Received: 22 September 2020 | Revised: 18 December 2020 | Accepted: 19 December 2020

DOI: 10.1002/eat.23461

ORIGINAL ARTICLE

International Journal of EATING DISORDERS WILEY

Exposure to the thin beauty ideal: Are there subliminal priming effects?

Judith Leins D Psych[1,2] | Manuel Waldorf PhD[3] | Boris Suchan PhD[4] | Martin Diers PhD[5] | Stephan Herpertz MD[5] | Georgios Paslakis MD[6] | Sabine Steins-Loeber PhD[2]

[1]Department of Psychiatry, Ubbo-Emmius Hospital Norden, Norden, Germany

[2]Department of Clinical Psychology and Psychotherapy, University of Bamberg, Bamberg, Germany

[3]Department of Clinical Psychology and Psychotherapy, Osnabrück University, Osnabrück, Germany

[4]Clinical Neuropsychology, Ruhr University Bochum, Bochum, Germany

[5]Department of Psychosomatic Medicine and Psychotherapy, LWL-University Hospital Bochum, Ruhr University Bochum, Bochum, Germany

[6]Department of Psychosomatic Medicine and Psychotherapy, Ruhr University Bochum, Lübbecke, Germany

Correspondence
Sabine Steins-Loeber, PhD, Department of Clinical Psychology and Psychotherapy, Otto-Friedrich-University of Bamberg, Markusplatz 3, 96047 Bamberg, Germany.
Email: sabine.steins-loeber@uni-bamberg.de

Action Editor: Ruth Weissman

Abstract

Objective: Previous research suggested that exposure to the thin beauty ideal propagated by the media is associated with body dissatisfaction and the development of disordered eating. Given recent suggestions regarding the role of automatic processes, we aimed to enhance our understanding of automatic, unconscious responses to body pictures and the association with the internalization of the thin ideal and the severity of eating disorder symptoms.

Method: An affective priming task with body pictures of different weight as primes and a normal-weight body picture as target, which had to be evaluated with regard to attractiveness and desirability, was administered to healthy women with either subliminal prime presentation (Experiment 1) or conscious presentation (Experiment 2).

Results: Subliminal presentation did not affect the evaluation of the normal-weight target, although strength of evaluative shifts was significantly associated with internalization of the thin ideal. In contrast, the conscious presentation of the ultra-thin prime decreased and of the obese prime increased desirability and attractiveness ratings of the target.

Discussion: Prevention strategies focusing on the critical evaluation of the thin ideal are important. Future studies are warranted to enhance our understanding of automatic, unconscious processes in women experiencing eating disorders.

KEYWORDS

anorexia nervosa, automatic processes, eating disorders, subliminal priming

1 | INTRODUCTION

Dissatisfaction with one's own body is a typical phenomenon in women in the western society (Myers & Crowther, 2009). Today, attractiveness is associated with a low body mass index (BMI; Crossley, Cornelissen, & Tovée, 2012; Wang et al., 2015), and mass media label a thin body as the standard beauty ideal for women (Kwan, Haynos, Blomquist, & Roberto, 2018). An important role regarding disordered eating is attributed to the media (Groesz, Levine, & Murnen, 2002). In one of our own studies (Loeber et al., 2016), we investigated the impact of exposure to the thin ideal presented in media portrayals on body satisfaction in healthy women and women experiencing anorexia nervosa (AN), bulimia nervosa, or anxiety/depression. Our results indicated that the instruction to imagine a thin body picture displayed in a fashion

magazine was associated with a decrease in body satisfaction with no significant differences across all groups. In contrast, leafing through a fashion magazine in a waiting room situation had no effect. These findings suggest that an exposure to the thin ideal might not automatically affect body satisfaction, but that cognitive processes, like, for example, preoccupation with the thin ideal, are involved. However, given that we used a simulation of a naturalistic waiting room situation, we did not control for viewing of the pictures in the magazine and cannot exclude confounding of our findings.

Only recently, several authors suggested that automatic processes and a shift from goal-directed to habitual behavior might be an important aspect in the development and maintenance of eating disorders (e.g., Paslakis et al., 2016; Paslakis, Scholz-Hehn, Sommer, & Kühn, 2020; Steinglass & Walsh, 2016; Uniacke, Walsh, Foerde, & Steinglass, 2018; Walsh, 2013). Walsh (2013) hypothesized that disorder-compatible stimuli (e.g., pictures of underweight bodies) trigger the mesolimbic reward system and promote restraint eating habits. In line with this, Fladung and colleagues found a higher activation of the ventral striatum, a central structure of the dopaminergic mesolimbic reward system, in response to pictures of underweight bodies in patients with AN—compared to healthy controls (Fladung et al., 2010; Fladung, Schulze, Schöll, Bauer, & Grön, 2013).

Even though the studies described above have assessed automatized (implicit) responses to body-related cues, the applied stimuli were not subliminal. In other words, the applied stimuli qualified for conscious perception (e.g., based on duration of their presentation), but were nonetheless not consciously perceived. By contrast, subliminal stimuli are defined as those that—based on their characteristics of intensity and/or duration of presentation—do not allow conscious representation. There is an extensive literature regarding the influence of subliminal cues on cognitive processing, mood, and behavior (e.g., Hassin, 2013; Mudrik, Faivre, & Koch, 2014), with research showing that subliminally presented information may have long-term effects on conscious, rational decision-making (Ruch, Züst, & Henke, 2016). With the aim to investigate whether women automatically evaluate body-related images, Watts, Cranney, and Gleitzman (2008) used an affective priming paradigm. Body pictures which participants had previously rated as either "good" or "bad" were presented as primes for 200 milliseconds followed by a target word (e.g., thin, fat), and participants were instructed to indicate as quickly as possible whether the target word is "good" or "bad." The results indicated lower response latency to congruent pairs (i.e., prime and target of the same valence) compared to incongruent pairs. The interpretation was that brief exposure to body pictures induces automatic affective responses. However, this study did not assess whether these automatic affective responses also affect subsequent processes, for example, the evaluation of body stimuli as attractive or desirable.

