

# An investigation of indirect effects of personality features on anorexia nervosa severity through interoceptive dysfunction in individuals with lifetime anorexia nervosa diagnoses

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## Abstract

**Objective:** This study examined a hypothesized pathway by which interoceptive dysfunction accounted for associations between personality features (harm avoidance, self-directedness, and perfectionism) and anorexia nervosa (AN) severity (indicated by drive for thinness, eating disorder-related preoccupations and rituals, and body mass index).

**Method:** The study sample ( $n = 270$ , mean age = 28.47, 95.2% female, 98% White/Caucasian) consisted of probands and biological relatives who met DSM-IV criteria for lifetime diagnoses of AN (omitting criterion D, amenorrhea) drawn from the Price Foundation Anorexia Nervosa Affected Relative Pairs Study (AN-ARP). Participants completed measures assessing personality, interoceptive dysfunction, and eating pathology.

**Results:** Associations between personality features of low self-directedness and high perfectionism and indicators of AN severity (drive for thinness and eating disorder-related preoccupations and rituals) were significant, as were the hypothesized indirect pathways through interoceptive dysfunction. Neither harm avoidance nor body mass index was significantly related to other study variables, and the proposed indirect pathways involving these variables were not significant.

**Discussion:** Findings suggest that certain personality features may relate to AN severity, in part, through their associations with interoceptive dysfunction. Future research should examine prospective associations and the value of interventions targeting interoceptive dysfunction for interrupting the link between personality and AN severity.

## KEYWORDS

anorexia nervosa, body mass index, feeding and eating disorders, perfectionism, personality, thinness

## 1 | INTRODUCTION

High harm avoidance, low self-directedness, and high perfectionism are temperamental and personality features that characterize anorexia nervosa (AN; Cassin & Von Ranson, 2005; Fassino, Amianto, Gramaglia, Facchini, & Abbate Daga, 2004; Klump et al., 2004). Harm avoidance represents a tendency to inhibit behavior to avoid punishment (Cloninger, Svrakic, & Przybeck, 1993) and may manifest as food restriction, as weight and fat are perceived as harmful and provoke anxiety in AN (Fairburn & Harrison, 2003). Self-directedness is the degree to which the self is viewed as autonomous and integrated (Cloninger et al., 1993). Low self-directedness has been hypothesized to increase susceptibility to social pressures for thinness (Fassino et al., 2004). Perfectionism is a multidimensional construct, characterized by high personal standards accompanied by excessive concern over making mistakes (Frost, Marten, Lahart, & Rosenblate, 1990), expressed as inflexible adherence to rules about food and weight in AN (Bastiani, Rao, Weltzin, & Kaye, 1995).

Across studies, these features have individually been associated with AN severity and prognosis (Bizeul, Sadowsky, & Rigaud, 2001; Bulik, Sullivan, Fear, & Pickering, 2000). Additionally, they combine to form the fearful, constrained temperament seen in those with AN (Wonderlich, Lilienfeld, Riso, Engel, & Mitchell, 2005; Woodside et al., 2002) through which stimuli related to food, weight, and shape become associated with threat (Strober, 2004). In response, those with AN follow rigid dietary rules in pursuit of the thin ideal (perfectionism), rather than utilizing internal sensations for guidance (self-directedness), in order to prevent weight gain (harm avoidance).

These features may also lead individuals with AN to feel anxious about bodily sensations related to eating and digestion (Boswell, Anderson, & Anderson, 2015), which may contribute to disturbances in one's ability to accurately sense, perceive, and/or respond to internal bodily sensations—interoceptive dysfunction (ID; Merwin, Zucker, Lacy, & Elliott, 2010). Importantly, ID has been associated with the development, severity, and maintenance of eating pathology (Boswell et al., 2015; Merwin et al., 2010). As individuals with AN avoid aversive interoceptive sensations, ID may further contribute to AN severity by increasing dependence on cognitions and external rules to govern eating. Through this pathway, harm avoidance, self-directedness, and perfectionism may contribute to ID, thereby perpetuating AN symptomatology.

This study tested the hypothesis that ID accounts for the relationships between these personality traits and AN severity, assessed through clinically relevant components of: (a) cognitions—drive for thinness (DFT; Garner, Olmstead, & Polivy, 1983); (b) behaviors—eating disorder-related preoccupations and rituals (YBC; Jordan et al., 2009); and (c) physical severity—body mass index (BMI; American Psychiatric Association [APA], 2013).

