

Testing the specificity of interpretation biases in women with eating disorder symptoms: An online experimental assessment

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Abstract

Objective: Cognitive biases, such as memory, attention, and interpretation bias, are thought to play a central role in the development and maintenance of eating disorders (EDs). The aim of the present study was to investigate whether the interpretation bias is ED-specific or can be generalized to comorbid disorder-related threats in women with high levels of ED symptoms.

Method: In an online study, we measured interpretation bias using the modified Sentence Word Association Paradigm (SWAP), comparing women with ($n = 39$) and without (sub)threshold eating disorders ($n = 56$). We assessed endorsement and rejection rates as well as reaction times in response to a positive/neutral or a negative ED-specific, social anxiety-specific (SAD), or generalized anxiety-specific (GAD) interpretive word following an ambiguous sentence.

Results: In ambiguous situations, women with high ED symptoms selected more negative ($p < .001$) and fewer positive/neutral ED-related interpretations ($p < .001$). Negative interpretations were endorsed significantly faster ($p < .001$), while positive interpretations were rejected faster in this group ($p < .001$). These women also manifested negative SAD-specific interpretation bias patterns in reaction time measures. Nevertheless, ED severity was best predicted by the endorsement of negative ED-specific stimuli, whereas ED and SAD reaction time measures seemed to have a negligible effect.

Discussion: The results indicate that the interpretation bias might be ED-specific. The SWAP can be a useful tool for the further investigation of the etiological relevance of the interpretation bias as well as for the development of modification training interventions.

KEYWORDS

eating disorder, generalized anxiety disorder, interpretation bias, online study, social anxiety disorder, transdiagnostic, sentence word association paradigm

According to the cognitive-behavioral theory of eating disorders (EDs), overvaluation of shape, weight, and eating plays a determining role in the development and maintenance of psychopathology (Fairburn, Cooper, & Shafran, 2003). Indeed, data indicate a negative interpretation bias (IB), that is, a tendency to interpret ambiguous information in

a threatening way (Hirsch, Meeten, Krahe, & Reeder, 2016), in relation to weight and shape in subclinical samples (Jackman, Williamson, Netemeyer, & Anderson, 1995; Misener & Libben, 2017; Rosser, Moss, & Rumsey, 2010) and in samples with EDs (e.g., Brockmeyer et al., 2018; Cooper, 1997). For instance, individuals with EDs typically

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interpret a situation like “you glance at your shape in a dressing mirror” as a negative evaluation of their body (“I’m too fat”). However, none of these studies tested whether the ED-IB was accompanied by IBs that are specific for other disorders.

Given the high comorbidity of EDs and anxiety disorders, with up to 83% of individuals with an ED also having an anxiety disorder diagnosis (Godart, Flament, Lecrubier, & Jeammot, 2000; Pallister & Waller, 2008), as well as a strong overlap in terms of genetic factors (Keel, Klump, Miller, McGue, & Iacono, 2005), IB for anxiety-relevant issues may also be present in individuals with EDs, or might even underlie the ED-IB. Of the different forms of anxiety disorders, social anxiety disorder (SAD) shows the highest occurrence in individuals with EDs. A lifetime comorbidity of social phobia was found in 26.5% of individuals with anorexia nervosa and in 50.1% of individuals with bulimia nervosa (see Hudson, Hiripi, Pope Jr., & Kessler, 2007). Social appearance anxiety is discussed as a shared risk factor for social anxiety and ED symptoms (Levinson et al., 2013). A negative SAD-specific bias that is, interpreting ambiguous social scenarios in a negative (social rejection / criticism) manner, has been shown to be involved in the maintenance of social anxiety (Beard & Amir, 2010). One of the most frequently existing anxiety disorders in women with ED, apart from SAD, is generalized anxiety disorder (GAD). While a negative IB in individuals with GAD has been verified (Hayes & Hirsch, 2007), the relation between ED and comorbid GAD has not yet been sufficiently examined.

Initial studies testing the “content-specific hypothesis” (Williamson, Muller, Reas, & Thaw, 1999), which assumes that the IB is selective for body and/or eating concerns, have revealed inconsistent findings. For instance, in one study, women with EDs, controls with body dysphoria, and nonsymptomatic controls were asked to imagine themselves in either body- or health-related ambiguous situations (Williamson, Perrin, Blouin, & Barbin, 2000). In a subsequent memory task, women in the ED group and the body dysphoria control group recalled imagery of body-related situations with a fatness interpretation, that is, a selective interpretation bias toward a large body, while women in the nonsymptomatic control group recalled imagery with a thinness interpretation. By contrast, there were no group differences in IB regarding health concerns. Moreover, a recent cognitive bias modification for IB (CBM-I) study compared two CBM-I conditions, one focusing on appearance and the other focusing on self-worth, in female students. The results suggested that the CBM-I was more useful for increasing positive interpretations related to appearance than those related to self-worth (Matheson, Wade, & Yiend, 2018). These findings indicate that the IB may be specific to ED-related threats. In contrast, a study using a sentence completion task (Cardi et al., 2017) found that women with anorexia nervosa endorsed more negative interpretations of socially ambiguous scenarios compared to healthy eaters. However, it remains unclear whether this finding is specific to women with anorexia nervosa or whether it can be generalized to other ED samples. Moreover, the predictive value of the negative SAD-specific bias, compared to that of an ED-specific bias, for ED pathology has yet to be explored.

