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Negative comments and social media: How cognitive biases relate to body image concerns

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A B S T R A C T

Body image concern (BIC) is a prevalent issue thought to be exacerbated by social media. In addition to sociocultural factors, cognitive biases may also contribute to BIC. We explore whether cognitive biases in memory for body image-related words, presented in a mock social-media context, are associated with BIC in young adult women. A sample of 150 University students was presented with a series of body image-related comments aimed at either themselves, a close friend, or a celebrity in a recognisable social media context. Afterwards, a surprise memory task was completed that assessed the participant's memory for body image-related words (item memory), their insight (metamemory), and to whom a specific word was directed (source memory). Self-referential biases were identified for both item memory and source memory. Individuals with greater BIC displayed a greater self-referential bias for correctly and incorrectly sourcing negative words to themselves compared with both friend and celebrity. A greater self-referential effect in metacognitive sensitivity was also associated with higher BIC. We provide novel evidence for a cognitive bias in sourcing negative body image-related information to the self in individuals with higher BIC. The results should inform cognitive remediation programmes aimed at treating individuals with body and eating-related disorders.

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1. Introduction

Body image concern (BIC) is highly prevalent and has been described as "an overlooked public health concern" (Bucchianeri & Neumark-Sztainer, 2014). BIC is a core component of eating disorders, with high BIC being a predictor for the onset of an eating disorder (Cornelissen & Tovée, 2021). In addition to sociocultural factors, cognitive biases have also been identified in individuals with eating disorders (e.g. Williamson, 1996; Williamson et al., 1999, 2004). Cognitive models of body image disturbances predict a greater self-bias, especially for negative appearance-related information (Clerkin & Teachman, 2008). Additionally, certain cognitive biases have been demonstrated in individuals with BIC including selective memory biases toward appearance related words (for review see Rodgers & DuBois, 2016). Understanding cognitive biases in interpreting information are increasingly important in today's society due to the pervasiveness of social media, resulting in a considerable rise in BIC in young adults (Holland & Tiggemann, 2016). Social media allows a constant means to compare oneself to others and to both comment and receive comments on physical appearances. Therefore, it is important to understand how self-bias for negative body image-related information may be associated with BIC within a social media context.

BIC is strongly associated with eating disorders (Rodgers & Melioli, 2016). Mechanistic accounts of eating disorders have often focused on cognitive biases that underly pathological cognition in relation to food consumption and body image (Vitousek & Hollon, 1990; Williamson, 1996; Williamson et al., 1999, 2004). For example, Vitousek and Hollon (1990) posit that individuals with eating disorders develop schemata that reinforce their pathological thought processes through cognitive means e.g. selective attention and memory, confirmation bias, and availability and representativeness heuristics (Taylor & Crocker, 1981; Turk & Salovey, 1985; Tversky & Kahneman, 1974). Cognitive biases have also been shown to influence memory in individuals with eating disorders. For example, Sebastian et al. (1996) compared a clinical eating disorder (ED) cohort with both a non-clinical sample who had a preoccupation with their body weight and a control group who did not present with any BIC. Women in the clinical ED group and in the non-clinical BIC group were equal on weight preoccupation, depression, and neuroticism. During a free recall task, those with eating disorders had greater recall of words associated with fatness (e.g. obese) than both the non-clinical and control samples, coupled with worse recall for words associated with thinness. Similar results were identified in a

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later study (Chen & Jackson, 2005). A review by Rodgers and DuBois (2016) proposed that individuals with an eating disorder found stimuli associated with fatness more salient, whereas stimuli associated with thinness were relatively ignored. In addition to memory effects in general, Chen and Jackson (2006) demonstrated that high BIC was associated with slower responses when required to judge whether a body size word was positive or negative following a self-priming word. The results of this study highlight the importance of understanding self-biases in episodic memory and how they are associated with BIC.

The self-reference effect (SRE) in episodic memory describes a phenomenon whereby information is preferentially encoded when it is related to the self, subsequently enhancing recall or recognition (Rogers et al., 1977). For example, a SRE has been identified for recognising adjectives directed at the self, compared with both close others (family or friends) and familiar celebrities (Argembeau et al., 2010; Kuiper, 1982; Kokici et al., 2021; Martin et al., 2017). The SRE in episodic memory is robust and provides an ideal experimental tool to assess self-biases in encoding and/or recognizing positive or negative body image-related information. Moreover, the inclusion of close others, such as friends, and distant others such as celebrities, allows for the assessment of self-biases in relation to horizontal comparisons (comparisons with someone you view as similar in terms of social status) to social group members and upward comparisons to those perceived as symbolizing aesthetic ideals. Research into the SRE has predominantly focused on item memory (e.g., remembering or recognizing specific words/pictures within a task; Klein, 2012; Symons & Johnson, 1997). However, another core component of episodic memory is the ability to contextualise, or source, the memory. For example, we may remember a particular insult (item memory), but it is also important to remember who that insult was directed at (source memory). There is contrasting evidence as to whether item and source memory reflect unique or overlapping cognitive processes (Guo et al., 2021). Positive (Madan et al., 2017) and negative correlations (Mather et al., 2006) between overall accuracy of item and source memory have been identified. However, using functional neuroimaging, dissociable brain networks have been identified for item and source memory activation (Davachi et al., 2003; Glisky et al., 1995; Slotnick et al., 2003). It is therefore important to assess self-biases across both item and source memory and explore individual differences relevant to both.

Memory performance is often measured using simple yes/no binary paradigms which fail to consider the strength of a memory trace. For example, we may remember an item but be somewhat unsure if we have remembered it correctly. Including confidence judgements after an initial memory judgement, allows for both accuracy and confidence in a memory trace, to be assessed. In addition to measuring overall confidence in memories, the inclusion of confidence judgements allows for the assessment of metacognitive sensitivity. Applying a signal-detection approach we can ascertain how well confidence judgements align to first-order accuracy performance. An individual with high metacognitive sensitivity is highly confident for correct responses and expresses lower confidence for incorrect responses. Previous research suggests a SRE is also apparent in metamemory (Kokici et al., 2021), but to date it is unknown if memory biases associated with BIC, extend to metamemory.

Regarding valence effects on metamemory, inconsistent findings have been presented. For example, greater metacognitive sensitivity has been shown for long term memory (a week) for positive items (Legrand et al., 2021) and for short-term memory (an hour) for negative items (Kokici et al., 2021). As metacognition reflects how we *think about our own thinking,* individuals with affective disturbances may present with diminished confidence in their ability, in line with previously discussed negativity biases or feelings of helplessness (Drueke et al., 2022). However, they may also show greater metacognitive sensitivity for negative stimuli, especially those directed at themselves. In the present study, we will provide further evidence for metacognition for self, close friend, and celebrity encoded words, and assess whether metamemory differences for appearance-related comments are associated with body image concerns.