## 2 | METHOD

### 2.1 | Participants and procedures

All participants were drawn from the Price Foundation Anorexia Nervosa Affected Relative Pairs Study (AN-ARP), an international multi-site study

**TABLE 1** Descriptive statistics and bivariate correlations for study variables

Variable	1	2	3	4	5	6	7	8	9
1. HA	1								
2. SD	-0.61***	1							
3. Perf	0.29***	-0.26***	1						
4. ID	0.33***	-0.42***	0.39***	1					
5. BMI	-0.10	0.03	-0.13*	-0.13*	1				
6. YBC	0.25***	-0.22***	0.26***	0.36***	-0.28***	1			
7. DFT	0.27***	-0.26***	0.37***	0.54***	-0.04	0.31***	1		
8. Sex	0.11	-0.07	0.08	0.12	-0.11	0.05	0.24***	1	
9. Age	-0.08	0.19**	0.08	-0.18**	0.14	-0.36***	-0.12	-0.02	1
Mean	22.12	25.61	101.81	11.06	14.43	25.05	15.12	0.95	28.47
Standard deviation	7.79	9.16	21.17	7.71	2.19	5.63	5.92	0.21	10.70
Range	0-35	4-43	37-145	0-30	6.84-18.24	2-32	0-21	0-1	14-74
Skewness	-0.46	-0.06	-0.37	0.39	-0.85	-1.25	-1.16	-4.25	1.41
Kurtosis	-0.4	-0.78	-0.44	-0.8	0.7	1.65	0.45	16.14	2.51

Note: BMI = lifetime lowest body mass index; DFT = drive for thinness; HA = harm avoidance; ID = interoceptive dysfunction; Perf = perfectionism; SD = self-directedness; YBC = lifetime worst Yale-Brown-Cornell eating disorder scale score.

\* $p < .05$ .; \*\* $p < .01$ .; \*\*\* $p < .001$ .

of the genetics of AN (Kaye et al., 2000). The original study included 196 male/female AN probands and 229 affected relatives. All participants granted informed consent or parental consent/participant assent prior to participation. Institutional ethics approval was obtained at each site. Kaye et al. (2000) provide details of procedures and sample characteristics.

The current investigation utilized data from participants meeting criteria for lifetime DSM-IV AN, with the exception of the amenorrhea criterion. Thus, all participants met DSM-5 criteria for AN (APA, 2013). This study sample ( $n = 270$ ) ranged in age from 14 to 74 years ( $M = 28.47$ ,  $SD = 10.7$ ), and mean age of AN onset was 15.68 ( $SD = 3.51$ ). Current BMI ranged from 11.12 to 26.57 ( $M = 18.72$ ,  $SD = 2.4$ ). The sample was 95.2% female and 98% White/Caucasian. Probands and affected relatives did not differ on demographic variables. Probands were significantly more likely to have AN-restricting subtype (50.6%), compared to affected relatives (37.1%;  $\chi^2(1) = 4.93$ ,  $p = .026$ ).

## 2.2 | Measures

This study was a secondary analysis of previously collected data; further information can be found in prior work (Kaye et al., 2000). All measures were selected for their relevance to AN pathology and established validity in AN samples, including: perfectionism (MPS; Frost et al., 1990), harm avoidance and self-directedness (TCl; Cloninger et al., 1993), lifetime lowest BMI, and YBC (YBC-EDS; Sunday, Halmi, & Einhorn, 1995), DFT, and ID for when AN was most severe (EDI-2; Garner, 1990).

## 2.3 | Data analytic strategy

Path analysis models, using maximum likelihood estimation with robust standard errors, were conducted to examine direct and indirect effects of harm avoidance, self-directedness, and perfectionism through ID on: (a) DFT; (b) YBC; and (c) BMI. Model fit was assessed using the chi-square statistic ( $\chi^2$ ), comparative fit

index (CFI), Tucker-Lewis index (TLI), and the root mean squared error of approximation (RMSEA). Good model fit was interpreted as a nonsignificant  $\chi^2$ ,  $CFI \geq 0.95$ ,  $TLI \geq 0.90$ , and  $RMSEA \leq 0.08$  (Hu & Bentler, 1999). Harm avoidance, self-directedness, and perfectionism were included as predictor variables, ID as a mediator variable, and DFT, YBC, and BMI as outcome variables. Participant sex and age were included as covariates. Probands and affected relatives were nested within family to control for nonindependence of observations.