Previous studies investigating subliminal priming effects in different mental disorders used a modified affective priming paradigm compared to the above mentioned investigation by Watts and colleagues (Watts et al., 2008). For example, Suslow, Roestel, and Arolt (2003) investigated automatic affect processing in schizophrenia and administered an affective priming task in which neutral faces were primed with subliminally (16.7 ms, visually masked) or supraliminal (i.e., consciously perceivable) presented sad, neutral, and happy faces. Dannlowski et al. (2006) investigated automatic processing of facial emotion in depressed patients and administered a similar affective priming task. The observed association between negatively biased evaluative processing of facial emotion and symptom severity was replicated by Dannlowski and colleagues in 2007 (Dannlowski et al., 2007). While the study by Watts and colleagues suggests automatic affective responses to body pictures (Watts et al., 2008), to the best of our knowledge, no studies so far have investigated whether such responses affect the evaluation of normal-weight body shapes. Given that the exposure to the thin ideal (and subsequent internalization) is considered as a very important factor regarding the development of body dissatisfaction and eating disorder psychopathology, it is important to enhance our understanding of mechanisms promoting this effect. The impact of subliminal body pictures of different BMI categories upon the evaluation of normal-weight body stimuli in healthy and clinical (i.e., eating disordered) cohorts is largely unknown. Cognitive interventions supporting patients to question the thin ideal and to cope with conscious triggers are part of many treatment approaches for eating disorders. However, if responses to the thin ideal begin outside conscious awareness, interventions would be needed that aim at altering automatic unconscious responses.

Against this background, we investigated whether subliminal body pictures of different weight categories would affect the evaluation of normal-weight body pictures in healthy women, and explored whether internalization of the thin ideal and presence/severity of eating disorder symptoms would moderate this effect. In Experiment 1, an ultra-thin, a thin, a normal-weight (as control item), an overweight, and an obese female body were presented as subliminal primes to test for automatic responses. In Experiment 2, the same body pictures were used as primes and targets, but the presentation time of primes was increased thus that participants became aware of the primes to test for conscious effects. We assumed that the subliminal as well as the conscious presentation of ultra-thin and thin body pictures would decrease evaluation of attractiveness and desirability of normal-weight body pictures (i.e., a negative evaluative shift), whereas exposure to overweight and obese body pictures was assumed to be associated with a positive evaluative shift.

2 | MATERIALS AND METHOD

2.1 | Experiment 1

Experiment 1 was designed to examine whether healthy women´s evaluation of normal-weight body pictures is differently affected by subliminal priming using body pictures of different weight categories ranging from ultra-thin to obese.

2.1.1 | Participants

Women aged between 18 and 30 were recruited among the student population of a German University via posters and postings in social

networks. Exclusion criteria were a diagnosis of a psychotic disorders or any other current mental disorders based on self-report of participants, pregnancy, and BMI under 18.5 kg/m^2 or above 24.9 kg/m^2 to control for possible confounding effects of eating- or weight-related disorders. The study was approved by the local ethics committee and adhered to the Declaration of Helsinki. Participants were informed about the content of the study, confidentiality and their freedom to discontinue participation at any time; all participants gave written informed consent. Participants received course credits for study participation.

2.1.2 | Procedure

Testing comprised a single test-session that lasted about 1 hr and started with the assessment of participants' height and weight and the administration of state measures on mood and body satisfaction (for details see below). Then, a computerized priming task (see below) was administered, in which participants were asked to rate pictures displaying normal-weight female bodies with regard to attractiveness and desirability after subliminal presentation of pictures displaying female bodies ranging in weight from ultra-thin to obese. After the priming task, participants performed a detection task (see below) to assess awareness of the subliminally presented body pictures. At the end of the test-session, participants were asked again to fill in state questionnaire measures on mood and body satisfaction along with questionnaires on eating behavior and sociocultural attitudes toward appearance (see below).

2.1.3 | Materials

Priming task

The priming task was adapted from the affective priming task described by Dannlowski et al. (2007). Participants were shown different pictures of women´s bodies and were asked to rate these bodies with regard to attractiveness (i.e., the body has a particular allure to the participant) and desirability (i.e., the participant strives for such a body) on a 7-point Likert-scale ranging from "not at all" to "extremely." After presentation of a fixation cross, a prime was presented for 16.67 ms (Suslow et al., 2013), immediately followed by a scrambled mask presented for 100 ms. The prime displayed either an ultra-thin, a thin, a normal-weight, an overweight or an obese female body (for details see below). Then, the target picture displaying a normal-weight female body was presented for 4,000 ms (Blechert, Ansorge, Beckmann, & Tuschen-Caffier, 2011) and the questions "How attractive is this body for you?" (1 = "not at all," 7 = "extremely") and "How desirable is this body for you?" (1 = "not at all", 7 = "extremely") were displayed while the target was still visible. Ten different pictures were used as target picture and presented five times with random assignment to the different primes. Thus, each participant performed 50 trials.

Stimulus materials

Five colored, computer-generated pictures (see Figure 1) displaying either an ultra-thin, a thin, a normal-weight, an overweight or an obese female body were used as primes, and 10 colored, computer-generated pictures displaying each a normal-weight body were used as targets for the priming task. All pictures were presented without the head to ensure evaluation of only the body, and all stimuli were of the same race (i.e., white) to enhance the individual relevance and ecological validity of the stimuli. Taking into account previous experience with the generation and selection of body stimuli of different builds (Voges et al., 2018; Waldorf, Vocks, Düsing, Bauer, & Cordes, 2019) a larger set of pictures of female bodies varying in body shape was created by MW using the software DAZ Studio Pro 4.6 (Daz Productions, Inc., Salt Lake City, UT). Two of the authors (JL and SSL) independently selected the pictures that represented in their view best each weight category. The resulting set of 32 pictures was

FIGURE 1 Pictures used in the priming task as primes (ultra-thin, thin, normal-weight, overweight, obese) [Color figure can be viewed at wileyonlinelibrary.com]

then subject to a pilot study, in which 66 women (who did not participate in the present study) rated the pictures with regard to weight (ultra-thin, thin, normal-weight, overweight, obese) as well as attractiveness and desirability (on a 7-point Likert-scale ranging from "not at all" to "extremely"). The pictures selected for the present study were those rated most consistently in the corresponding weight categories.

Detection task

The detection task was designed to assess awareness of the body pictures used as primes. Participants were informed about the subliminal presentation of primes and the priming task was administered again, with the difference that, instead of questions on attractiveness and desirability, participants were asked to rate the primes with regard to weight (ultra-thin, thin, normal-weight, overweight, obese). Given five different prime categories, guess probability was 20% (Dannlowski et al., 2007). Participants were considered as aware if they correctly indicated the weight category above chance level.