The affective component of a stimulus has been shown to have different effects on item and source memory. Emotional arousal increases item memory (Bradley et al., 1992, Brown & Kulik, 1977, Cahill & McGaugh, 1998), but mixed evidence exists for valence effects on source memory (Mather, 2007; Mather & Sutherland, 2011; Murray & Kensinger, 2013; Yonelinas & Ritchey, 2015). Further studies have illustrated that positive emotional context encourages associative memory (Fredrickson & Branigan, 2005; Madan et al., 2019), but little is known about how this interacts with sourcing memories to the self or others. Self-reference effects have been identified in source memory and found to be dependent on valence. For example, Durbin et al. (2017) identified a self-referential bias in the ability to correctly source positive items. The authors suggested that source memory accuracy depends on how well an item aligns with the self-schema. Therefore, the self-reference effect in source memory is typically associated with a self-positivity bias, whereby individuals are motivated to remember positive information that was directed at themselves, as protection of their positive self-image (D'Argembeau et al., 2005; D'Argembeau & Van der Linden, 2008). However, individuals who present with affective disturbances, such as depression, often show a reduced positivity bias (Alloy & Ahrens, 1987; Korn et al., 2014; Moore & Fresco, 2012). A negative self-image, and a subsequent negativity bias, may result in greater attention, encoding, and memory for negative stimuli, especially when sourcing information to the self in comparison to sourcing information to others.

Emotional regulation difficulties are also considered a key contributor to BIC (Lavender & Anderson, 2010) and a possible mediator in the relationship between BIC and pathological eating behaviour (Hughes & Gullone, 2011). However, little is known about biases toward encoding and retrieving emotional information in individuals with greater body image concerns. Memory biases relevant to social feedback are especially pertinent considering the vast abundance of media available, especially platforms that allow both positive and negative social feedback. One growing area of concern is the effects of social media on aesthetic ideals and subsequent body image concerns (Fardouly & Vartanian, 2016), especially in young women (Perloff, 2014). Social media platforms facilitate continuous comparisons with social peers (horizontal comparison) and aesthetic ideals in the form of celebrities/influencers (upward comparison). Moreover, social media platforms have transformed peer relations (Nesi et al., 2018), especially in young adults and adolescents, who are acutely attuned to their own physical appearance and tend to engage in high levels of appearance-based comparisons against both peers and notable others such as celebrities/influencers (de Vries et al., 2016). Upward comparisons are seen to have a more pronounced effect on individuals generally, with exposure on social media leading to greater negative biases regarding how they perceive themselves (Haferkamp & Krämer, 2011; Lee, 2014; Vogel et al., 2014, 2015). However, those with BIC have been shown to have greater negative reactions to all types of comparison (Laker & Waller, 2022). Consequently, BIC have risen considerably in adolescents and young adults, which has also been exacerbated by the ongoing Covid-19 pandemic (Swami et al., 2021). BIC may arise from both the unrealistic ideals presented on social media (Aparicio-Martinez et al., 2019) and the lasting effects of negative appearance-related comments or cyberbullying (King et al., 2015; Salazar, 2021). For example, research has shown a direct link between appearance related comments on social media platforms and negative body image (Kim, 2020; Tiggemann & Barbato, 2018).

In addition to the sociocultural aspects of the social media phenomena, individual differences are likely to exist in how information on such platforms is attended to, encoded, and subsequently remembered. Individuals with higher BIC may present with cognitive biases that result in a greater focus on negative appearance-related comments. Ultimately, such cognitive biases may result in a positive feedback loop, with individuals high in BIC focusing on negative self-directed words, leading to further BIC, increasing the chance of an eating disorder. Previous research by Bailey and Ricciardelli (2010) found individuals with high BIC self-reported receiving more negative comments directed at them in their daily life. However, experimental evidence is lacking as to whether individuals high in BIC show both an explicit bias, whereby they report receiving more negative comments regardless of actual frequency, and an implicit bias whereby they show greater accuracy in both remembering and sourcing self-directed negative comments. Existing research in this area has identified a covariation bias (Alleva et al., 2014, 2016), whereby individuals high in BIC expect a greater proportion of negative social feedback on their appearance, and therefore overestimate the true amount of negative feedback directed at themselves. More broadly, interpretation biases have also associated with body image concerns, with individuals scoring higher on BIC tending to interpret ambiguous information negatively, especially in relation to body image (Brockmeyer et al., 2018; Martinelli et al., 2014; Rosser et al., 2010). The current study will explore cognitive biases using a self-referential memory task with both negative and positive comments presented in a mock social media context and explore individual differences attributable to the extent of BIC in a cohort of healthy young women. As interpretation biases, such as a covariation bias, are common in emotional disturbances (e.g. Brendle & Wenzel, 2004; Wisco & Nolen-Hoeksema, 2010), and are central to cognitive models of depression (Lawson et al., 2002; Rude et al., 2003), we will assess whether depressive traits explain any association between BIC and cognitive biases.

We hypothesized that self-encoded words would be recognized with greater accuracy sensitivity than friend and celebrity words with friend-encoded words having an intermediate memory advantage. This effect would be apparent across both item and source memory, for memory sensitivity and metacognitive sensitivity. We also hypothesized that valence would influence the SRE in source memory with positive words sourced to the self with greater accuracy than for both the friend and celebrity-encoded words. Individuals with higher BIC would show a stronger SRE and this would be driven by a greater recognition of negative words directed at the self. In addition to self-referential biases, we also expect individuals higher in BIC to report receiving a greater proportion of negative comments directed at themselves. Our social comparison analysis was exploratory in nature, but we expected negative words encoded in comparison to a celebrity would be remembered better than words encoded in relation to a friend. That is, an upward comparison effect would be identified. We predicted individuals with BIC would show less difference between comparison conditions.

2. Method

2.1. Participants

The sample comprised 150 (M = 19.13, SD = 1.14) women who were undertaking an undergraduate psychology degree at university and were recruited through the [REDACTED FOR BLINDING PURPOSES] research participation scheme, receiving course credit upon completion. Data collection occurred between December 2021 and May 2022. We focused on women for whom body image dissatisfaction is more prevalent than it is among men (Al Sabbah et al., 2009). Three were excluded due to incomplete data resulting in a final sample of 147.

2.2. Measures

2.2.1. Body image concern

The Body Shape Questionnaire (BSQ; Cooper et al., 1987) is a 34-item self-report questionnaire that produces a total score of between 34 and 204 indicating the extent of body image concerns (BIC). We adopt a continuous approach using the total score of an index of body image concern. Participants indicated their level of agreement on a scale of 1 (Never) to 6 (Always) on questions such as “Have you felt so bad about your shape that you have cried?”. The BSQ has good test-retest reliability, concurrent validity with other measures of body image, and criterion validity for clinical status (Rosen et al., 1996). Within-study reliability was high (α = 0.97). The BSQ is the earliest and one of the most widely used tools measuring BIC and its validity has been shown within multiple studies, including various translations/cultures (Akdemir et al., 2012; Ghaderi & Scott, 2004; Lentillon-Kaestner et al., 2014; Marzola et al., 2022; Warren et al., 2008). In comparison to other scales related to symptomology of eating disorders, the BSQ-34 explores a more comprehensive set of cognition, emotion and behaviour related to body image, such as excessive internal concern around body image and external concern around public views and embarrassment, as well as avoidance (Marzola et al., 2022). Additionally, due to the nature of the items, the BSQ measures concerns about body image beyond anorexia and bulimia nervosa, for example, in people with obesity without comorbid symptoms of binge eating disorder (Adami et al., 1999; Rosen et al., 1996). Therefore, the BSQ is not eating disorder specific and can identify high BIC without the presenting symptoms that would be required for an eating disorder diagnosis.