Besides the aforementioned need for a more transdiagnostic set of stimuli, previous studies show further methodological shortcomings

that must be addressed in order to reliably assess the IB. To date, studies on EDs have not differentiated between the two components of the IB postulated by Beard and Amir (2008, 2009): the tendency to endorse negative interpretations and the tendency to reject positive interpretations. For participants with SAD, both threat bias and lack of positive IB (interpreting an ambiguous situation as neutral) have been found (Amir, Prouvost, & Kuckertz, 2012), with the former potentially resulting in avoidance of social situations and the latter in a decreased tendency to experience positive affect in such situations (Kashdan, Weeks, & Savotyanova, 2011). In contrast, a greater severity of GAD symptoms and worry was not found to be associated with a tendency to reject positive interpretations, but was related to endorsement of threat interpretations (Ogniewicz, Dugas, Langlois, Gosselin, & Koerner, 2014). As only the first component has been studied in EDs so far, it remains unclear whether the IB may result in a higher endorsement rate of negative interpretations, in a higher rejection rate of positive interpretations, or in both. Moreover, self-report measures have limited validity and may assess a response bias rather than a cognitive bias (Hindash & Amir, 2012; MacLeod, 1993). As the IB can be characterized by an automatic and an effortful component (Hirsch & Clark, 2004), self-report methods need to be supplemented by more implicit measures, for example, reaction times. To date, these IB indices have only been assessed simultaneously for other disorders (e.g., SAD (Beard & Amir, 2010); depression (Hindash & Amir, 2012)).

In the current study, we used the modified Word Sentence Association Paradigm (WSAP), the Sentence Word Association Paradigm (SWAP; Hindash & Amir, 2012), in an online version, which meets the aforementioned requirements, in order to assess ED-specific, SAD-specific, and GAD-specific interpretations of ambiguous sentences in women with ED symptoms. In the SWAP, “interpretation” is operationalized as whether or not the participants endorse either a positive/neutral or a negative/threatening word as related to an ambiguous sentence. Hence, the possible reactions were to endorse a sentence-negative word combination (endorsement of negative interpretation = negative IB), to endorse a sentence-positive word combination (endorsement of positive interpretation = positive IB), to reject a sentence-negative word combination (rejection of negative interpretation = positive IB), and to reject a sentence-positive word combination (rejection of positive interpretation = negative IB). In addition to response choices, information on the IB is also provided by reaction times. Both IB indices, endorsement rate and reaction time, seem to be relatively automatic measures, as participants have minimal time to elaborate the information presented (Cowden Hindash & Amir, 2012; Cowden Hindash & Rottenberg, 2017). We hypothesized that women with high levels of ED symptoms (ED+) would endorse more negative and fewer positive ED-specific interpretations compared to women with no or low levels of symptoms (ED−). Additionally, we hypothesized faster reaction times for the endorsement of negative ED interpretations and for the rejection of positive ED interpretations in women in the ED+ group. From a metacognitive perspective, the process that underlies anxiety, namely worrying, is a shared factor across disorders that translates into disorder-specific behaviors (e.g., body checking in EDs). Furthermore, positive and negative metacognitions about worry have been found to predict drive for thinness in samples with AN

(Davenport, Rushford, Soon, & McDermott, 2015). Given the high comorbidity with anxiety disorders (Keski-Rahkonen & Mustelin, 2016; Puccio et al., 2017) and shared cognitive processes, we assumed that for women in the ED+ group, reaction patterns to SAD- and GAD-specific stimuli would be similar to those to ED-specific stimuli. However, the aforementioned study by Williamson et al. (2000) reported that women with ED did not differ from controls in their interpretation of health-related situations. Therefore, we expected that ED severity would be predicted by higher endorsement rates and faster reaction times to negative ED stimuli, but also, to a significantly lesser extent, to negative SAD and GAD stimuli. Finally, to allow a comparison with clinical samples, we further selected women with very high ED severity (ED⁺⁺) comparable to women with anorexia nervosa (Hilbert, Tuschen-Caffier, Karwautz, Niederhofer, & Munsch, 2007) and women without ED symptoms (ED[−]) for extreme group comparisons. We hypothesized that our findings would be replicated when comparing these two extreme groups.

1 | METHOD

1.1 | Recruitment and participants

Participants with (sub)threshold EDs were recruited via online advertisements on ED-specific internet forums and on social networking sites. Similar forums, social networking sites, and homepages for women were used for the recruitment of controls. As reimbursement, participants were entered into a lottery with the chance to win one of six 15 € Amazon vouchers.

An a priori power analysis in G*Power (Faul, Erdfelder, Lang, & Buchner, 2007) indicated that a sample size of $n = 32$ per group would be sufficient to detect medium-sized interaction effects with an $\alpha = .05$ and a power of .95 in multivariate analysis of variance. A total of 114 women were recruited for the study. Inclusion criteria for all participants were female gender, age 18 years or older and German language fluency. We chose to exclude male participants for mainly two reasons. First, given the low base rate of eating disorders in men, we were not confident that we would be able to recruit a sufficient number of men to also analyze gender differences. Second, and more importantly, men and women (with EDs) might show differences in shape and weight concerns, which might lead to different associations in our SWAP paradigm. Another exclusion criterion was acute suicidality ($n = 8$), defined by answering the respective item on the Patient Health Questionnaire-9 (PHQ-9; (Gräfe, Zipfel, Herzog, & Löwe, 2004) ("Thoughts that you would be better off dead or of hurting yourself in some way") with "nearly every day." In such cases, respondents were guided to external sources of assistance, as participation was anonymous and we were unable to intervene. Further exclusion criteria were severe depression (PHQ-9 score ≥ 20), current problematic substance use, and/or schizophrenia ($n = 10$), in order to minimize the risk of a delayed reaction time due to poor concentration or loss of energy. One participant was excluded due to too many missing values. The total sample comprised 95 women. Ethical approval for this study was granted by the Osnabrueck University's Ethics Committee.