Questionnaire measures

To provide state measures of body satisfaction and mood two questionnaires were administered before and after the experimental procedure. The adapted German version of the Body Shape Questionnaire (Waadt, Laessle, & Pirke, 1992) was administered to assess body satisfaction by asking for example "Have you been so worried about your shape that you have been feeling you ought to diet?". In contrast to the original version (Cooper, Taylor, Cooper, & Fairbum, 1987) the instruction "over the past four weeks" was omitted. Cronbach's alpha ranged from .95 to .96 for the two assessments.

The German version of the Profile of Mood States (Dalbert, 1992) was used to assess mood states before and after the evaluation task. This questionnaire comprises a list of 19 adjectives (including, e.g., "sad," "listless," "happy") and participants are asked to indicate how these adjectives best describe their current mood using a seven-point Likert rating scale (ranging from not at all to very much). Cronbach's alpha ranged from .89 to .92.

Further questionnaires were administered at the end of the test session to assess eating disorder symptoms and the internalization of the thin ideal. To assess disordered eating behavior, the total score of the German version of the Eating Disorder Examination Questionnaire (EDE-Q; Hilbert & Tuschen-Caffier, 2016) was used. In the present sample, Cronbach's alpha for this score was .96.

To assess sociocultural attitudes toward appearance, the German version of the extended Sociocultural Attitudes Toward Appearance Questionnaire (SATAQ-G; Knauss, Paxton, & Alsaker, 2008) was administered. It includes the subscales Awareness of the existence of the thin body ideal, Internalization of this ideal, and Perceived pressure to conform to media ideals. In the current sample, Cronbach's alpha ranged from .77 to .92 for the different subscales.

Statistical analysis

To analyze priming effects, nonparametric measures were used in line with previous studies using this priming paradigm (e.g., Dannlowski et al., 2006; Suslow et al., 2003), given that equal distances between any two numbers on the rating scales used to assess priming effects cannot be assumed. Thus, two-tailed Wilcoxon signed-ranks tests were calculated to compare ratings between targets primed with a normal-weight body picture with ratings of targets primed with ultra-thin, thin, overweight, or obese body pictures, respectively.

In addition, as suggested by Dannlowski et al. (2007) for each prime category (ultra-thin, thin, overweight, obese) a bias score was computed by subtracting mean evaluative ratings of targets primed by normal-weight body pictures from mean evaluative ratings of targets primed by the different prime categories. A negative bias score thus indicates that the normal-weight body picture was rated less attractive/desirable if primed for example by the thin compared to the normal-weight body picture (negative evaluative shift). In contrast, a positive bias score indicates a positive evaluative shift. Bias scores were used to calculate Spearman rho correlations to identify associations between severity of eating disorder psychopathology and awareness, and internalization of the thin ideal with priming effects.

The sample size was based on previous studies investigating subliminal priming effects with facial picture (e.g., Dannlowski et al., 2006; Suslow et al., 2003). For all analyses, statistical assumptions were met; a significance level of $p \leq 0.05$ was considered as significant. Effect size statistics are reported as appropriate, that is, for the Wilcoxon signed-ranks test r_W = was calculated as Z/sqrt(N) with $r_W \leq 0.3$ indicating a small effect, $0.30 < r_W \leq 0.5$ a moderate effect, and $r_W \geq 0.5$ a large effect. IBM SPSS Statistics (Statistical Package of the Social Science, 25.0) was used for all analyses.

2.2 | Experiment 2

Experiment 2 aimed to test whether healthy women´s evaluation of normal-weight female body pictures is consciously affected by presenting body pictures of different weight categories used as primes for 2000 ms.

2.2.1 | Participants

For Experiment 2, again women aged between 18 and 30 were recruited among the student population of a German University via posters and postings in social networks. Exclusion criteria for all study participants were the same as in Experiment 1. The study was approved by the local ethics committee and adhered to the Declaration of Helsinki. All participants received course credits for their study participation.

2.2.2 | Procedure

The procedure was similar to Experiment 1. Only the presentation of the primes was 2,000 ms and there was no detection task.

2.2.3 | Materials

Priming task

Participants and were asked to rate the different pictures of women´s bodies with regard to attractiveness and desirability on a 7-point Likert-scale ranging from "not at all" to "extremely". The task was identical to Experiment 1 with the exception that primes were presented for 2,000 ms.

Questionnaires

The same questionnaires as in Experiment 1 were administered. We only report Cronbach's alpha in the sample of Experiment 2 here. For further details on questionnaires please see above.

For the Body Shape Questionnaire (Waadt et al., 1992), Cronbach's alpha ranged from .96 to .97.

Cronbach's alpha was .94 for the Profile of Mood States (Dalbert, 1992).

Cronbach's alpha for the EDE-Q (Hilbert & Tuschen-Caffier, 2016) was .88 for the total scale.

For the SATAQ-G (Knauss et al., 2008), Cronbach's alpha was .90 for "internalization of thin body ideal," .74 for "awareness of the existence of the thin body ideal," and .92 for "perceived pressure to conform to media ideals."

Statistical analysis

Statistical analyses were similar as in Experiment 1.

3 | RESULTS

3.1 | Experiment 1

3.1.1 | Sample characteristics

A total of 30 women with a mean age of 20.73 years (*SD* = 2.52, range 18–30 years) and a mean BMI of 21.47 kg/m^2 (*SD* = 1.75, range 18.72–24.76 kg/m^2) were recruited. All participants were white/Caucasian. Further characteristics with regard to internalization of the thin ideal and eating disorder-related psychopathology are displayed in Table 1. None of the participants was aware of the subliminally presented primes.

3.1.2 | Effects of subliminal priming

Significant priming effects on the evaluative ratings of the normal-weight body pictures were not observed, neither with regard to attractiveness (all $Z \geq -1.04$; all $p \geq .30$, all $r_W \leq 0.19$) nor desirability (all $Z \geq -0.96$; all $p \geq .34$, all $r_W \leq 0.18$). Mean attractiveness ratings of the normal-weight body pictures ranged from 4.00 (*SD* = 0.94) to 4.06 (*SD* = 0.89); with regard to desirability, mean ratings ranged from 3.66 (*SD* = 0.89) to 3.76 (*SD* = 0.84).