2.2.2. Depressive traits

The Patient Health Questionnaire (PHQ-9; Spitzer et al., 1999) is a nine-item self-report questionnaire, with scores ranging from 0 to 27, which measures symptoms and severity of depression. Participants reported on a scale of 0 (Not at all) to 3 (Nearly every day) how much over the past two weeks they have experienced items such as “Little interest and pleasure in doing things”. The PHQ-9 has good test-retest reliability, concurrent validity with other measures of body image, and criterion validity for clinical status (Sun et al., 2020). Within-study reliability was high (α = 0.90).

2.3. Materials

2.3.1. Mock social media task

We selected 120 body image-based adjectives (e.g. stunning, beautiful, chubby, revolting) from the word-lists provided in Warriner et al. (2013; see Table S1 and S2) and created six lists matched on valence and arousal, each containing ten positive and ten negative words. Three of the lists formed the words to be encoded in relation to either the self, friend, or a celebrity, and three lists provided the 60 unseen words for the surprise recognition memory task.

Participants were initially instructed to enter a female friend’s first name and then prompted to answer how close they are with this friend on a scale from 1 (not close) to 10 (very close). Two questions related to the celebrity were asked. The first measured how familiar with the celebrity Rihanna they were, from 1 (not familiar) to 10 (very familiar). The second asked about their opinion on Rihanna on a scale from 1 (very negative) to 10 (very positive). Participants were then prompted to enter their first name using a fake social media type log in screen. After this, the task began, with comments appearing in pairs on a mock social media platform (see Fig. 1). The comments were directed at the participant, their close

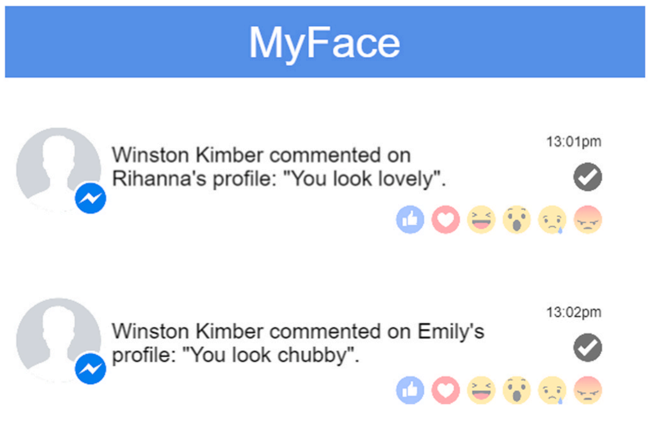

Fig. 1. Example stimuli from the "social media" task. *Note.* Participants were presented with these comments and instructed to respond with an emoji.

friend or Rihanna, and participants were simply instructed to respond with one of the six emojis provided. Comments were delivered using fake profiles of anonymous social media users. The pairs of adjectives were always of contrasting valence and directed at different agents (e.g. self and celebrity, self and friend, friend and celebrity).

The task included 30 pairs of comments, totalling 60 adjectives to be recognised in the subsequent memory task, twenty for each agent (self, friend, and celebrity). The pairings were matched on order of presentation, so each agent appeared an equal number of times on the top and bottom of the screen. The conditions were randomised for each participant resulting in no set order of how the pairs of comments appeared. The word lists were counterbalanced (i.e the self-directed comments for one participant were directed at the friend for another participant) across the sample to control for any unforeseen differences in familiarity or frequency of use for specific words. Participants had to 'react' to both comments in each pair using an emoji before a 'refresh' button appeared. These 'reaction' buttons were based on familiar social media emojis (see Fig. 1). The emojis were used to ensure a level of engagement in the task but did not form part of the analysis in the present study.

2.3.2. Surprise memory task

Following the task, participants were asked to judge whether they had received more negative or positive comments on a 5-point Likert scale (1 mostly negative to 5 mostly positive) and likewise for the friend and celebrity. This scale provided the data for the interpretation bias analysis. Participants then completed the surprise memory task which included all 60 previously seen adjectives, plus 60 new words (30 positive and 30 negative). After each 'yes/no' answered (item memory), the participant was prompted to indicate their confidence on a scale from 1 (not confident) to 9 (very confident). This provided the data for the analyses on metacognition. If the participant answered 'yes', they were also asked a follow-up question - 'who was this comment in relation to?' followed by the three options of 'you', 'your friend' and 'Rihanna', providing the data for the source memory analyses. Once the memory task was completed, participants were redirected back to Qualtrics and debriefed on the purpose of the study.

2.4. Procedure

All demographic and questionnaire data were collected using Qualtrics. The social media and surprise memory tasks were completed on the Pavlovia platform. Demographic and questionnaire data was collected prior to the social media and memory tasks. The entire study lasted approximately one hour for each participant.

This study received full ethical approval from the [REDACTED FOR BLINDING PURPOSES] Committee [ID: 202116367167297357].

2.5. Statistical analyses

All analyses were completed using JASP (version 0.14.1, http://www.jasp-stats.org) and we report both frequentist and Bayesian statistics. For the Bayesian analyses, we adopted default Cauchy priors across all analyses (t-test: $r = 0.707$; ANOVA: $r_{fixed} = 1$, r *random* $= 0.5$) and for the correlation analyses, a default stretched beta prior (width = 1; Wagenmakers et al., 2018). In brief, a Bayes factor (BF) quantifies the evidence for a particular model. For example, a BF_{10} of 12 equates to data that is 12 times as likely under an alternate model compared against the null model. Evidence for the alternate model is interpreted in a linear fashion, but for the ease of interpretation we conclude $BF_{10} = 1–3$ as inconclusive or preliminary evidence, 3–10 as moderate evidence, and > 10 as strong evidence for the alternate model. Likewise, a BF_{10} between 0.33 and 1 is considered inconclusive or preliminary evidence, between 0.1 and 0.33 as moderate evidence, and < 0.1 as strong evidence in favour of the null model.

In order to calculate signal detection measures of first-order sensitivity (d'), second-order sensitivity (meta d') and metacognitive efficiency (meta d'/ d' or M-ratio), we employed a single-subject Bayesian estimation using HMeta-d (Fleming, 2017) in MATLAB (version r2021a). All analyses were calculated using participants' accuracy and confidence judgements for each of the six conditions (Self, Friend, Celebrity encoding of positive and negative words). Accuracy and confidence for correctly identifying the distractor words as unseen were used in each comparison (self, friend, and celebrity). These were separated by valence, meaning sensitivity for positive words was calculated using correctly labelled positive words that were presented to the participant and 30 unseen positive distractor words.