1.2 | Procedure

The advertisements included brief information about the study, the inclusion criteria, reimbursement, and the necessity to install Inquisit 4 Web player 4.0.8.0 (Millisecond) on their personal computer by following a link. After informed consent was obtained from the participants, they were screened for inclusion and exclusion criteria. During both the recruitment and consent stage, participants were informed and agreed to take part in a study with the aim to examine interpretation biases in eating disorders. Prior to the following task, participants were instructed to participate using a computer and not to use a mobile device. Furthermore, they were asked to choose a situation in which they did not need to leave their computer for the next 15 min in order to minimize possible distractions from their surroundings, and to close other running programs. Following this, the SWAP was executed. Finally, participants were asked to complete the questionnaires as described later. The active recruitment and testing period lasted for 67 days. The mean duration of participation was 35 min.

1.3 | Material

1.3.1 | Stimuli

We generated ambiguous sentences and corresponding interpretation words on the basis of treatment manuals for ED, SAD, GAD, and disorder-specific internet platforms and by translating already existing stimuli kindly provided by other research groups (Beard & Amir, 2008; Buhlmann et al., 2002; Martinelli, Holzinger, & Chasson, 2014; Mobius, Tendolkar, Lohner, Baltussen, & Becker, 2015; Ogniewicz et al., 2014). For each disorder-specific ambiguous situation, a negative (disorder-specific) and a positive (non-disorder-specific or neutral) interpretive word were selected (e.g., "You notice that your voice is trembling," followed by either "fear" or "cold" (SAD); "You have three missed calls from your mother," followed by "worry" or "call back" (GAD), and "You calculate your BMI and discover it is in the normal range" followed by "satisfied" or "disappointed" (ED)). For each disorder-specific stimulus, a separate validation process was conducted. Here, we present the validation of the ED stimuli by way of example.

First, we generated 219 new ED-specific stimuli. Three sentence-word pairs were excluded following an expert rating by staff at the Department of Clinical Psychology and Psychotherapy of the University of Osnabrueck. The remaining 216 stimuli were validated in an online validation trial. Out of all of the stimuli, 40 ambiguous situations were randomly presented to each of the 209 participating women. Situations that were judged to be at least moderately ($M > 4$) vivid, ambiguous, and self-referent on a 7-point Likert scale (1 = not at all to 7 = extremely) were selected for the present study, resulting in a final total of 60 ED sentence-word pairs. SAD- and GAD-relevant stimuli were validated and selected through a process identical to that described in Dietel, Möllmann, Bürkner, Wilhelm, and Buhlmann (2019).

1.3.2 | Sentence Word Association Paradigm

The original version, the Word Sentence Association Paradigm (WSAP), has been used to assess interpretation bias in various mental

disorders (e.g., SAD (Amir et al., 2012), GAD (Ogniewicz et al., 2014), and in women with body dysphoria (Martinelli et al., 2014). In the current study, we used a modified version, the SWAP, thus presenting an ambiguous (either ED-, SAD-, or GAD-specific) sentence followed by a valent word (disorder-specific negative or non-disorder-specific) in order to minimize priming and anchor effects (Beard & Amir, 2009; Hayes & Hirsch, 2007). Otherwise, a prime (threat word) may activate cognitive processes involved in interpretation, consequently influencing the interpretation of the ambiguous sentence. The present version has been previously used by Möbius and colleagues (2015) as well as Dietel et al. (2019). Participants were instructed to concentrate on the task, to rate the relatedness of sentences and words, and to respond as quickly as possible. Response choices and reaction times provide information about interpretation biases. Each trial of the SWAP comprised three steps (Figure 1).

Before the main assessment began, eight training trials were conducted. The actual paradigm consisted of 60 ED, 60 SAD, and 60 GAD trials (30 negative and 30 positive sentence-word combinations), resulting in a total of 180 randomly presented trials. Each sentence was only displayed once to each participant.

1.4 | Measures

A questionnaire was devised to obtain demographic data such as age, marital status, and educational level, and to assess the inclusion and exclusion criteria.

Participants completed the Eating Disorder Examination-Questionnaire (EDE-Q (Fairburn & Beglin, 1994); German version (Hilbert & Tuschen-Caffier, 2006)), which is a well-validated and reliable measure of eating

pathology in the general population as well as in clinical samples. The questionnaire includes 22 self-report items allocated to the four subscales restraint, eating concern, weight concern, and shape concern, with $.86 \leq \alpha \leq .95$ in this sample. A further six items assess the frequency of diagnostically relevant information over the past 28 days. The EDE-Q yields a global score (the mean of the four subscales; $\alpha = .97$ in this sample), which is indicative of overall general severity of ED pathology. A cutoff score of 3.18 points has been reported to indicate the presence of an ED in samples with bulimia nervosa and was used in this study to differentiate between a group with high ED symptoms (ED+) and a group with few or no symptoms (ED-). For extreme group comparisons, we used the cutoff scores of 3.81 found in samples with anorexia nervosa and 1.44 in nonclinical controls (Hilbert et al., 2007). In addition, participants were asked to report their weight and height to enable us to calculate their body mass index (BMI).

Participants also completed the Social Phobia Inventory (SPIN (Connor et al., 2000), German version (Sobic, Gieler, & Stangier, 2008)), which is a well-validated instrument comprising 17 items assessing the severity of social phobia. The total score ranges from 0 to 68. Internal consistency for the present study was $\alpha = .95$.