With regard to self-reported body satisfaction, a significant main effect of time $F(1,29) = 29.94$, $p < .001$, $\eta^2 = .51$) indicated that the administration of the priming task was associated with a decrease in body satisfaction (mean/*SD* pre: 81.83/24.84; mean/*SD* post: 72.60/27.28). No changes in negative mood were observed ($F(1,29) = 1.58$, $p = .22$, $\eta^2 = .05$; mean/*SD* pre: 44.23/13.74; mean/*SD* post: 45.80/13.11).

TABLE 1 Sample characteristics ($n = 30$) for Experiment 1 with subliminal (unconscious) presented primes

	Mean	*SD*
Age (years) (mean [*SD*])	20.73	2.52
BMI (kg^2/m) (mean [*SD*])	21.47	1.75
SATAQ-G (a) (mean [*SD*])	17.30	3.64
SATAQ-G (i) (mean [*SD*])	16.53	7.52
SATAQ-G (p) (mean [*SD*])	16.27	5.67
EDE-Q (sum score) (mean [*SD*])	1.07	1.15

Abbreviations: BMI, body mass index; EDE-Q, German Version of the Eating Disorder Examination-Questionnaire; SATAQ-G, German version of the Sociocultural Attitudes Toward Appearance Questionnaire; SATAQ-G (a), subscale awareness; SATAQ-G (i), subscale internalization; SATAQ-G (p), subscale pressure.

3.1.3 | Associations with the internalization of the thin ideal and eating-disorder psychopathology

A positive correlation was observed between the bias score reflecting the priming effect of the ultra-thin body picture with regard to desirability ratings and awareness of the thin ideal ($r = .38$ $p = .04$), and internalization of the thin ideal, although this later association only approached significance ($r = .35$, $p = .06$). This suggests that participants with increased awareness and internalization of the thin ideal evaluated the normal-weight body picture more positive after priming with the ultra-thin compared to the normal-weight body picture.

In addition, increasing internalization of the thin ideal was associated with an enhanced positive evaluative shift in attractiveness ratings of the normal-weight body picture following priming with the overweight body picture ($r = .42$, $p = .02$). With regard to desirability ratings, this association approached significance ($r = .35$, $p = .06$). Although severity of eating-disorder psychopathology (as indicated by the total score of the EDE-Q) was positively associated with a positive evaluative shift regarding attractiveness of the normal-weight body picture after presentation of the obese prime, this association only approached significance ($r = .34$, $p = .07$).

3.2 | Experiment 2

3.2.1 | Sample characteristics

Thirty-three women were recruited for Experiment 2, two participants had to be excluded due to technical problems. The final sample

TABLE 2 Sample characteristics (n = 31) for Experiment 2 with conscious presentation of primes

	Mean	*SD*
Age (years) (mean [*SD*])	21.87	4.09
BMI (kg^2/m) (mean [*SD*])	21.44	1.76
SATAQ-G (a) (mean [*SD*])	16.35	3.81
SATAQ-G (i) (mean [*SD*])	15.90	6.40
SATAQ-G (p) (mean [*SD*])	14.29	5.72
EDE-Q (sum score) (mean [*SD*])	0.98	0.91

Abbreviations: BMI, Body Mass Index; EDE-Q, German Version of the Eating Disorder Examination-Questionnaire; SATAQ-G, German version of the Sociocultural Attitudes Toward Appearance Questionnaire; SATAQ-G (a), subscale awareness; SATAQ-G (i), subscale internalization; SATAQ-G (p), subscale pressure.

consisted of 31 women. Mean age was 21.87 (*SD* = 4.09) years and BMI ranged between 18.53 kg/m^2 and 24.83 kg/m^2 with a mean of 21.44 (*SD* = 1.76). All participants were white/Caucasian. Table 2 shows further sample characteristics with regard to internalization of the thin ideal and eating disorder-related psychopathology. The sample did not differ significantly from Experiment 1 with regard to age, BMI and further characteristics reported in Tables 1 and 2 (all $ts \leq |1.30|$, all $ps \geq .18$).

3.2.2 | Effects of conscious priming

Mean attractiveness ratings of normal-weight body pictures ranged from 4.81 (*SD* = 1.02) for the pictures primed by the ultrathin body picture to 5.13 (*SD* = 0.88) for the pictures primed by the obese body picture. With regard to desirability, mean ratings ranged from 4.44 (*SD* = 1.06) for the pictures primed by the ultrathin body picture to 4.84 (*SD* = 0.96) for the pictures primed by the obese body picture.

With regard to desirability ratings, results of the Wilcoxon rank test indicated that desirability ratings of the normal-weight target decreased significantly after presentation of the ultra-thin prime compared to presentation of the normal-weight prime (Z = −2.08, p = .04, r_W = 0.37; see Figure 2, upper panel). In addition, presentation of the obese prime was associated with a significant increase in desirability ratings of the normal-weight target compared to presentation of the normal-weight prime (Z = −2.58, p = .01, r_W = 0.46; see Figure 2, upper panel). This finding was reflected in attractiveness ratings, as presentation of the obese prime compared to the normal-weight prime was associated with a significant increase in attractiveness ratings of the normal-weight target (Z = −2.13, p = .03, r_W = 0.38).

With regard to self-reported body satisfaction, we found again a significant main effect of time, $F(1,30) = 21.27$, $p < .001$, $\eta^2 = .42$, indicating that the administration of the priming task was associated with a decrease in body satisfaction (M $[SD]_{pre}$: 81.04(25.23); M $[SD]_{post}$: 72.13(27.55)). In addition, a significant increase in negative mood was observed ($F(1,30) = 5.13$, $p = .03$, $\eta^2 = .152$; M $[SD]_{pre}$: 43.16(15.03); M $[SD]_{post}$: 45.35/15.78).