Multiple group analyses were conducted to examine structural invariance among those with (a) restricting subtype versus binge/purge subtype and (2) child (<18 years) versus adult ( $\geq 18$  years) AN onset. First, models were examined separately in each group to establish the configural invariance of the model. Second, a model in which paths were allowed to vary across groups was applied. Third, paths were constrained to be equal across groups. The chi-square difference test ( $\Delta\chi^2$ ) was utilized to examine if model fit significantly differed between the constrained and freed models, which would indicate significant differences across groups. Missing data were handled using full information maximum likelihood.

## 3 | RESULTS

Descriptive statistics and bivariate correlations are presented in Table 1. Personality variables demonstrated significant associations with ID and with cognitive (DFT) and behavioral (YBC) indicators of AN severity. ID demonstrated significant associations with all indicators of AN severity, and perfectionism was associated with BMI.

Tests of indirect effects to predict lifetime worst AN severity appear in Table 2.<sup>1</sup> All model fits were acceptable to excellent ( $\chi^2 = 7.27-15.59$ ,  $df = 8$ ,  $p = .048-0.508$ ,  $CFI = 0.92-1.00$ ,  $TLI = 0.90-1.01$ ,  $RMSEA = 0.00-0.06$ ). In all models, self-directedness ( $\beta = -0.30$ ,  $SE = 0.07$ ,

<sup>1</sup>Analyses with current YBC and with current BMI yielded the same overall pattern of results.

$p < .001$ ), and perfectionism ( $\beta = 0.30$ ,  $SE = 0.06$ ,  $p < .001$ ), but not harm avoidance ( $\beta = 0.06$ ,  $SE = 0.07$ ,  $p = .349$ ) were associated with ID; ID was related to DFT ( $\beta = 0.45$ ,  $SE = 0.05$ ,  $p < .001$ ) and YBC ( $\beta = 0.14$ ,  $SE = 0.07$ ,  $p = .038$ ), but not BMI ( $\beta = -0.03$ ,  $SE = 0.07$ ,  $p = .645$ ). Direct and indirect paths are presented in Table 2. Indirect effects through ID (*ab*) from self-directedness to DFT and YBC and from perfectionism to YBC were significant and rendered direct paths (*c'*) nonsignificant. Indirect effects through ID from perfectionism (*ab*) to DFT also were significant, but direct paths (*c'*) remained significant. All indirect effects involving harm avoidance as the predictor, as well as those with lifetime lowest BMI as the outcome were nonsignificant.

Multiple group analyses were then conducted on each model. There were no differences between the freed or constrained models, indicating that all models were comparable between AN subtypes and across adult versus child AN onset ( $\Delta\chi^2_s = 6.41-14.27$ ,  $\Delta df = 11$ ,  $ps = 0.218-0.844$ ).

## 4 | DISCUSSION

Findings partially supported hypotheses: ID statistically accounted for associations between some but not all personality traits and some but not all indicators of AN severity. The mediating role of ID for links between self-directedness/perfectionism with AN cognitions/behaviors was supported. However, indirect effects with harm avoidance as the predictor, as well as those with BMI as the outcome, were nonsignificant.

**TABLE 2** Indirect effects of personality features on AN severity through interoceptive dysfunction

Outcome	Predictor	Path	$\beta$	SE	$p$
DFT	HA	<i>ab</i>	0.03	0.03	.347
		<i>c'</i>	0.08	0.07	.270
	SD	<b><i>ab</i></b>	<b>-0.14</b>	<b>0.04</b>	<b>&lt;.001</b>
		<i>c'</i>	0.03	0.06	.621
	Perf	<b><i>ab</i></b>	<b>0.13</b>	<b>0.03</b>	<b>&lt;.001</b>
		<b><i>c'</i></b>	<b>0.16</b>	<b>0.07</b>	<b>.013</b>
YBC	HA	<i>ab</i>	0.01	0.01	.350
		<i>c'</i>	0.13	0.08	.100
	SD	<b><i>ab</i></b>	<b>-0.05</b>	<b>0.02</b>	<b>.001</b>
		<i>c'</i>	0.002	0.07	.980
	Perf	<b><i>ab</i></b>	<b>0.02</b>	<b>0.01</b>	<b>.002</b>
		<i>c'</i>	0.12	0.06	.061
BMI	HA	<i>ab</i>	-0.002	0.002	.437
		<i>c'</i>	-0.10	0.08	.221
	SD	<i>ab</i>	0.007	0.005	.199
		<i>c'</i>	-0.10	0.08	.203
	Perf	<i>ab</i>	-0.003	0.002	.179
		<i>c'</i>	0.08	0.06	.153

Note: *ab* = indirect effect of predictor on outcome through interoceptive dysfunction, *c'* = direct effect of predictor on outcome after addition of interoceptive dysfunction;  $\beta$  = standardized path coefficient; BMI = lifetime lowest body mass index; DFT = drive for thinness; HA = harm avoidance; Perf = perfectionism; SD = self-directedness; SE = standard error of the estimate; YBC = lifetime worst Yale-Brown-Cornell eating disorder scale score; statistically significant paths are bolded for ease of interpretation.