The Generalized Anxiety Disorder Questionnaire IV (GAD-Q-IV (Newman et al., 2002); German version (Hoyer, 2002)) was included as a checklist with nine items, which mimics the structure of the DSM-IV diagnosis of GAD. The total score ranges from 0 to 12. The questionnaire shows good sensitivity and specificity. Internal consistency for the present study was $\alpha = .83$.

Symptoms of depression were measured using the Patient Health Questionnaire-9 (PHQ-9 (Kroenke, Spitzer, & Williams, 2001); German version (Gräfe et al., 2004)). The PHQ-9 contains nine items

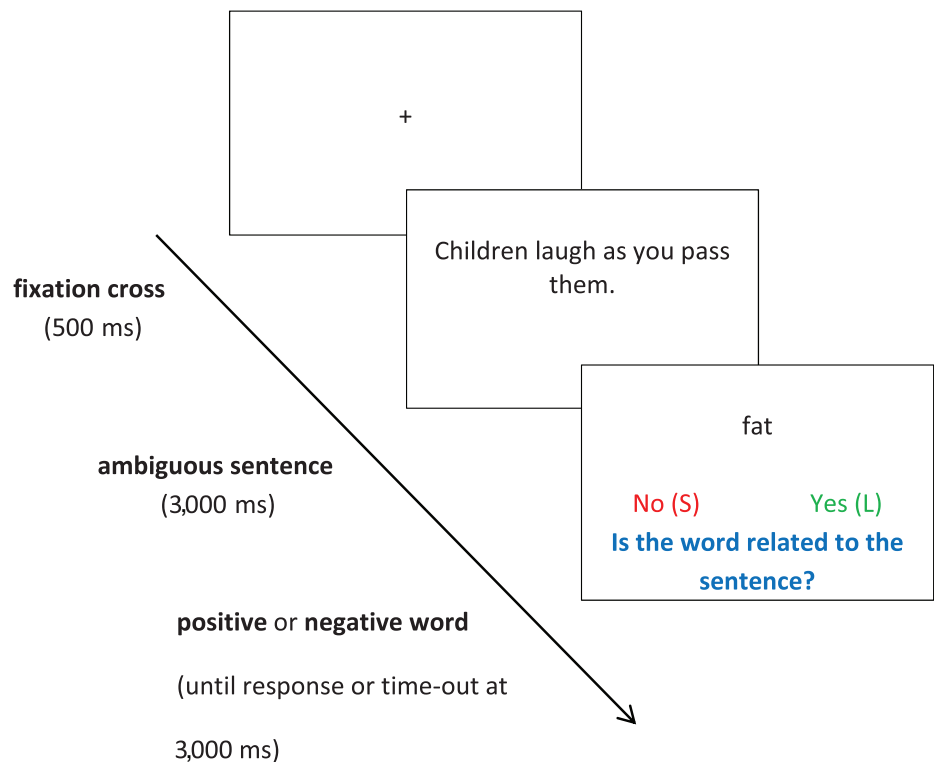


FIGURE 1 Example of an ED-specific trial [Color figure can be viewed at wileyonlinelibrary.com]

corresponding to the DSM-IV diagnostic criteria for depression, with a total score ranging from 0 to 27. Internal consistency for the present study was Cronbach's $\alpha = .84$. As mentioned earlier, the item "suicidality" in the PHQ-9 was used as an exclusion criterion for the study.

1.5 | Statistical analyses

Data analysis was conducted using SPSS Statistics Version 22. Analyses of variance, Welch's t tests and χ^2 tests were used to evaluate demographic and psychosocial differences between groups. As measures of effect sizes, partial eta-squared was used for F -tests (small = 0.01; medium = 0.06; large = 0.14), Cohen's d was used for t tests (small = 0.2; medium = 0.5; large = 0.8), and Cramer's V was used for chi-squared tests (small = 0.1; medium = 0.3; large = 0.5).

For each participant, the percentages of endorsement (endorsement rate) of positive and negative interpretations were calculated. In order to eliminate outliers in reaction times, the lower limit was defined as ≥ 50 ms and the upper limit as $< 3,000$ ms (Amir et al., 2012; Beard & Amir, 2009). These eliminated trials and missing reaction time data (a total of 2.56% of trials) were imputed using the expectation-maximization algorithm (Dempster, Laird, & Rubin, 1977). Mean reaction times for endorsement and rejection of positive and negative ED, SAD, and GAD interpretations were calculated.

Multivariate analyses of covariance (MANCOVAs) and follow-up univariate analyses of covariance were used to examine group differences in endorsement rates of positive and negative interpretations and reaction times to endorse and reject positive and negative interpretations for ED, SAD, and GAD separately. We decided to adjust for symptoms of depression using the PHQ-9 score, for symptoms of social phobia assessed with the SPIN, and for symptoms of GAD assessed with the GAD-IV, as all three scales differ significantly between ED+ and ED-. Moreover, we also adjusted for BMI, as some of the ED-specific stimuli are weight-specific. Main effects of the covariates are only reported if significant.