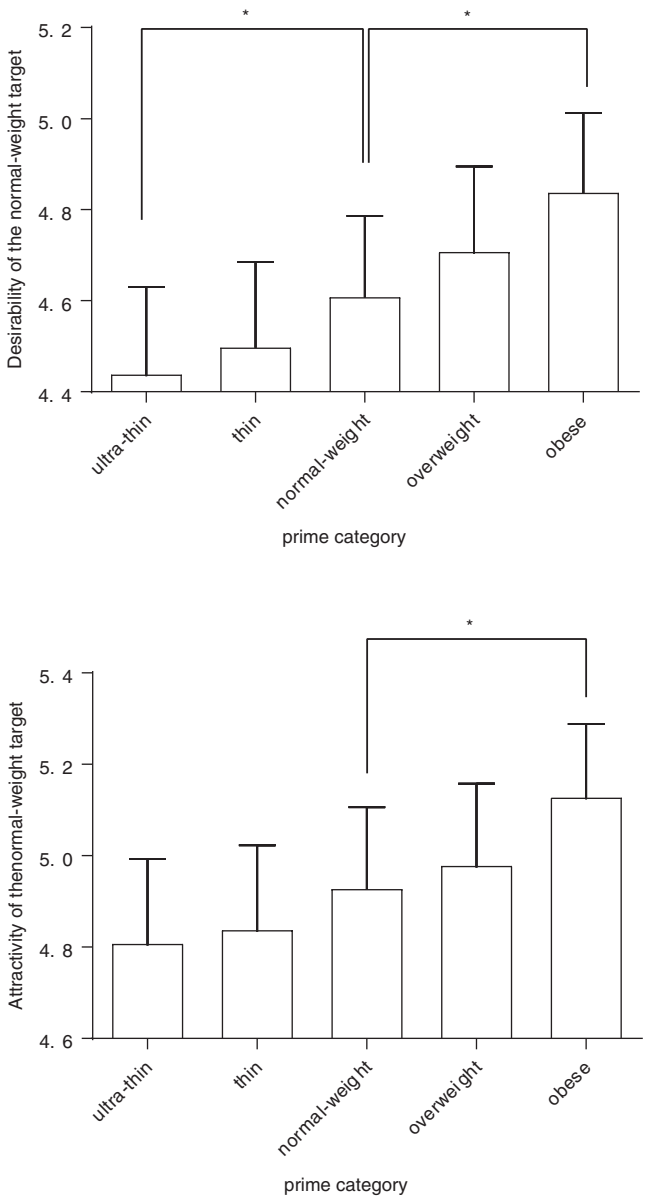

FIGURE 2 Conscious presentation of the ultra-thin and the obese prime affected evaluative ratings of the normal-weight target compared to presentation of the normal-weight prime

3.2.3 | Associations with internalization of the thin ideal and eating disorder-related psychopathology

Correlation analysis indicated that bias scores reflecting priming were not significantly associated with both awareness and internalization of the thin ideal or eating disorder-related psychopathology. We only found a trend for a significant association between awareness of the thin ideal and a negative evaluative shift regarding desirability of the normal-weight target after priming with the thin compared to the normal-weight body picture (r = −.35, p = .06).

4 | DISCUSSION

The aim of the present study was to enhance our understanding of automatic responses to body pictures in healthy women. We found that the subliminal presentation of body pictures of different weight categories (Experiment 1) did not affect the evaluation of a normal-weight target. In contrast, when primes were presented consciously (Experiment 2), evaluative shifts were observed as hypothesized. Conscious presentation of the ultra-thin prime decreased desirability, but not attractiveness ratings of the normal-weight target picture, while presentation of the obese prime increased both attractiveness and desirability ratings of the normal-weight target. These findings suggest that the conscious presentation of the ultra-thin prime may retrieve an internal representation of the thin ideal as presented in the media and thus lead to a negative evaluative shift regarding the normal-weight body.

Interestingly, when we calculated difference scores representing evaluative shifts after conscious prime presentation, evaluative shifts were not significantly associated with a stronger internalization of the thin ideal or more severe eating disorder psychopathology. However, this finding is in line with our previous research on the effects of exposure to the thin ideal presented in the media (Loeber et al., 2016); when healthy women and women experiencing AN or bulimia nervosa were instructed to imagine a body displayed in a fashion magazine, the groups similarly showed a significant increase in body dissatisfaction. It may therefore be assumed that the conscious exposure to the thin ideal induces evaluative processes which are comparable between healthy women and women experiencing eating disorders and that there might be other, more significant mechanisms that contribute to the development and maintenance of eating disordered behaviors.

Although we did not observe any significant evaluative shifts after subliminal presentation of the primes in Experiment 1, significant associations were observed between awareness and internalization of the thin ideal and the bias score reflecting the subliminal priming effect of the ultra-thin body picture. These associations indicate that - with increasing awareness and internalization of the thin ideal - the normal-weight target picture was rated as more desirable after priming with the ultra-thin compared to the normal-weight prime. We assume that low desirability of ultra-thin body pictures might have led to the reported increase of desirability of the normal-weight body (in terms of a positive contrast effect). On the other hand, and maybe more importantly, we investigated healthy women who did not experience an eating disorder and who achieved low scores in questionnaires of eating disorder-related psychopathology. It is important for future research to replicate this study in a sample of women showing stronger symptoms of disordered eating or even experiencing AN, and to investigate whether subliminal priming effects are observed - assuming that these participants might be more sensitized to automatic processes. In addition, if priming effects are observed, it would be interesting to see whether they are pointing toward lower attractiveness and desirability ratings of the normal-weight target after presentation of ultra-thin primes as these participants might evaluate ultra-thin primes more attractive and desirable (Fladung et al., 2010; Fladung et al., 2013).

Recently, several authors (e.g., Paslakis et al., 2016; Paslakis et al., 2020; Steinglass & Walsh, 2016; Uniacke et al., 2018; Walsh, 2013) suggested that automatic, or implicit, processes might be an important mechanism in the development and maintenance of eating disorders. It is assumed that a shift from goal-directed to habitual behavior, as observed in addictive behaviors (Everitt & Robbins, 2016), might also be relevant in eating disorders. The results from the present study support this assumption as significant associations were observed between evaluative shifts after subliminal priming with an ultra-thin body picture and awareness and internalization of the thin ideal. However, research on automatic, habitual processes in AN is scarce and results are conflicting. For example, Brooks et al. (2012) found that subliminally presented food stimuli compromised cognitive performance of patients with AN compared to healthy controls in an N-back-task, while Boehm et al. (2018) did not observe significant differences in brain activation between patients with AN and healthy controls after subliminal presentation of food stimuli. In an own study on habitual responding in AN (Vogel et al., 2020), we administered a Pavlovian-to-Instrumental-Transfer-Paradigm with low- and high caloric food stimuli and found that behavioral responding of women with AN was more in line with goal-directed than stimulus driven habitual behavior. However, an affective priming paradigm might be more appropriate to investigate rapid, automatic processes and future studies in this direction might contribute to our understanding of subliminal priming effects of food- and body-related stimuli in the development and maintenance of eating and weight disorders. This is especially important as in the present study, a BMI below 18.5 kg/m^2 or above 24.9 kg/m^2 was an exclusion criterion.