Meta-d' is theoretically bound at zero. However, when fit using an unbounded maximum likelihood procedure, it can return negative values. The estimation error is relevant across all ranges of meta d' but is most evident when it exceeds the boundary of zero. As the negative values are indicative of estimation error that is consistent across the data, we did not remove negative meta d' values. We removed one participant who had a negative average d' score across all conditions, suggesting they did not perform the task appropriately, resulting in a total sample size of N = 146. Participants were removed from the metacognitive efficiency analyses if their first-level sensitivity (d') was too low (d' < 0.1), as this can severely affect the M-ratio score (Lee et al., 2018). However, the use of Bayesian estimation analysis allowed increased accuracy for metacognitive efficiency at lower levels of item and metacognitive sensitivity (Fleming, 2017), with only those performing below a d' of 0.1 returning metacognitive efficiency scores that fell consistently outside 4SDs of the mean. This resulted in the removal of thirty participants for the metacognitive efficiency analysis and a total sample size of N = 116. However, it should be noted that all results are comparable using the entire sample.

For the source memory analyses, we were unable to conduct sensitivity analyses due to the low number of trials in several conditions. We therefore present correct hits and false alarms as separate analyses in the complete cohort, N = 146.

SRE were analyzed using a 2 × 3 RM-ANOVA with VALENCE (positive, negative) and AGENT (self, friend, celebrity) as the independent variables and the memory performance measure, as the dependent variable. Post-hoc analyses were used to follow-up any significant effects. We analyzed both sensitivity and followed up with analyses focused on both correct hits (see Supplementary Section) and false alarms. A general SRE was calculated as SRE = self − (friend + celebrity)/2. The relationship between BIC and SREs across each memory measure were calculated using Pearson's correlations. The interpretation bias was calculated using a 1 × 3 RM-ANOVA. Then one sample t-tests were used to assess whether responses were different from neutral. The relationship between BIC and interpretation biases was assessed using Pearson's correlation for each AGENT (self, friend, celebrity). We used Steiger's Z tests implemented in the R package cocor (Diedenhofen & Musch, 2015) to compare correlation coefficients for overlapping pairs of dependent measures. All significant correlations, with moderate to strong evidence according to Bayesian analysis, were added to regression models to test whether BIC remains a significant predictor after controlling for depression.

A power analysis was conducted to determine the sample required to detect a correlation of 0.25 with an alpha = 0.05 and power = 0.8. A sample of at least 123 was required. We collected more data due to the parallel nature of online data collection and to minimise any potential effects due to incomplete data. However, we use Bayesian statistics to discourage a dichotomous approach to significance testing. We use Bayes Factors to base our conclusions for strength of evidence, with only moderate or strong evidence seen as indicative of an effect, removing issues such as multiple comparisons.

Raincloud plots (Allen et al., 2019) are used throughout to present key results. The plots consist of boxplots detailing the median, interquartile range, whiskers extending to the furthest data point within 1.5 standard deviations from the mean. Data distribution "clouds" are also presented alongside individual data points. Significance bars are also presented.

3. Results

3.1. Preliminary analyses

All the following scales were scored out of 10. Participants generally reported that they were very close to the selected friend (M = 8.6, SD = 1.9). Additionally, participants stated that they were very familiar with the celebrity Rihanna (M = 9.0; SD = 1.8). Participants overall reported that they liked Rihanna (M = 8.1; 1.7). Closeness with friend, familiarity and how much they liked Rihanna did not correlate with SRE with either item memory or source memory (all p values between.12 and.94). BIC and depression were correlated, $r(145) = 0.47$, $p < .001$ [BF_{10} = 4.37 e+ 6]. All correlations were comparable in the reduced sample for the metacognitive efficiency analyses (see S2).

The cohort consisted of 95 who identified as white, 36 as Asian, and 15 as Black African or Caribbean. Ethnicity had no significant effect on BIC, $F(2, 143) = 1.14$, $p = .32$, depression, $F(2, 143) = 0.28$, $p = .75$, close friend rating, $F(2, 143) = 0.07$, $p = .93$, familiarity with Rihanna, $F(2, 143) = 2.60$, $p = .08$, and whether they liked Rihanna, $F(2, 143) = 1.04$, $p = .36$. Ethnicity had no effect on memory performance in the celebrity condition, $F(2, 143) = 0.71$, $p = .49$ for item memory, and $F(2, 143) = 0.72$, $p = .49$ for source memory.

3.2. Item memory

3.2.1. Accuracy (d')

A 3 × 2 repeated measures ANOVA was calculated and identified a main effect of AGENT, $F(2, 290) = 11.78$, $p < .001$ [BF_{10} = 112.26], η_p^2 = .08. There was also a main effect of VALENCE, $F(1, 145) = 4.62$, $p = .03$ [BF_{10} = 3.61], η_p^2 = .03, such that memory sensitivity was higher for negative words. No AGENT x VALENCE interaction was identified, $F(2, 290) = 0.88$, $p = .42$ [BF_{10} = 0.05], η_p^2 = .01 (see Table 1). Post-hoc analyses were conducted on the factor AGENT and identified a difference between SELF and FRIEND, $t = 4.38$, $p < .001$[BF_{10} = 351.68], d = 0.36 and SELF and CELEBRITY, $t = 4.01$, $p < .001$ [BF_{10} = 111.63], d = 0.33. There was no difference in memory sensitivity between FRIEND and CELEBRITY encoded words, $t = -0.37$, $p = .71$ [BF_{10} = 0.07], $d = -0.03$. Therefore, item memory shows a self-referential bias when compared against both a close friend and a celebrity (see Fig. S2).

3.2.2. False alarms

Main effects of AGENT, $F(2, 290) = 6.27$, $p = .002$ **[**BF_{10} = 2.21**]**, η_p^2 = .04 and VALENCE, $F(1, 145) = 15.86$ **[**BF_{10} = 10.77**]**, $\eta_p{}^2$ = .10, were significant. However, an AGENT x VALENCE interaction was also supported, $F(2, 290) = 22.66$, $p < .001$ **[**BF_{10} = 5.02e+ 9**]**, η_p^2 = .14. To explore the interaction, we conducted separate RM-ANOVAs for positive and negative words.

For positive words, an effect of AGENT was supported, $F(2, 290) = 23.32$, p < .001 **[**BF_{10} = 2.47e+ 7**]**, η_p^2 = .14. Post-hoc analyses showed that compared to the self, a greater number of false alarms towards both friend, $t = -6.64$, $p < .001$ [BF_{10} = 1.73e+ 7], $d = -0.55$, and celebrity, $t = -4.69$, $p < .001$ [4911.81], $d = -0.39$ were produced. A difference between friend and celebrity was not supported, $t = 1.95$, $p = .05$ [BF_{10} = 0.51], d = 0.16, although the evidence was inconclusive (see Fig. S3).

For negative words, an effect of AGENT was supported, $F(2, 290) = 8.90$, $p < .001$ [BF_{10} = 138.76], η_p^2 = .06. Post-hoc analyses showed a greater number of false alarms towards the self, compared with celebrity, $t = 4.21$, $p < .001$ [BF_{10} = 284.78], d = 0.35. The evidence supported no difference for false alarms towards the self and friend, $t = 2.29$, $p = .05$ [BF_{10} = 0.92], d = 0.19, and between friend and celebrity, $t = 1.92$ [BF_{10} = 0.71], d = 0.16, although the evidence was inconclusive in both cases (see Fig. S3).