For endorsement rates and reaction times that were shown to significantly differ between the two groups in the MANCOVAs, we conducted a hierarchical regression analysis (blockwise entry) in order to identify relevant predictors of ED symptomatology as measured by the EDE-Q sum score. In the first model, we entered ED-specific SWAP indices (endorsement of negative ED interpretations, endorsement of positive ED interpretations, reaction time for endorsement of negative ED interpretations, reaction time for rejection of positive ED interpretations), and in the second model, we also included reaction times related to SAD stimuli (endorsement of negative ED interpretations, endorsement of positive ED interpretations, reaction time for endorsement of negative ED interpretations, reaction time for rejection of positive ED interpretations, reaction time for endorsement of

TABLE 1 Sample characteristics and psychopathology

	ED+ group (<i>n</i> = 39)	ED- group (<i>n</i> = 56)	Range	<i>F</i> (1, 93)	<i>t</i> (<i>df</i>)	χ^2 (<i>df</i> , <i>N</i>)	<i>p</i>	η_p^2 , <i>d</i> , Cramer's <i>V</i>
Age	30.41	27.91	18–60		–1.11 (69.04)		.27	–.23
BMI	27.69	23.08	15.39–58.03		–2.62 (46.86)		.01	–.55
Marital status (%)						8.97 (3, 95)	.03	.31
Single	26 (66.7)	24 (42.9)						
Married/in relationship	13 (33.3)	28 (50)						
Divorced	0	2 (3.6)						
Educational level (%)								
No formal educational attainment	2 (5.1)	1 (1.8)						
Vocational education	12 (30.8)	6 (10.7)						
University entry level	15 (38.5)	27 (48.2)						
University degree	10 (25.6)	22 (39.3)						
Current psychotherapy (%)	23 (58.97)	9 (16.07)				18.94 (1, 95)	<.001	.45
Use of psychotropic medication (%)	19 (48.7)	12 (21.4)				7.79 (1, 95)	.01	.29
Self-report measures								
EDE-Q	4.51 (0.83)	1.45 (0.86)	0.19–5.90	299.96			<.001	.76
SPIN	40.85 (14.67)	23.68 (13.21)	0–65	35.45			<.001	.28
GAD-Q-IV	7.09 (3.73)	3.51 (3.49)	0–12	22.37			<.001	.19
PHQ-9	13.38 (3.66)	7.30 (4.20)	0–19	53.38			<.001	.37

Note: Data are provided in means (SD) or numbers.

Abbreviations: EDE-Q, Eating Disorder Examination Questionnaire; GAD-Q-IV, Generalized Anxiety Disorder Questionnaire IV; PHQ-9, Patient Health Questionnaire-9; SPIN, Social Phobia Inventory.

positive SAD interpretations, reaction time for endorsement of negative SAD interpretations, and reaction time for rejection of negative SAD interpretations).

Finally, we assigned participants with an EDE-Q total score of ≥ 3.81 to the extreme group ED⁺⁺ and those with a total score of ≤ 1.44 to the ED⁻⁻ group. We conducted the same analyses as previously described for these subsamples. In the first model, we entered the same ED-specific SWAP indices as used in the full sample. In the second model, we entered endorsement of negative ED interpretations, endorsement of positive ED interpretations, reaction time of rejection of positive ED interpretations, reaction time of endorsement of negative interpretations, endorsement of negative SAD interpretations, and endorsement of negative GAD interpretations.

2 | RESULTS

2.1 | Sample characteristics

Significant differences between the ED+ group ($n = 39$) and the ED- group ($n = 56$) were found regarding BMI, psychotherapy status, marital status, and use of psychotropic medication. Demographic

information is presented in Table 1. There were no significant differences regarding age, handedness, and educational level.

2.2 | Interpretation bias

Eating disorder-specific interpretations—endorsement and rejection. A MANCOVA with depression, SAD, GAD, and BMI as covariates yielded a significant main effect of group on the endorsement rate of ED interpretations ($F(2, 88) = 29.39, p < .001, \eta_p^2 = .40$) and a main effect of symptoms of SAD ($F(2, 88) = 7.67, p = .001, \eta_p^2 = .15$). Results of the subsequent univariate ANCOVAs for endorsement rates (including means and standard deviations) are presented in Table 2. The data indicate that individuals with ED+ endorsed significantly more negative and rejected more positive interpretations than did ED-.

Eating disorder-specific interpretations—reaction times. A MANCOVA revealed a significant main effect of group on reaction time to endorse or reject positive and negative ED interpretations ($F(4, 86) = 7.92, p < .001, \eta_p^2 = .27$). There were no significant main effects of the covariates. Subsequent univariate ANOVAs indicated that ED+

TABLE 2 Group differences in the indices of the Sentence Word Association Paradigm (SWAP)

SWAP indices	ED+ ($n = 39$) M (SD)	ED- ($n = 56$) M (SD)	F (1, 89)	<i>p</i>	$\hat{\eta}_p^2$
ED endorsement rate (%)					
Negative	79.61 (16.44)	32.81 (20.42)	56.51	<.001	.39
Positive	38.53 (16.60)	68.37 (15.29)	23.35	<.001	.21
SAD endorsement rate (%)					
n.s.					
Negative	70.67 (22.06)	44.23 (20.03)			
Positive	51.43 (14.75)	67.56 (13.99)			
GAD endorsement (%)					
n.s.					
Negative	66.48 (18.35)	43.45 (16.75)			
Positive	51.43 (14.67)	67.55 (13.70)			
Reaction time (ms)					
ED interpretations					
Endorsement negative	1,007.25 (208.50)	1,239.66 (268.35)	20.57	<.001	.18
Endorsement positive	1,240.23 (308.84)	1,185.29 (228.89)	1.00	.322	.01
Rejection negative	1,242.28 (295.82)	1,190.14 (243.99)	.88	.350	.01
Rejection positive	1,198.91 (235.32)	1,423.59 (293.42)	15.78	<.001	.15
SAD interpretations					
Endorsement negative	1,059.18 (199.43)	1,241.39 (264.10)	11.55	.001	.12
Endorsement positive	1,202.40 (291.44)	1,232.68 (224.55)	6.33	.014	.03
Rejection negative	1,279.18 (375.79)	1,312.14 (278.41)	5.58	.020	.06
Rejection positive	1,256.34 (257.36)	1,340.71 (310.51)	3.31	.072	.04
GAD interpretations					
n.s.					
Endorsement negative	1,085.83 (228.18)	1,196.60 (237.34)			
Endorsement positive	1,245.31 (275.76)	1,212.29 (228.98)			
Rejection negative	1,281.34 (309.30)	1,267.10 (269.82)			
Rejection positive	1,255.23 (297.43)	1,370.70 (299.12)			

Abbreviations: ED, eating disorder; GAD, generalized anxiety disorder; SAD, social anxiety disorder.

