



## Voluntary emotion regulation in anorexia nervosa: A preliminary emotion-modulated startle investigation



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### ABSTRACT

Emotion regulation difficulties are implicated in the development and maintenance of anorexia nervosa (AN). However, research has been limited by an almost exclusive reliance on self-report. This study is the first to use the emotion-modulated startle paradigm (EMSP) to investigate emotional reactivity and voluntary emotion regulation in individuals with AN. Twenty women with AN viewed negative, positive, neutral, and food images and were asked to enhance, suppress, or maintain their emotional responses mid-way through picture presentation. Startle eyeblink magnitudes in response to startle probes administered prior, and subsequent, to regulation instructions indexed emotional reactivity and regulation, respectively. On emotional reactivity trials, startle magnitudes were greater for negative, positive, and food images, compared to neutral images. Participants had difficulty suppressing startle responses to negative and food images, as indicated by non-significant suppress-maintain comparisons. In contrast, startle responses to enhance and suppress cues during presentation of pleasant images were comparable and significantly lower than maintain cues. Findings converge with self-report data to suggest that patients with AN have difficulties with voluntary emotion regulation. The EMSP may be a promising trans-diagnostic method for examining emotion regulation difficulties that underlie risk for eating disorders and other psychiatric conditions.

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### 1. Introduction

Theoretical models and treatment development efforts have increasingly focused on the role of emotion regulation difficulties in the etiology and maintenance of anorexia nervosa (AN) (Haynos and Fruzzetti, 2011; Schmidt et al., 2012; Treasure and Schmidt, 2013; Wildes et al., 2014). Emotion regulation can be defined as the process of intensifying, weakening, altering, or maintaining emotions (both positive and negative) according to one's goals (Gross and Thompson, 2007). AN is associated with broad impairments in emotion regulation (Lavender et al., 2015; Oldershaw et al., 2015), and emotion dysregulation prospectively predicts the

maintenance of AN symptoms (Racine and Wildes, 2015). However, almost all studies in this area assess emotion regulation using self-report questionnaires. This is potentially problematic because data suggest that individuals with AN have problems with emotion recognition, awareness, and avoidance (Oldershaw et al., 2011, 2015; Wildes et al., 2010). Moreover, several studies have found discrepancies between self-reported emotional and physiologic reactivity to emotional events (Nandrino et al., 2012; Zonneville-Bender et al., 2005). Thus, individuals with AN may have difficulty accurately reporting on their emotion regulation skills. Employing psychophysiological methods to more objectively assess emotion regulation has the potential to significantly contribute to our understanding of emotion dysregulation in patients with AN.

The emotion-modulated startle paradigm (EMSP) is a well-validated psychophysiological method that has been used extensively to study emotional reactivity (Grillon and Baas, 2003; Lang et al., 1990) and, more recently, voluntary emotion regulation

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(Conzelmann et al., 2015; Dillon and LaBar, 2005; Jackson et al., 2000; Piper and Curtin, 2006). Typically in this paradigm, participants are presented with images that vary on valence (i.e., positive vs. negative) and arousal (i.e., low vs. high). The magnitude of the eyeblink response when participants are presented with a startle-inducing stimulus (e.g., acoustic probe) is potentiated (strengthened) in response to fearful or aversive stimuli and inhibited (weakened) in response to pleasant stimuli, relative to neutral stimuli (Lang et al., 1990). Voluntary emotion regulation can be assessed by providing participants with a regulation cue (e.g., enhance, suppress, maintain) and examining startle responses during the period of instructed emotion regulation (Jackson et al., 2000). The neural circuitry that mediates the startle response has been mapped in rodents, with the central and basolateral nuclei of the amygdala underlying startle potentiation during acute negative emotional states (Davis, 1998; Davis et al., 1997; Lang et al., 1990) and the nucleus accumbens underlying startle attenuation during positive emotional states (Koch et al., 1996, 2000). Recently, the EMSP has been proposed as a key biomarker to aid in the classification of psychiatric conditions (Vaidyanathan et al., 2012, 2009), consistent with the Research Domain Criteria (RDoC) approach (Insel et al., 2010).

To our knowledge, only two published studies have administered the EMSP to patients with AN. Friederich et al. (2006) examined motivational responses to emotional images as well as food and thin-body images in 13 patients with AN, 15 patients with bulimia nervosa (BN), and 25 control participants. Both individuals with AN and BN showed potentiated startle responses to pleasant relative to neutral images, unlike the (typical) attenuated response seen in controls. Further, patients with AN had a greater startle response to food images than patients with BN, supporting the premise that food is experienced as aversive among persons with AN (Friederich et al., 2006). More recently, both patients with AN and controls ( $N = 36$  in each group) exhibited attenuated startle to pleasant images, but differed substantially in their responses to emaciated body pictures (Reichel et al., 2014). Startle findings suggested that patients with AN found emaciated body images pleasant, whereas control participants perceived these images as aversive, despite non-significant group differences for self-reported valence and arousal. Importantly, no study has examined voluntary emotion regulation in patients with AN using the EMSP.