3.2.3. Metacognitive sensitivity and efficiency

A main effect of AGENT was not supported, $F(2, 290) = 4.00$, $p = .02$ [BF_{10} = 0.23], η_p^2 = .03, with the Bayesian analysis favouring the null model. Moderate evidence for a main effect of VALENCE was identified, $F(1, 145) = 4.49$, $p = .04$ [BF_{10} = 7.87], η_p^2 = .03, such that negative words were recognized with greater metacognitive sensitivity. The interaction between AGENT x VALENCE was not supported, $F(2, 290) = 0.68$, $p = .51$ [BF_{10} = 0.04], η_p^2 = .004. As metacognitive sensitivity is associated with first-level performance (d'), we next computed the effects of AGENT and VALENCE on metacognitive efficacy (meta d'/d'). No difference in metacognitive efficiency was identified across the conditions of AGENT, $F(2, 230) = 0.96$, $p = .38$ [BF_{10} = 0.04], η_p^2 = .01, or VALENCE, $F(1, 115) = 0.25$, $p = .62$ [BF_{10} = 0.10], η_p^2 = .002. No AGENT x VALENCE interaction was found, $F(2, 230)$= 0.15, $p = .86$ [BF_{10} = 0.03], η_p^2 = .001. Therefore, confidence in the memory trace showed a comparable pattern across encoding and valence conditions after controlling for first-level performance (d').

3.3. Source memory

3.3.1. Correct hits

A main effect of AGENT was identified, $F(2, 264) = 6.75$, $p = .001$ [BF_{10} = 3.20], $\eta_p{}^2$ = .05. No main effect of VALENCE was found, $F(1, 132) = 1.40$, $p = .24$ [BF_{10} = 0.13], $\eta_p{}^2$ = .01. However, an AGENT x VALENCE interaction was found, $F(2, 264) = 13.10$, $p < .001$ [BF_{10} = 382389.44], $\eta_p{}^2$ = .09. Separate 1 × 3 RM-ANOVAs were computed for source memory for negative and positive words.

For negative words, a main effect of AGENT was found, $F(2, 264) = 16.88$, $p < .001$ [BF_{10} = 1.02e+ 6], $\eta_p{}^2$ = .11. Post-hoc analyses demonstrated superior recognition of self-encoded negative words than both friend-encoded, $t = 3.74$, $p < .001$ [BF_{10} = 58.35], d = 0.32, and celebrity-encoded negative words, $t = 5.72$, $p < .001$ [BF_{10} = 156713.95], d = 0.50. Friend-encoded negative words were not better recognized than celebrity-encoded words, although the evidence for the null model was inconclusive, $t = 1.99$, $p = .048$ [BF_{10} = 0.67], d = 0.17 (see Fig. S4).

Table 1
Means and Standard Deviations for Item and Source Memory Accuracy.

	Self	Friend	Celebrity
	M (*SD*)	*M* (*SD*)	*M* (*SD*)
Item Memory			
Sensitivity (d')	1.18 (*0.50*)	1.02 (*0.44*)	1.04 (*0.40*)
Positive words	1.11 (*0.61*)	0.98 (*0.59*)	1.01 (*0.58*)
Negative words	1.24 (*0.61*)	1.07 (*0.54*)	1.06 (*0.49*)
Metacognitive Sensitivity (meta d')			
Positive words	0.34 (0.68)	0.30 (0.62)	0.31 (0.61)
Negative words	0.45 (0.66)	0.36 (0.70)	0.37 (0.71)
Metacognitive Efficiency (meta d'/d') ~~ddd(reduced~~ (reduced sample of 116)	0.42 (*0.58*)	0.49 (*0.69*)	0.50 (*0.87*)
Positive words	0.43 (*0.75*)	0.50 (*0.93*)	0.53 (*1.15*)
Negative words	0.42 (*0.57*)	0.48 (*0.82*)	0.47 (*0.92*)
Source Memory			
Correct Hits	43.22 (19.55)	41.66 (17.47)	35.35 (17.35)
Positive words	36.24 (27.96)	45.49 (24.91)	40.93 (27.60)
Negative words	49.71 (26.90)	37.10 (27.11)	30.39 (25.98)
False Alarms			
Positive words	22.63 (18.79)	34.69 (19.29)	32.00 (18.60)
Negative Words	38.15 (24.74)	28.93 (18.30)	22.48 (18.47)
Interpretation Bias	2.88 (0.85)	3.06 (0.89)	3.22 (0.87)

Note: For the interpretation bias, perceiving an even number of negative and positive words would equal a score of 3. Less than 3 indicates a perception of a greater proportion of negative words and a number greater than 3 indicates a perception of a greater proportion of positive words. The scale was from 1 to 5.

For positive words, an inconclusive main effect of AGENT was identified, $F(2, 264) = 3.98$, $p = .01$ [$BF_{10} = 1.56$], $\eta_p^2 = .03$. Post-hoc analyses showed superior recognition of friend-encoded compared with self-encoded positive words, $t = -2.82$, $p = .02$ [$BF_{10} = 3.72$], $d = -0.24$. There was no difference between self and celebrity-encoded positive words, $t = -1.43$, $p = .31$ [$BF_{10} = 0.24$], $d = -0.12$ nor friend and celebrity-encoded positive words, $t = 1.39$ [$BF_{10} = 0.28$], $d = 0.12$ (see Fig. S4).

Therefore, the overall sample demonstrated a negativity bias for remembering if words were self-directed, in comparison to both friend and celebrity. The sample was more likely to identify if positive words were directed at their friend rather than themselves.

3.3.2. False alarms

A main effect of AGENT was not supported, $F(2, 290) = 4.47$, $p = .01$ **[**$BF_{10} = 0.55$], $\eta_p^2 = .03$. No main effect of VALENCE was found, $F(1, 145) = 0.01$, $p = .92$ **[**$BF_{10} = 0.07$], $\eta_p^2 < .001$. However, an AGENT x VALENCE interaction was supported, $F(2, 290) = 21.08$, $p < .001$ **[**$BF_{10} = 2.12e+12$], $\eta_p^2 = .13$. Separate 1 × 3 RM-ANOVAs were computed for false alarms in source memory for negative and positive words.

For positive words, false alarm rates depended on AGENT, $F(2, 290) = 13.54$, $p < .001$ **[**$BF_{10} = 137382.99$], $\eta_p^2 = .09$. Post-hoc analyses showed a greater rate of false alarms for both the friend, $t = -4.96$, $p < .001$ **[**$BF_{10} = 4904.54$], $d = -0.41$ and celebrity, $t = -3.85$, $p < .001$ **[**$BF_{10} = 66.57$], $d = -0.32$, compared to the self. No difference was found between friend and celebrity, $t = 1.11$, $p = .27$ **[**$BF_{10} = 0.16$] (see Fig. S4).