TABLE 3 Regression analyses with SWAP indices for prediction of ED severity in the full sample

Predictors	B	SE B	β
First model			
Constant	2.34	0.69	
Endorsement rate negative ED	0.04	0.00	.63***
Endorsement rate positive ED	-0.02	0.01	-.30***
RT endorsement negative ED	-0.00	0.00	-.12
RT rejection positive ED	0.00	0.00	.09
Second model			
Constant	2.66	0.71	
Endorsement rate negative ED	0.04	0.01	.68***
Endorsement rate positive ED	-0.03	0.01	-.33***
RT endorsement negative ED	0.00	0.00	-.07
RT rejection positive ED	0.00	0.00	.14
RT endorsement positive SAD	-0.00	0.00	-.19*
RT endorsement negative SAD	0.00	0.00	.07
RT rejection negative SAD	-0.00	0.00	-.01

Abbreviations: ED, eating disorder; RT, reaction time; SAD, social anxiety disorder.

* $p < .05$; *** $p < .001$.

TABLE 5 Regression analyses with SWAP indices for prediction of ED severity in extreme groups

Predictors	B	SE B	β
First model			
Constant	1.90	0.71	
Endorsement rate negative ED	0.05	0.00	.72***
Endorsement rate positive ED	-0.02	0.01	-.26***
Reaction time rejection positive ED	0.00	0.00	.04
Reaction time endorsement negative ED	0.00	0.00	-.07
Second model			
Constant	2.86	0.68	
Endorsement rate negative ED	0.05	0.00	.78***
Endorsement rate positive ED	-0.03	0.01	-.33***
Reaction time rejection positive ED	0.00	0.00	.06
Reaction time endorsement negative ED	-0.00	0.00	-.12
Endorsement rate negative SAD	-0.03	0.01	-.30***
Endorsement rate negative GAD	0.02	0.01	.16*

Abbreviations: ED, eating disorder; GAD, generalized anxiety disorder; SAD, social anxiety disorder.

* $p < .05$; *** $p < .001$.

TABLE 4 Extreme group comparison for endorsement rates and reaction times to ED, SAD, and GAD stimuli

SWAP indices	ED ⁺⁺ (n = 30) M (SD)	ED ⁻⁻ (n = 26) M (SD)	F	p	η_p^2
ED endorsement rate (%)			98.97 (2, 49)	<.001	.80
Negative	85.12 (9.84)	21.44 (14.34)	180.74 (1, 50)	<.001	.78
Positive	36.19 (16.48)	76.00 (10.86)	40.22 (1, 50)	<.001	.45
SAD endorsement rate (%)			6.31 (2, 49)	.004	.21
Negative	74.83 (18.45)	42.30 (18.65)	12.37 (1, 50)	.001	.20
Positive	50.81 (13.96)	72.38 (14.41)	1.74 (1, 50)	.193	.03
GAD endorsement rate (%)			4.31 (2, 49)	.019	.15
Negative	70.00 (14.83)	44.20 (17.88)	6.00 (1, 50)	.018	.11
Positive	50.98 (13.84)	72.52 (14.00)	1.60 (1, 50)	.212	.03
Reaction time ED (ms)			7.10 (4, 47)	<.001	.38
Rejection negative	1,237 (296)	1,146 (270)	0.58 (1, 53)	.450	.01
Rejection positive	1,177 (229)	1,452 (340)	6.20 (1, 50)	.016	.11
Endorsement negative	987 (216)	1,261 (317)	6.41 (1, 50)	.015	.11
Endorsement positive	1,228 (319)	1,164 (257)	0.00 (1, 50)	.969	.00

Abbreviations: ED, eating disorder; ED⁺⁺, women with very high ED severity; GAD, generalized anxiety disorder; SAD, social anxiety disorder.

endorsed negative and rejected positive interpretations significantly faster than did ED- (Table 2).

Social anxiety-specific interpretations—endorsement and rejection. A MANCOVA showed no significant main effect of group on the endorsement rate of SAD interpretations ($F(2, 88) = 2.00, p = .142, \eta_p^2 = .04$), but did reveal main effects of symptoms of SAD ($F(2, 88) = 35.56, p < .001, \eta_p^2 = .45$), symptoms of depression ($F(2, 88) = 4.46, p = .014, \eta_p^2 = .09$), and symptoms of GAD ($F(2, 88) = 3.12, p = .049, \eta_p^2 = .07$).

Social anxiety-specific interpretations—reaction times. A MANCOVA revealed a significant main effect of group on reaction time to endorse or reject negative or benign SAD interpretations ($F(4, 86) = 2.95, p = .024, \eta_p^2 = .12$), and a main effect of symptoms of SAD ($F(4, 86) = 5.18, p = .001, \eta_p^2 = .19$). Subsequent univariate ANCOVAs indicated that ED+ endorsed negative and rejected positive interpretations significantly faster, and were also significantly slower to endorse positive interpretations compared to ED- (Table 2).