In the present study, priming effects were also observed after conscious presentation of the obese prime which increased attractiveness as well as desirability ratings of the normal-weight target. It may be assumed that this positive evaluative shift is due to a positive contrast effect (low attractiveness and desirability of the obese prime) as based on the internalization of the thin beauty ideal, women evaluate an obese body not as attractive or desirable (Horndasch et al., 2015). Interestingly, this positive evaluative shift increased with increasing internalization of the thin ideal and, although only marginally significant, with eating disorder severity - but only after the subliminal, not conscious, presentation of overweight and obese primes. This suggests that negative evaluation of overweight and obesity increases with increasing internalization of the thin ideal and may be symptoms of an eating disorder, and may become more automatic and habitual resulting in automatic priming effects.

The finding that priming effects in healthy women are observed after the conscious presentation of an ultra-thin and an obese prime has practical implications. Prevention strategies that challenge the thin beauty ideal would appear promising as these processes seem to not be automatic. As reviewed by Ciao, Loth, and Neumark-Sztainer (2014), a number of prevention programs have been developed for adolescent girls or college students to typically address

aspects identified as risk factors for the development of eating disorders. Most programs include information on healthy eating and nutrition, address media literacy and sociocultural factors relating to beauty ideals aiming to enhance body acceptance. Across several programs, modifying beliefs regarding the thin ideal and the perceived pressure to be thin were identified as important targets of effective prevention programs. Results from the present study underline the importance of these contents, but also suggest that more severe disordered eating might be associated with automatic responses that need to be addressed in the context of more tailored interventions.

There are a few limitations that should be acknowledged when interpreting the findings of the present study. First of all, as no previous studies regarding priming effects with subliminally presented body pictures are available, the sample size of the current study was based on previous studies that used this paradigm with facial pictures to investigate affective priming effects. However, priming effects of body pictures might be smaller than with facial pictures and although only very small effect sizes were observed regarding subliminal priming, our sample size might have been too small to detect relevant effects. Replication studies with larger samples are thus needed.

Related to study methodology, we present data from two independent studies with two groups of participants, and we cannot exclude that different results would have been observed with random allocation of participants to the subliminal or conscious condition or when using a within subjects design with the administration of both paradigms to each participant. However, study participants were recruited from the same basic population and no significant differences were observed between the two samples regarding age and eating-disorder symptoms making it unlikely that differences between the two groups account for our finding.

Also related to study methodology, the German version of the Body Shape Questionnaire (Waadt et al., 1992) was administered to assess body satisfaction before and after administration of the priming task and in contrast to the original version (Cooper et al., 1987) the instruction "over the past four weeks" was omitted. However, we cannot be assure that this resulted in a state measure of body satisfaction.

In addition, we used computerized body pictures of different weight categories as primes and normal-weight body pictures as targets, but had no information on the individual evaluation of the weight status of the pictures used as primes or the ecological validity of the pictures in general. However, pictures were selected based on the results of a pilot study recruited from the same basic population and in Experiment 2, with conscious presentation of primes, priming effects were observed as hypothesized. It is therefore unlikely that the present findings on subliminal priming are solely attributable to the nature of the applied stimuli. Also regarding the stimuli, it should be acknowledged that with the aim to increase individual relevance and ecological validity of the stimuli, all pictures displayed female bodies of the same race as the participants (i.e., white/Caucasian). However, some skin tones might be considered more attractive than others (Cafri et al., 2006). Moreover, although Cafri, Yamamiya, Brannick, and Thompson (2005) did not observe any moderating effects of ethnicity on the association between the internalization of the thin ideal and body image, other findings suggests that the association between internalization of the thin ideal and body dissatisfaction is moderated by ethnicity with stronger effects observed in European American women (Warren, Gleaves, Cepeda-Benito, Fernandez, & Rodriguez-Ruiz, 2005). We are thus not able to generalize our findings to participants with different cultural or racial background and future studies are warranted.

Finally, effect sizes relating to behavioral measures of subliminal priming with body-related stimuli might be rather small and we cannot exclude that different results would have been observed when investigating subliminal priming effects in a more naturalistic testing procedure, for example, by presenting pictures on a smart phone. As demonstrated by Fardouly, Pinkus, and Vartanian (2017), social comparisons on social media have a strong impact on body satisfaction and mood—even stronger than in contexts like fashion magazines or in person. Thus, the presentation of computerized body pictures on a computer in a laboratory setting might lead to an underestimation of effects. In this regard, it would also be interesting to investigate priming effects on brain level by assessing, for example, event-related potentials as suggested by Elgendi et al. (2018).

Taken together, the results of the present study indicate that the conscious, but not the subliminal presentation of body pictures of different weight categories impacts the evaluation of target pictures displaying normal-weight bodies in healthy women. Presentation of an ultra-thin prime decreased desirability, but not attractiveness ratings, while presentation of an obese prime increased attractiveness and desirability ratings. Based on the observed associations between the degree of awareness and internalization of the thin ideal as well as the severity of eating disorder symptoms with evaluative shifts, it can be hypothesized that rapid automatic processes might be a relevant mechanism in eating disorders, but not in healthy women. Future studies are warranted to enhance our understanding of automatic processes in the development and maintenance of eating disorders. The present study of subliminal picture presentation was carried out to assess evaluative responses toward body pictures in healthy controls. With next steps being assessments in clinical cohorts, basic science studies like the present one may prove to be meaningful contributions to the field of eating disorders. Subliminal priming effects of body-related or food stimuli in patients experiencing eating disorders would suggest that current behavioral treatments like cognitive behavioral therapy that address conscious responses to disorder-specific cues may be inherently limited in their efficacy. In addition, it would be important to sensitize patients for unconscious automatic reactions and to develop training techniques to overcome these responses.

ACKNOWLEDGEMENTS

The authors wish to thank Svenja Prill and Lisa Taubmann for their support in the collection of the data reported here.