For negative words, false alarm rates also depended on AGENT, $F(2, 290) = 16.27$, $p < .001$ **[**$BF_{10} = 7.85e+6$], $\eta_p^2 = .10$. Post-hoc analyses showed a greater rate of false alarms for the self, compared to both friend, $t = 3.34$, $p = .002$ **[**$BF_{10} = 7.73$], $d = 0.28$, and celebrity, $t = 5.67$, $p < .001$ **[**$BF_{10} = 5823.73$], $d = 0.47$. A greater rate of false alarms was supported for friend compared to celebrity encoded words, $t = 2.34$, $p = .02$ **[**$BF_{10} = 10.59$] (see Fig. S4).

3.4. Association between BIC and SRE in item and source memory

3.4.1. Sensitivity (d')

No correlation was identified between BIC and the SRE in item memory sensitivity for either positive words, $r(144) = .09$, $p =$ [0.25[$BF_{10} = 0.20$] or negative words, $r(144) = -.01$, $p =$[0.88[$BF_{10} = 0.10$]. No correlation was identified between BIC and the SRE in source memory sensitivity for either positive words, $r(106) = -.03$, $p =$[0.73[$BF_{10} = 0.13$] or negative words, $r(106) = -.06$, $p =$ [0.53[$BF_{10} = 0.15$].

3.4.2. False alarms

Evidence supported a correlation between BIC and the SRE in false alarms for negative words, $r(144) = .28$, $p <$ [0.001[$BF_{10} = 30.48$] (see Fig. S5). The opposite effect was identified for false alarms for positive words, $r(144) = -.19$, $p =$[0.02[$BF_{10} = 1.36$] although the evidence was inconclusive. Evidence strongly supported a correlation between BIC and the SRE for false alarms in source memory, $r(106) = .50$, $p <$ [0.001[$BF_{10} = 369524.45$]. The opposite effect was observed for false alarms for positive words during source memory, $r(106) = -0.21$, $p = .03$ [$BF_{10} = 1.17$] but the evidence was inconclusive.

3.4.3. Metacognition

A positive correlation was supported between BIC and the SRE in metacognitive sensitivity for negative words, $r(114) = .23$, $p =$ [0.01[$BF_{10} = 2.16$] although the evidence was inconclusive. The correlation was not supported for positive words, $r(114) = -.09$, $p =$ [0.33[$BF_{10} = 0.19$]. No correlation was found between BIC and SRE in metacognitive efficiency for either positive words, $r(114) = -.01$, $p =$ [0.90[$BF_{10} = 0.12$], or negative words, $r(114) = .05$, $p =$ [0.59[$BF_{10} = 0.13$].

3.4.4. Regression models

To show that the relationship between BIC and the SRE in both correct hits and false alarms in source memory for negative words was not better captured by depression, we ran two regression models. Both BIC and depression were entered as predictors of SRE for correct hits in source memory for negative words and the model was a significant fit, $F(2, 107) = 14.86$, $p < .001$. Depression was a non-significant predictor, $\beta = 0.18$, $t = 1.79$, $p = .08$, and BIC remained significant, $\beta = 0.35$, $t = 3.49$, $p < .001$. The Bayesian model favoured the inclusion of BIC only [$BF_{10} = 143.97$], although there was inconclusive support for also including depression [$BF_{10} = 1.77$].

For false alarms, the model was significant, $F(2, 107) = 19.08$, $p < .001$. Depression was a non-significant predictor, $\beta = 0.15$, $t = 1.56$, $p = .12$ and BIC remained significant, $\beta = 0.42$, $t = 4.32$, $p < .001$. The Bayesian model favoured the inclusion of BIC only [$BF_{10} = 143.97$], although there was inconclusive support for also including depression [$BF_{10} = 1.12$].

We also explored whether the inconclusive relationship between BIC and the SRE in metacognitive sensitivity remained when

Table 2
Effects on self-encoded memories dependent on valence and whether the comment was presented in comparison with a friend or a celebrity.

	Comparison Condition	
	Friend	Celebrity
Item Memory		
Positive (out of 5)	2.78 (*1.50*)	2.58 (*1.32*)
Negative (out of 5)	**2.49 (*1.23*)**	**2.99 (*1.51*)**
Source Memory		
Positive %	35.36 (*32.32*)	36.78 (*34.78*)
Negative %	48.20 (*34.70*)	50.22 (*34.39*)

Note. Bold equals strong support for a difference between comparison conditions, $BF_{10} > 100$.

controlling for depression. Both BIC and depression were entered as predictors and the model was significant, $F(2, 115) = 5.16$, $p = .007$. BIC was a significant predictor, $\beta = 0.32$, $t = 3.14$, $p = .002$. Depression was also a significant predictor, albeit having the opposite effect as BIC, $\beta = -0.20$, $t = 2.01$, $p = .047$. The Bayesian model favoured the inclusion of BIC only [$BF_{10} = 5.44$], although there was inconclusive support for also including depression [$BF_{10} = 1.91$].

Therefore, the relationship between BIC and the SRE in correct hits and false alarms for source memory of negative words, was not explained by greater depressive symptoms. For metacognitive sensitivity, the relationship between BIC and a greater SRE for negative words was strengthened after controlling for depressive symptoms.

3.5. Interpretation bias

Participants were asked to report on a 5-point Likert scale whether the encoded words for SELF, FRIEND and CELEBRITY were, 1 - mostly negative through to 5 - mostly positive. A 3 × 1 RM-ANOVA was conducted, demonstrating a difference according to AGENT, $F(2, 292) = 5.03$, $p = .01$ [$BF_{10} = 7.31$], $\eta_p^2 = .03$. Post-hoc tests showed a significant difference between SELF and CELEBRITY $t = -3.17$, $p = .01$ [$BF_{10} = 6.65$], $d = -0.40$. There was no difference between SELF and FRIEND $t = -1.68$, $p = .19$ [$BF_{10} = 0.32$], $d = -0.21$ or FRIEND and CELEBRITY $t = -1.49$, $p = .19$ [$BF_{10} = 0.36$], $d = -0.19$. Further analyses showed that, no self-reported bias was identified for SELF, $t(146) = -1.74$, $p = .08$ [$BF_{10} = 0.40$], $d = -0.13$ and FRIEND conditions, $t(146) = 0.83$, $p = .41$ [$BF_{10} = 0.13$], $d = 0.07$. A self-reported positivity bias was found for CELEBRITY, $t(146) = 3.11$, $p = .002$ [$BF_{10} = 9.20$], $d = 0.23$. Therefore, the overall sample perceived the celebrity had received more positive words, and the difference was significant between the self and celebrity.

BIC negatively correlated with the interpretation bias for SELF, $r(146) = -.32$, $p < .001$ [$BF_{10} = 281.68$] (see Fig. S6). However, BIC did not correlate with the interpretation bias for FRIEND, $r(146) =$ [T 0.09$p = .26$, [$BF_{10} = 0.19$] or CELEBRITY, $r(146) =$[T 0.08$p = .31$ [$BF_{10} = 0.17$]. The correlation between BIC and the interpretation bias for SELF significantly differed from both the correlation between BIC and friend, $Z = -3.21$, $p =$[T 0.001nd that between BIC and celebrity, $Z = -3.08$, $p = .002$. Therefore, individuals with higher BIC reported receiving more negative words in relation to the self.