GAD-specific interpretations—endorsement and rejection. A MANCOVA revealed no significant main effect of group on the endorsement rate of GAD interpretations ($F(2, 88) = 2.07, p = .132, \eta_p^2 = .05$), but did reveal main effects of symptoms of SAD ($F(2, 88) = 23.69, p < .001, \eta_p^2 = .35$), symptoms of GAD ($F(2, 88) = 4.17, p = .019, \eta_p^2 = .09$) and symptoms of depression ($F(2, 88) = 3.76, p = .027, \eta_p^2 = .08$).

GAD-specific interpretations—reaction times. The MANCOVA revealed no significant effect of group on reaction time to endorse and reject GAD interpretations ($F(4, 86) = 1.92, p = .115, \eta_p^2 = .08$).

2.3 | Eating disorder-specificity of the interpretation bias

Due to a significant Mahalanobis distance, one outlier had to be eliminated a priori. Homoscedasticity, linearity, multicollinearity (VIF 2.45–4.26) and multivariate normality were checked and all assumptions were fulfilled. Model 1 accounted for 80.4% of the variance. When indices of SAD-specific IBs (reaction times) were also added, only the reaction time to endorse positive SAD stimuli qualified as an additional, negative predictor of ED severity. This second model explained a further 1.6% of the variance (Table 3).

2.4 | Extreme Group Analyses

There were no significant differences between the ED⁺⁺ ($n = 30$) and the ED⁻⁻ group ($n = 26$) in terms of sociodemographic factors (age, marital status, educational level), with the exception of BMI ($t = -2.11; p = .042$). The ED⁺⁺ group had a mean BMI of 27.65 ($SD 10.83$) whereas the control group had a mean BMI of 23.21 ($SD 3.73$). As expected, the ED⁺⁺ group also scored significantly higher on the PHQ-9, SPIN and GAD-Q-IV. The results of the extreme group differences in SWAP indices are presented in Table 4, and are similar to those presented in the subthreshold group comparisons for ED-specific stimuli. The ED⁺⁺ group endorsed significantly more negative ED-, SAD- and GAD-specific interpretations than did the ED⁻⁻ group. The two groups also differed significantly in their reaction time for ED-specific interpretations. However, there were no significant group differences in reaction times to SAD and GAD stimuli (all $ps > .05$) Table 4.

Again, we conducted the regression analyses as previously described. The first model of the regression analysis explained 92.0% of the variance. Adding endorsement rates of SAD- and GAD-specific negative interpretations explained a further 2.1% of the variance Table 5.

3 | DISCUSSION

The main purpose of this online study was to clarify whether the IB is specific to ED-related content or whether it extends to threats relating to highly comorbid disorders. To this end, we compared women with a high ED psychopathology to women with a low ED pathology.

To enable a differentiation between the various components of an IB, we used the SWAP, an adapted version of the WSAP.

As expected, and in line with previous studies with subclinical (Rosser et al., 2010) and clinical ED samples (Cooper, 1997; Williamson et al., 2000), women with higher ED symptoms endorsed more negative ED-specific interpretations, even when symptoms of depression, social and general anxiety, and BMI were adjusted for. The higher rejection rate of positive interpretations, that is, lack of a positive bias, in women with ED symptoms is a novel finding and may be interpreted as an additional component of the IB (Hirsch & Clark, 2004), which has also been established in samples with SAD (Amir et al., 2012; Beard & Amir, 2009). Furthermore, in partial support of our hypothesis, women with high ED symptoms were quicker to endorse negative ED-specific interpretations and to reject positive interpretations than women with low ED symptoms. However, there were no significant group differences in reaction times to reject negative interpretations and to endorse positive interpretations. Other studies using the WSAP also found faster reaction times to endorse negative interpretations in a sample with depression (Hindash & Amir, 2012), and in contrast to our nonsignificant results, a considerably slower endorsement of positive interpretations in participants with SAD (Amir et al., 2012).

In the present study, the results for IBs in response to SAD- and GAD-related stimuli were mixed. While we did not find significant group differences between ED+ and ED- for endorsement rates of SAD and GAD stimuli, women with high ED symptoms showed a negative SAD-specific IB in their reaction times, in line with expectation. Group differences on the more implicit level could be explained by high levels of avoidance and rejection sensitivity in samples with EDs, but when looking at the content, the SAD- and GAD-specific sentence-word pairs did not completely correspond to their specific appearance-based rejection sensitivity (Linardon, Braithwaite, Cousins, & Brennan, 2017). Consistent with our hypotheses, women with very high ED symptoms endorsed more negative SAD and GAD interpretations than did nonclinical controls, yet this negative IB was not reflected in their reaction times. We can only assume that the absence of significant group differences in RT scores for the SAD- and GAD-specific IBs in participants with very high ED severity can be explained by cognitive impairments, which reduce RTs. Hence, an implicit IB for SAD and GAD, which may be less pronounced than for ED-specific content, could not be detected. Overall, these findings support the results of Cardi et al. (2017), who reported a SAD-IB in women with anorexia nervosa, and is also in line with data from participants with SAD (Amir, Foa, & Coles, 1998) as well as patients with body dysmorphic disorder (Buhlmann et al., 2002; Dietel et al., 2019), who showed a negative interpretive bias for general social information. In contrast to the results of our extreme group comparisons, two previous studies, in women with body dysphoria (Jackman et al., 1995) and in women with EDs (Williamson et al., 2000), found no group differences for health-related stimuli compared to nonsymptomatic controls. This discrepancy might be explained by differences in the choice of stimuli. In our study, health concerns were only one of 10 GAD-specific concerns that were used (e.g., romantic relationships, physical harm to

self, physical harm to others, finances, academic performance (Ogniewicz et al., 2014)). Moreover, the literature on women with anorexia nervosa discusses the idea of acquired fearlessness (Selby et al., 2010) as well as illness denial (Abbate-Daga et al., 2013), both of which may lead to low levels of health concerns. Overall, our results indicate a negative SAD-specific IB and, at least in individuals with higher ED pathology, also a GAD-specific IB, even after controlling for symptoms of social and general anxiety. Hence, these results lend support to the hypothesis of an underlying cognitive component of general interpretation biases that is a shared factor across the disorders and is also linked to ED pathology. Although the data from reaction time measures seem to be more inconsistent than the data from explicit measures, these results support the application of response latency as another index of the IB in samples with EDs.

