaffiero:** conceptualization, writing – review and editing, visualization, validation, methodology, formal analysis, supervision.

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Ethics Statement

The study received approval from the University of Derby, College of Health, Psychological and Social Care Research Ethics Committee (approval no. ETH2324-1475).

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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