To show that the relationship between BIC and the negative self-reported bias for SELF was not better captured by depression, we ran a regression model. Both BIC and depression were entered as predictors of the self-reported bias for SELF and the model was a significant fit, $F(2, 130) = 9.18$, $p < .001$. BIC was a significant predictor, $\beta = 0.32$, $t = 3.37$, $p = .001$, whereas depression was not, $\beta = -0.06$, $t = 0.69$, $p = .49$. The Bayesian model favoured the inclusion of BIC [$BF_{10} = 91.43$] but the inclusion of depression was not supported [$BF_{10} = 0.58$].

3.6. Social comparison

The design of our study also allowed us to analyze whether self-encoded words were remembered better when paired with either the friend or celebrity directed word. We computed a 2 × 2 RM-ANOVA with VALENCE (Positive or Negative) and COMPARISON condition (Friend or Celebrity) as predictors for both item and source memory.

For item memory, a VALENCE x COMPARISON interaction was identified, $F(1, 145) = 15.13$, $p < .001$ [$BF_{10} = 124.97$], $\eta_p^2 = .09$. Post-hoc paired t-tests were computed and showed that negative self-encoded words were remembered better when paired with a positive comment directed at a celebrity compared with a friend, $t(145) = -4.17$, $p < .001$ [$BF_{10} = 291.87$], $d = -0.35$, whereas no difference was found for positive self-encoded words when paired with either a negative comment directed at a friend or celebrity, $t(145) = 1.70$, $p = .09$ [$BF_{10} = 0.37$], $d = 0.14$.

For source memory, the main effect of COMPARISON was not significant, $F(1, 120) = 0.50$, $p = .48$ [$BF_{10} = 0.12$], $\eta_p^2 < .01$, and neither was the VALENCE x COMPARISON interaction, $F(1, 120) = 0.01$, $p = .92$ [$BF_{10} = 0.13$], $\eta_p^2 < .001$. (Table 2).

We computed a difference score for negative words encoded in relation to the self when compared with either a friend or celebrity. We then analysed whether the difference score for negative comments correlated with BIC, but no relationship was identified for item memory, $r(145) = .02$, $p = .79$ [$BF_{10} = 0.11$], or for source memory, $r(135) =$[T 0.008$p = .93$ [$BF_{10} = 0.11$].

4. Discussion

In the current study, we assessed how cognitive biases are associated with body image concerns (BIC), using a self-referential memory paradigm. Using an episodic memory task that involved the encoding and sourcing of information directed at the self, a close friend, or a well-known celebrity, we provide strong evidence for a BIC associated negativity bias for sourcing negative body image-related adjectives to the self. The self-bias extended to false memories for unseen items and to an explicit belief of having received a greater proportion of negative stimuli. The self-bias for negative comments provides novel evidence of cognitive biases associated with BIC and has the potential to improve cognitive remediation programmes aimed at treating individuals with body and eating related disorders.

BIC increase the chance of an eating disorder in young women (Cornelissen & Tovée, 2021) and psychological therapies often target styles of thinking, including cognitive biases (Murphy et al., 2010). The results from the current study provide further evidence for cognitive biases and demonstrate that a bias in sourcing negative body image-related comments towards the self is associated with BIC. When asked to indicate, to whom a negative body image-related adjective was directed towards, young women with greater BIC were disproportionately more likely to state that it was directed themselves. One theoretical account of source memory states that contextual elements of a memory trace are more likely to be remembered if they are embedded within an individual's self-schema (Durbin et al., 2017). Therefore, when a negative comment is directed at a woman with high BIC, this aligns with their negative self-schema, strengthening the encoding and subsequent recognition of the negative comment. We extend this to include falsely believing an item was directed at the self when it was in fact directed at others, resulting in a belief that disproportionally more negative comments were directed towards themselves. This general negativity bias was also apparent when falsely recognising items that were not seen in the encoding stage, with young women reporting greater BIC again more likely to state that it was directed at themselves.

Previous research has demonstrated distortions in cognitive processing in individuals with high BIC. For example, a magnification of perceived flaws or dichotomous thinking regarding thin versus fat (Jakatdar et al., 2006), that maintain and reinforce negative body evaluation (Williamson et al., 2004) has been identified in those with BIC. Interestingly, it has been found that individuals high in BIC expect a greater amount of negative social feedback towards an image of their body, described as a covariation bias (Alleva et al., 2014, 2016). The current results are consistent with a covariation bias and provide further evidence using a mock social media task. Covariation bias refers to a distortion in cognitive processing whereby individuals tend to overestimate the contingency between a stimulus and an aversive outcome, even in the absence of any relationship (Chapman & Chapman, 1967). The corroborating evidence demonstrated in the present study should encourage future clinical considerations of both an individual's thoughts towards their own body and their thoughts on how others think about their body.

The present study introduced a novel task for exploring self-biases in memory within a mock social media context. We simply presented words directed at either the self, a close friend, or a celebrity without any requirement to engage with the word other than using a social media style reaction emoji. Regardless of the limited explicit processing of the words, we identified a self-reference effect in comparison to both a close friend and a celebrity for item and source memory. Previously, using a different celebrity (Boris Johnson), we also identified a friend-referential effect, whereby memory performance was superior for friend-encoded words compared against celebrity-encoded words (Kokici et al., 2021). The lack of a friend-referential effect in the current study may be due to the nature of the celebrity chosen. Rihanna is of a similar demographic in that she is younger and a woman, but also, likely to be more popular and liked by a cohort of young women. It emphasises the need to consider the nature of the other person(s) used in self-referential memory tasks.

A general negativity bias was found in item memory, regardless of condition, such that participants were more likely to correctly label negative words as previously observed or new distractor words. Greater sensitivity for negative words is consistent with previous research (Bradley et al., 1992, Brown & Kulik, 1977, Cahill & McGaugh, 1998). It is thought that emotionally arousing stimuli are encoded, consolidated, and subsequently recognised or recalled with greater accuracy (Mather & Sutherland, 2011; Sharot & Phelps, 2004) and we extend these findings to a memory task based on body image-related stimuli. A negativity bias in memory is especially prominent in younger adults (Carstensen & DeLiema, 2018) and when considered alongside a heightened focus on the approval of their peers (Brown et al., 1986), goes some way to understanding the devastating effects that negative interactions over social media can have.