CONFLICT OF INTEREST

We declare that there are no conflict of interest.

DATA AVAILABILITY STATEMENT

Data available on request from the authors.

ORCID

Martin Diers https://orcid.org/0000-0002-3257-7299
Sabine Steins-Loeber https://orcid.org/0000-0002-7651-0627

REFERENCES

Blechert, J., Ansorge, U., Beckmann, S., & Tuschen-Caffier, B. (2011). The undue influence of shape and weight on self-evaluation in anorexia nervosa, bulimia nervosa and restrained eaters: A combined ERP and behavioral study. *Psychological Medicine*, *41*(1), 185–194. https://doi.org/10.1017/S0033291710000395

Boehm, I., King, J. A., Bernardoni, F., Geisler, D., Seidel, M., Ritschel, F., … Ehrlich, S. (2018). Subliminal and supraliminal processing of reward-related stimuli in anorexia nervosa. *Psychological Medicine*, *48*(5), 790–800. https://doi.org/10.1017/S0033291717002161

Brooks, S. J., O'Daly, O. G., Uher, R., Schiöth, H. B., Treasure, J., & Campbell, I. C. (2012). Subliminal food images compromise superior working memory performance in women with restricting anorexia nervosa. *Consciousness and Cognition*, *21*(2), 751–763. https://doi.org/10.1016/j.concog.2012.02.006

Cafri, G., Thompson, J. K., Roehrig, M., van den Berg, P., Jacobsen, P. B., & Stark, S. (2006). An investigation of appearance motives for tanning: The development and evaluation of the physical appearance reasons for tanning scale (PARTS) and its relation to sunbathing and indoor tanning intentions. *Body Image*, *3*(3), 199–209. https://doi.org/10.1016/j.bodyim.2006.05.002

Cafri, G., Yamamiya, Y., Brannick, M., & Thompson, J. K. (2005). The influence of sociocultural factors on body image: A meta-analysis. *Clinical Psychology: Science and Practice*, *12*(4), 421–433. https://doi.org/10.1093/clipsy.bpi053

Ciao, A. C., Loth, K., & Neumark-Sztainer, D. (2014). Preventing eating disorder pathology: Common and unique features of successful eating disorders prevention programs. *Current Psychiatry Reports*, *16*(7), 453. https://doi.org/10.1007/s11920-014-0453-0

Cooper, P. J., Taylor, M. J., Cooper, Z., & Fairbum, C. G. (1987). The development and validation of the body shape questionnaire. *International Journal of Eating Disorders*, *6*(4), 485–494. https://doi.org/10.1002/1098-108X(198707)6:4<485::AID-EAT2260060405>3.0.CO;2-O

Crossley, K. L., Cornelissen, P. L., & Tovée, M. J. (2012). What is an attractive body? Using an interactive 3D program to create the ideal body for you and your partner. *PLoS One*, *7*(11), e50601. https://doi.org/10.1371/journal.pone.0050601

Dalbert, C. (1992). Subjektives Wohlbefinden junger Erwachsener: Theoretische und empirische Analysen der Struktur und Stabilität [young adults' subjective well-being: Theoretical and empirical analyses of its structure and stability]. *Zeitschrift Für Differentielle Und Diagnostische Psychologie*, *13*(4), 207–220.

Dannlowski, U., Kersting, A., Donges, U.-S., Lalee-Mentzel, J., Arolt, V., & Suslow, T. (2006). Masked facial affect priming is associated with therapy response in clinical depression. *European Archives of Psychiatry and Clinical Neuroscience*, *256*(4), 215–221. https://doi.org/10.1007/s00406-005-0628-0

Dannlowski, U., Ohrmann, P., Bauer, J., Kugel, H., Arolt, V., Heindel, W., & Suslow, T. (2007). Amygdala reactivity predicts automatic negative evaluations for facial emotions. *Psychiatry Research: Neuroimaging*, *154*(1), 13–20. https://doi.org/10.1016/j.pscychresns.2006.05.005

Elgendi, M., Kumar, P., Barbic, S., Howard, N., Abbott, D., & Cichocki, A. (2018). Subliminal priming-state of the art and future perspectives. *Behavioral Sciences (Basel, Switzerland)*, *8*(6), 54. https://doi.org/10.3390/bs8060054

Everitt, B. J., & Robbins, T. W. (2016). Drug addiction: Updating actions to habits to compulsions ten years on. *Annual Review of Psychology*, *67*, 23–50. https://doi.org/10.1146/annurev-psych-122414-033457

Fardouly, J., Pinkus, R. T., & Vartanian, L. R. (2017). The impact of appearance comparisons made through social media, traditional media, and in person in women's everyday lives. *Body Image*, *20*, 31–39. https://doi.org/10.1016/j.bodyim.2016.11.002

Fladung, A.-K., Grön, G., Grammer, K., Herrnberger, B., Schilly, E., Grasteit, S., … von Wietersheim, J. (2010). A neural signature of anorexia nervosa in the ventral striatal reward system. *The American Journal of Psychiatry*, *167*(2), 206–212. https://doi.org/10.1176/appi.ajp.2009.09010071

Fladung, A.-K., Schulze, U. M. E., Schöll, F., Bauer, K., & Grön, G. (2013). Role of the ventral striatum in developing anorexia nervosa. *Translational Psychiatry*, *3*, e315. https://doi.org/10.1038/tp.2013.88

Groesz, L. M., Levine, M. P., & Murnen, S. K. (2002). The effect of experimental presentation of thin media images on body satisfaction: A meta-analytic review. *International Journal of Eating Disorders*, *31*(1), 1–16. https://doi.org/10.1002/eat.10005

Hassin, R. R. (2013). Yes it can: On the functional abilities of the human unconscious. *Perspectives on Psychological Science: A Journal of the Association for Psychological Science*, *8*(2), 195–207. https://doi.org/10.1177/1745691612460684

Hilbert, A., & Tuschen-Caffier, B. (2016). *Eating Disorder Examination-Questionnaire: Deutschsprachige Übersetzung [Eating Disorder Examination-Questionnaire: German translation.]*. Münster: Verlag für Psychotherapie.