To assess the predictive value of the ED-IB and to explore the additional influence of SAD- and GAD-IBs on ED psychopathology, we conducted regression analyses, which revealed that the endorsement rate of negative ED interpretations was the most influential predictor. While the endorsement rate of positive ED interpretations also predicted ED symptoms, this was to a far lesser degree. Women with higher ED symptoms endorsed more negative ED interpretations and fewer positive ED interpretations. Furthermore, the reaction time to endorse positive SAD interpretations was a negative predictor of ED symptoms, and for the individuals with very high ED severity, the endorsement rate of negative SAD and negative GAD interpretations also predicted ED symptoms, but the latter to a very small extent. The finding that the endorsement of negative SAD interpretations was a negative predictor of ED symptomatology might appear surprising at first glance. However, the unexpectedly negative sign is explained by negative suppression effects (Tzelgov & Henik, 1991), as the sign changed as soon as the endorsement rate of negative ED interpretations was entered into the model. In sum, and in line with results for SAD (Amir et al., 2012), endorsement rates seem to be a better predictor than response latency measures, although these findings are inconsistent (Amir et al., 1998; Hindash & Amir, 2012). Especially when looking at the extreme groups, the predictive value of reaction times in general, as well as IB to SAD and GAD stimuli, was very low. Overall, these results suggest that the IB in women with ED psychopathology seems to be rather ED-specific and particularly pronounced with regard to the endorsement of negative ED-specific interpretations.

The present findings need to be interpreted in the light of some strengths and limitations of the study. A strength of the online study lies in the economic benefits of the paradigm, that is, the SWAP was successfully adapted for ED stimuli and used for online assessment. Response choices as well as reaction times, both of which are discussed as relatively automatic measures (Cowden Hindash & Amir, 2012; Cowden Hindash & Rottenberg, 2017), provided information about interpretation biases. We adjusted for a number of covariates that partially had a large impact on the results. Furthermore, by including depression as a covariate, we tried to minimize a general negative bias. In terms of limitations, the inconsistent results of response latency measures may be attributable to confounding variables that

cannot be controlled for in online assessments, such as distractions or speed of internet connection. The SWAP provides an index of how quickly a participant endorses or rejects different interpretations (including reading and understanding the sentence-word pairs and making a decision) and therefore differs from typical reaction time data (Beard & Amir, 2009). Hence, one can argue that our response latency data do not qualify as an implicit measure of the interpretation bias. Due to the design of the SWAP, participants vary in terms of the number of times they endorse or reject sentence-word pairs (Amir et al., 2012). As such, it is possible that unequal or small cell sizes may have affected the results. A higher number of trials could increase the reliability (Mobius et al., 2015; Ogniewicz et al., 2014).

Further strengths and limitations pertain to the sample: For instance, our sample comprised individuals with high ED symptoms from the community, which limits the ability to generalize our results to clinical samples. Nevertheless, the high EDE-Q scores reflect clinically relevant symptomatology, which is comparable to that of women with diagnoses of bulimia nervosa and anorexia nervosa (Hilbert et al., 2007). It should be noted that the women in our study with high ED psychopathology also reached clinically relevant levels of SAD (Sosic et al., 2008) and GAD (Moore, Anderson, Barnes, Haigh, & Fresco, 2014), which reflects the typically high rates of comorbidity in ED samples. Furthermore, we replicated our results by comparing women with very high ED pathology to women with nonclinical scores. As expected, the results of the extreme group comparisons revealed larger effect sizes. However, future studies should use a screening based on DSM-5 diagnostic criteria. The high mean BMI of our participants might imply a high number of women with (sub)threshold binge-eating disorder, which is the most common diagnosis in community-based samples (Hudson et al., 2007). To supplement our findings, future studies could attempt to replicate them in low-weight eating disorders. As high comorbidity is characteristic for individuals with EDs, the clinically relevant scores for GAD and SAD in our sample strengthen the external validity of our study. Finally, given the online format, we cannot rule out the occurrence of a selection bias of the sample.

Despite these limitations, we believe that the current work provides insights into relevant components of the IB that are associated with ED symptoms. Future studies using the SWAP may include a sentence comprehension task to ensure that participants read both the sentence and the word before endorsing or rejecting the word. The paradigm has already been adapted for use as an IB modification tool with students with social anxiety (Beard & Amir, 2008) and for depression in healthy volunteers (Mobius et al., 2015). If future experimental and longitudinal studies provide evidence that the ED-IB is etiologically relevant and modifiable, online training interventions to modify the ED-IB using the SWAP could already be offered while patients are waiting for treatment or could accompany therapy. Our findings suggest that the inclusion of ED-specific situations as used here would be sufficient. An early assessment and modification could possibly reduce symptoms before treatment starts, yielding significant individual and economic benefits.

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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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