To the authors' knowledge, the current study is only the second to investigate whether a self-referential bias is also apparent in metamemory. We asked participants to indicate their confidence in each item memory decision and computed measures of metacognitive sensitivity and metacognitive efficiency. Consistent with our previous study (Kokici et al., 2021), we found that second-level metacognitive sensitivity closely resembled first-level memory accuracy. Therefore, not only were self-encoded words remembered with greater sensitivity, but the difference in confidence was greater for correctly and incorrectly self-encoded words compared to both friend and celebrity-encoded words. This resulted in consistent metacognitive efficiency across the three conditions. Interestingly, evidence supported an association between BIC and greater SRE in metacognitive sensitivity for negative words. It suggests that although first-level sensitivity is not associated with BIC, the model underpinning a binary decision about negative words aimed at the self, may be more precise in those with higher BIC. It should be noted that no association was identified with metacognitive efficiency, which controls for first-level performance. In general, a negativity bias was not found at the level of metacognitive efficiency, which is inconsistent with the results of our previous study (Kokici et al., 2021). How valence affects metacognitive efficiency in memory remains understudied, with the existing studies providing conflicting and inconsistent results depending on the nature of the task (Kokici et al., 2021), or the time between encoding and recognition tasks (Legrand et al., 2021). Future research is required to ascertain how metacognition is affected by encoding and retrieval conditions as well as exploring the influence of individual differences, including BIC.

Prior to the memory task we asked participants to judge whether they received more negative or positive words during the task. Although all participants received an even number of positive and negative comments, participants perceived that the celebrity received more positive comments, but no bias was identified for the self or friend. Despite no self-bias in general, we found a correlation with BIC, such that those reporting higher BIC perceived that they received more negative comments. This explicit interpretation bias is consistent with the covariation bias observed in both the item and source memory tasks. The positivity bias towards the celebrity coupled with the negativity bias towards the self, in those with higher BIC, also supports the schema theory (Vedejová & Čavojová, 2022). Specifically, individuals are familiar with positive social feedback towards celebrities and therefore may expect them to receive more positive appearance-related comments. Using the same rationale, individuals with higher BIC view their bodies in a negative light, therefore may expect a higher proportion of negative comments.

We also conducted a novel analysis of how a comparison with either a close friend (horizontal comparison) or celebrity (upward comparison) may affect biases in memory. Adjectives were presented in pairs, with each stimulus consisting of a comment directed at two of the three possible agents (self, friend, celebrity). The adjectives differed in valence (one positive and one negative) to increase a sense of comparison between the two agents. We specifically were interested in how self-biases in memory were affected by the presence of a horizontal or upwards comparator. In item memory, we show that negative words directed at the self were remembered better when compared against positive words directed at a celebrity rather than a close friend, supporting our hypothesis. However, there was no difference along the BIC continuum, contrasting our prediction. Upward comparisons are common on social media and suggests it might heighten negativity biases. Social comparison with both friends and celebrities has previously been associated with body image dissatisfaction, through the use of questionnaires (Ho et al., 2016). To the authors' knowledge, the current study is the first to identify a cognitive bias in memory related to the comparator condition using a mock social media task. A greater memory for negative comments directed at the self when paired with positive comments directed at a celebrity, again supports a schema theory, whereby participants are expecting positive comments directed at a celebrity such as Rihanna. This may facilitate the encoding and subsequent recognition of the positive celebrity directed comment, but also the context in which it occurs, in this case, a negative comment directed at the participant. Although the present study is limited in the conclusions in can reach regarding social comparison and cognitive biases, it provides initial evidence to encourage future research in this direction.

Previously, greater self-referential effects for negative information, and covariation biases, have been identified in patients with depression (Connolly et al., 2016; Disner et al., 2017; Goldstein et al., 2015). We present the first evidence of self-referential biases related to BIC. Importantly, as BIC and depression often co-occur, it was important to demonstrate that the self-referential bias for negative comments was not explained by greater depressive symptoms. Likewise, we provide evidence that covariation biases were not explained by depressive symptoms. Previous research has shown a bidirectional relationship between negativity biases and depressive symptoms (Connolly et al., 2016; Disner et al., 2017; Goldstein et al., 2015), such that greater negativity biases lead to increased depressive symptoms and vice versa. The current study presents evidence of a relationship between cognitive biases and BIC, relevant to learning and memory, but future research is required to ascertain the directionality of such effects. Understanding the direction of effects will better inform clinical interventions that target cognitive biases and their role in the onset and maintenance of body and eating related disorders. To date, modifying interpretation biases has been unsuccessfully applied to cognitive remediation programmes to treat body and eating related disorders (Bradatsch et al., 2020). Results from the current study offer exciting new avenues for targeting cognitive biases in individuals with BIC and preventing or treating body and eating related disorders. For example, cognitive behavioural therapeutic approaches should address negativity biases towards the self, especially for body-related information presented on social media. Interventions such as “Boost Confidence and Social Media Savvy (BOOST)” (Dunstan et al., 2017; McLean et al., 2017) provide lessons that are experiential and interactive and aim to: increase media literacy relating to the influential and targeted nature of advertising on social media, critique digitally manipulated images on social media, reduce appearance comparisons with social media images, develop resilience to upward comparisons on social media, reduce frequency of peer appearance-related commenting on social media, and reduce focus on and importance of appearance in social media interactions. Such interventions could also integrate cognitive bias remediation to ensure that perceptions of negative body image related information are as accurate as possible and that individuals are aware of how comparisons with others may distort cognition.

The current study was conducted online and future work in more controlled lab-based conditions is warranted. Although women show higher prevalence of BIC (Al Sabbah et al., 2009) and were the sole focus of the current study, future research should investigate whether similar cognitive biases are associated with BIC in males. The continuous approach in a non-clinical sample is a strength of the current study, but future research could focus on recruiting individuals with clinically relevant BIC to confirm that the cognitive biases identified in the present study are consistent at the extreme end of the spectrum, and therefore relevant for future clinical interventions. Covariation biases can be expressed a priori, online, or *a posteriori* (Mayer et al., 2012; Pauli et al., 1996, 2001). In the current study we provide evidence for an *a posteriori* covariation bias in that participants reported a negative bias after the task was completed. We also demonstrate that this affects memory for previously observed stimuli. However, further research could assess a priori and online covariation biases within a social media context. For example, does a covariation bias affect how stimuli are attended to and subsequently encoded into memory? It will also be important for future research to ascertain whether negativity biases for negative stimuli in those high in BIC is specific to body image-related items or whether a bias exists for negative stimuli more broadly. Also, although the use of a mock social media platform increases the ecological validity in the current study, future research could go further in assessing cognitive biases using more realistic or actual social media platforms. For example, negative comments are usually accompanied by a picture of the person in question, and this could be included in future research. The study design precluded an accurate sensitivity analysis to be conducted for source memory and this could be the focus of future research. The use of Rihanna as the celebrity was to ensure familiarity and a general favourable opinion amongst our cohort. Although we show no differences in familiarity, likeability, upward comparison in terms of body-image, and memory performance across broad categories of ethnicity, future research could explore the effects of upward comparisons using celebrities of other ethnicities.

In sum, using a novel mock social media task, we provide evidence for cognitive biases as a potential contributor to BIC in young women. A general covariation bias for reporting negative words as directed at themselves, coupled with a self-referential bias in metamemory for negative comments directed at themselves, improve our understanding of BIC and associated cognitive biases, and offer a possible target for clinical interventions in individuals with body and eating-related disorders.

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Author contributions

ED and AKM contributed to all aspects of the manuscript.

Data Availability

Data will be made available on request.

Competing interests

The authors declare no competing interests.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.bodyim.2023.01.008.

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