Horndasch, S., Heinrich, H., Kratz, O., Mai, S., Graap, H., & Moll, G. H. (2015). Perception and evaluation of women's bodies in adolescents and adults with anorexia nervosa. *European Archives of Psychiatry and Clinical Neuroscience*, *265*(8), 677–687. https://doi.org/10.1007/s00406-015-0603-3

Knauss, C., Paxton, S. J., & Alsaker, F. D. (2008). Body dissatisfaction in adolescent boys and girls: Objectified body consciousness, internalization of the media body ideal and perceived pressure from media. *Sex Roles*, *59*(9–10), 633–643. https://doi.org/10.1007/s11199-008-9474-7

Kwan, M. Y., Haynos, A. F., Blomquist, K. K., & Roberto, C. A. (2018). Warning labels on fashion images: Short- and longer-term effects on body dissatisfaction, eating disorder symptoms, and eating behavior. *The International Journal of Eating Disorders*, *51*(10), 1153–1161. https://doi.org/10.1002/eat.22951

Loeber, S., Burgmer, R., Wyssen, A., Leins, J., Rustemeier, M., Munsch, S., & Herpertz, S. (2016). Short-term effects of media exposure to the thin ideal in female inpatients with an eating disorder compared to female inpatients with a mood or anxiety disorder or women with no psychiatric disorder. *International Journal of Eating Disorders*, *49*(7), 708–715. https://doi.org/10.1002/eat.22524

Mudrik, L., Faivre, N., & Koch, C. (2014). Information integration without awareness. *Trends in Cognitive Sciences*, *18*(9), 488–496. https://doi.org/10.1016/j.tics.2014.04.009

Myers, T. A., & Crowther, J. H. (2009). Social comparison as a predictor of body dissatisfaction: A meta-analytic review. *Journal of Abnormal Psychology*, *118*(4), 683–698. https://doi.org/10.1037/a0016763

Paslakis, G., Kühn, S., Schaubschläger, A., Schieber, K., Röder, K., Rauh, E., & Erim, Y. (2016). Explicit and implicit approach vs. avoidance tendencies towards high vs. low calorie food cues in patients with anorexia nervosa and healthy controls. *Appetite*, *107*, 171–179. https://doi.org/10.1016/j.appet.2016.08.001

Paslakis, G., Scholz-Hehn, A. D., Sommer, L. M., & Kühn, S. (2020). Implicit bias to food and body cues in eating disorders: A systematic review. *Eating and Weight Disorders: EWD*. https://doi.org/10.1007/s40519-020-00974-9

Ruch, S., Züst, M. A., & Henke, K. (2016). Subliminal messages exert long-term effects on decision-making. *Neuroscience of Consciousness*, *2016*(1), niw013. https://doi.org/10.1093/nc/niw013

Steinglass, J. E., & Walsh, B. T. (2016). Neurobiological model of the persistence of anorexia nervosa. *Journal of Eating Disorders*, *4*, 19. https://doi.org/10.1186/s40337-016-0106-2

Suslow, T., Kugel, H., Ohrmann, P., Stuhrmann, A., Grotegerd, D., Redlich, R., … Dannlowski, U. (2013). Neural correlates of affective priming effects based on masked facial emotion: An fMRI study. *Psychiatry Research*, *211*(3), 239–245. https://doi.org/10.1016/j.pscychresns.2012.09.008

Suslow, T., Roestel, C., & Arolt, V. (2003). Affective priming in schizophrenia with and without affective negative symptoms. *European Archives of Psychiatry and Clinical Neuroscience*, *253*(6), 292–300. https://doi.org/10.1007/s00406-003-0443-4

Uniacke, B., Walsh, T. B., Foerde, K., & Steinglass, J. (2018). The role of habits in anorexia nervosa: Where we are and where to go from here? *Current Psychiatry Reports*, *20*(8), 61. https://doi.org/10.1007/s11920-018-0928-5

Vogel, V., Dittrich, M., Horndasch, S., Kratz, O., Moll, G. H., Erim, Y., … Steins-Loeber, S. (2020). Pavlovian-to-instrumental transfer in anorexia nervosa: A pilot study on conditioned learning and instrumental responding to low- and high-calorie food stimuli. *The European Journal of Neuroscience*, *51*(8), 1794–1805. https://doi.org/10.1111/ejn.14592

Voges, M. M., Giabbiconi, C.-M., Schöne, B., Braks, K., Huber, T. J., Waldorf, M., … Vocks, S. (2018). Double standards in body evaluation? How identifying with a body stimulus influences ratings in women with anorexia nervosa and bulimia nervosa. *International Journal of Eating Disorders*, *51*(11), 1223–1232. https://doi.org/10.1002/eat.22967

Waadt, S., Laessle, R. G., & Pirke, K. M. (1992). *Bulimie. Ursachen und Therapie [bulimia nervosa: Etiology and therapy.]*. Berlin: Springer. https://doi.org/10.1007/978-3-642-77517-8

Waldorf, M., Vocks, S., Düsing, R., Bauer, A., & Cordes, M. (2019). Body-oriented gaze behaviors in men with muscle dysmorphia diagnoses. *Journal of Abnormal Psychology*, *128*(2), 140–150. https://doi.org/10.1037/abn0000403

Walsh, B. T. (2013). The enigmatic persistence of anorexia nervosa. *The American Journal of Psychiatry*, *170*(5), 477–484. https://doi.org/10.1176/appi.ajp.2012.12081074

Wang, G., Djafarian, K., Egedigwe, C. A., El Hamdouchi, A., Ojiambo, R., Ramuth, H., … Speakman, J. R. (2015). The relationship of female physical attractiveness to body fatness. *PeerJ*, *3*, e1155. https://doi.org/10.7717/peerj.1155

Warren, C. S., Gleaves, D. H., Cepeda-Benito, A., Fernandez, M. d. C., & Rodriguez-Ruiz, S. (2005). Ethnicity as a protective factor against internalization of a thin ideal and body dissatisfaction. *International Journal of Eating Disorders*, *37*(3), 241–249. https://doi.org/10.1002/eat.20102

Watts, K., Cranney, J., & Gleitzman, M. (2008). Automatic evaluation of body-related images. *Body Image*, *5*(4), 352–364. https://doi.org/10.1016/j.bodyim.2008.06.001

How to cite this article: Leins J, Waldorf M, Suchan B, et al. Exposure to the thin beauty ideal: Are there subliminal priming effects? *Int J Eat Disord*. 2021;54:506–515. https://doi.org/10.1002/eat.23461