The aim of this preliminary study was to use the EMSP to test emotional reactivity and voluntary emotion regulation in patients with AN. Using a within-subjects design, we compared startle responses to disorder-neutral (i.e., positive, negative, neutral) and disorder-specific (i.e., food) images both before and after receiving an emotion regulation cue. We predicted that patients with AN would show: 1) enhanced emotional reactivity, as indicated by a potentiated startle response, to negative and food images (compared to neutral images), and 2) difficulty suppressing emotional responses to negative and food images, as indicated by similar startle responses when receiving suppress and maintain regulation cues. Given inconsistent findings for positive images between the two previous EMSP studies in AN (Friederich et al., 2006; Reichel et al., 2014), we did not have a priori hypotheses regarding within-subject differences for positive images.

## 2. Material and methods

This study was approved by the University of Pittsburgh Institutional Review Board and carried out in accordance with the latest version of the declaration of Helsinki. Informed consent was obtained from all participants after procedures were explained.

**Table 1**  
Demographic and clinical characteristics (N = 19).

Characteristic	M (SD)	N (%)
Age	25.11 (9.13)	
Duration of illness (years)	6.94 (6.09)	
BMI at admission	16.72 (1.63)	
BMI at time of study	17.30 (1.73)	
Anorexia nervosa subtype		
Restricting		7 (36.8)
Binge eating/purging		12 (63.1)
Level of care at time of study		
Inpatient		13 (68.4)
Partial hospitalization		2 (10.5)
Intensive outpatient		2 (10.5)
No current treatment		2 (10.5)

BMI = body mass index. Participants not currently receiving treatment had completed an intake assessment, but had not begun treatment at the time of the study ( $n = 2$ ).

### 2.1. Participants

Nineteen participants with a medical chart diagnosis of AN were recruited from a specialty eating disorders treatment facility located in the Eastern United States.<sup>1</sup> Most participants were currently receiving treatment at the facility; two participants recently completed an intake for treatment (see Table 1). Eligibility criteria were as follows: 1) *Diagnostic and Statistical Manual of Mental Disorders, 5th edition* (American Psychiatric Association, 2013) diagnosis of AN; 2) female; 3) age  $\geq 18$  years; 4) no hearing or uncorrected vision problems; 5) no current use of anticonvulsant, stimulant, or narcotic medications. Participants taking anti-anxiety medications (26.3%), antihistamines (10.5%), or other sedatives (21.0%) were required to stop these medications for at least 24 h prior to study participation, given known effects of these medications on startle response (Grillon and Baas, 2003; Treit et al., 2010). Antidepressants (52.6%) and antipsychotic medications (21.0%) were commonly prescribed to participants and were not considered exclusion criteria based on several studies examining the effects of these medications on startle response in clinical samples (Dichter et al., 2004; Wynn et al., 2007). AN diagnoses were confirmed using the *Structured Clinical Interview for DSM-IV-TR Axis I Disorders* (First et al., 2007) adjusted for DSM-5 criteria; this modified interview demonstrated excellent inter-rater reliability for eating disorder diagnoses in previous work (Conger's  $\kappa = .89-.90$ ; Forbush et al., under review). The behavioral items from the *Eating Disorder Examination 16.0* (Fairburn et al., 2008) were administered to further characterize the sample and establish AN-restricting and AN-binge-eating/purging subtypes. Demographic and clinical characteristics of the sample are presented in Table 1.

### 2.2. Images

Ninety-eight color images (28 negative; 28 positive; 28 food; 14 neutral) were selected from the International Affective Picture System (IAPS; Lang et al., 2008) based on normative ratings in females.<sup>2</sup> Given the limited number of food images in the IAPS, and

<sup>1</sup> Twenty participants were recruited for the current study, but a technical error rendered data from one participant unavailable.

<sup>2</sup> Selected IAPS pictures: Negative: 1052, 1120, 1201, 1220, 1271, 1300, 2120, 2141, 2205, 2683, 2691, 2703, 3000, 3010, 3030, 3130, 3150, 3300, 3530, 6020, 6212, 6230, 6240, 9187, 9300, 9400, 9471, 9910; Positive: 1340, 1440, 1463, 1710, 1722, 1750, 2040, 2045, 2050, 2070, 2080, 2091, 2156, 2158, 2165, 2274, 2347, 2395, 2550, 2655, 4525, 4532, 4572, 4597, 4599, 5270, 5831, 7502; Neutral: 7000, 7010, 7012, 7050, 7052, 7090, 7100, 7130, 7140, 7150, 7175, 7179, 7491, 7900; Food: 7220, 7220, 7230, 7260, 7270, 7330, 7340, 7350, 7400, 7405, 7410, 7430, 7450, 7460, 7470, 7480.

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