Significant findings suggest that a focus on external goals and values rather than internal values and intuitions may lead to altered ability to sense and respond to internal bodily sensations. This may mean that cognitive components of the ability to interact with and listen to bodily sensations, not just fear and anxiety-related avoidance of such sensations, are important to consider in understanding the role of interoceptive abilities in AN symptoms. It will be important to repeat these analyses in a currently ill sample. Should the hypothesized relationships be replicated, it would be worth assessing the impact of interventions such as interoceptive exposure (Boswell et al., 2015) on DFT and YBC.

Results concerning BMI were contrary to hypotheses. Although significant correlations were found for perfectionism and ID for BMI, none of the variables of interest were significantly related to lifetime lowest BMI in structural models. Although BMI is widely used in distinguishing those with and without AN, the lack of expected relationships may indicate that BMI is not a sufficient indicator of severity among those with AN, consistent with recent findings (Smith et al., 2017). This reinforces the importance of considering behavioral and psychological components when determining recovery status, rather than relying solely on physical parameters, such as BMI (Bardone-Cone et al., 2010). Future research should investigate how these constructs relate to presence, severity, and chronicity of AN.

Although harm avoidance demonstrated significant correlations with ID and with AN cognitions and behaviors, it was not significantly uniquely related to ID or outcome variables in structural models. This likely reflects the impact of including self-directedness and perfectionism in models. Although harm avoidance has a well-documented association with AN (Bulik et al., 2000), it may possess low specificity to eating disorders (Fassino et al., 2004).

This study had limitations, which point to future research directions. First, it was cross-sectional, precluding temporal or causal inferences. Although research suggests personality traits predate eating disorder onset (Bizeul et al., 2001; Fassino et al., 2004; Leon, Fulkerson, Perry, & Early-Zaid, 1995), state of illness may influence scores on personality measures, and prospective studies are needed for understanding their relationship to ID in the development of AN.<sup>2</sup> Second, the study sample consisted of individuals with lifetime AN diagnoses, without data on current illness status or treatment history, reflecting the parent study's focus on genetic factors. As a consequence, we were unable to distinguish among currently ill, partially remitted, and fully recovered participants. We utilized lifetime lowest BMI and lifetime worst symptom variables in an attempt to minimize this issue, but these and other values may be biased by retrospective self-report. Third, data were collected nearly two decades ago, and findings may or may not generalize to today's presentations of AN. Last, there may have been an effect of method variance on the significant results found in the model with DFT as the outcome, as both DFT and ID were drawn from the EDI-2 (Garner, 1990). However, significant findings in the YBC model support that findings do not merely reflect method variance.

<sup>2</sup>We examined alternative models in which personality mediated associations between ID and AN severity outcomes. Model fit of all three models was very poor, violating all guidelines used in evaluating models in the reported analyses ( $\chi^2 = 108.61-116.08$ ,  $df = 9$ ,  $p < .001$ , CFI = 0.54-0.68, TLI = 0.07-0.36, RMSEA = 0.20-0.21)

Nonetheless, future work may wish to include objectively measured BMI and a multimodal assessment of interoception.

Importantly, there were several notable strengths of the current study. We utilized a large, international sample of individuals with a lifetime AN diagnosis, confirmed by clinical interview. The study also relied on measures chosen for their clinical relevance to AN and validated for use with AN samples (Kaye et al., 2000). Last, we assessed indirect effects through ID, a modifiable mechanism which can be targeted by existing treatments (Amianto, Spalatro, Ottone, Abbate Daga, & Fassino, 2017; Boswell et al., 2015).

## 5 | CONCLUSIONS

The temperamental, character, and personality features examined in this study have well-established associations with AN pathology but have been shown to persist over time and present both before illness onset and after recovery (Bastiani et al., 1995; Klump et al., 2004; Wonderlich et al., 2005). As such, these traits are not strong candidates for intervention. This creates a need to understand mechanisms by which these traits contribute to AN symptoms to identify targets for intervention. Results suggest ID may be worthy of exploration as a maintaining factor and feasible target for intervention in breaking the link between predisposing factors and AN-related outcomes.

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