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ABSTRACT

Caught in the Bulimic Trap? Persistence and State Dependence of Bulimia Among Young Women*

Eating disorders are an important and growing health concern, and bulimia nervosa (BN) accounts for the largest fraction of eating disorders. Health consequences of BN are substantial and especially serious given the increasingly compulsive nature of the disorder. However, remarkably little is known about the mechanisms underlying the persistent nature of BN. Using a unique panel data set on young women and instrumental variable techniques, we document that unobserved heterogeneity plays a role in the persistence of BN, but strikingly up to two thirds is due to true state dependence. Our results, together with support from the medical literature, provide evidence that bulimia should be considered an addiction. Our findings have important implications for public policy since they suggest that the timing of the policy is crucial: preventive educational programs should be coupled with more intense (rehabilitation) treatment at the early stages of bingeing and purging behaviors. Our results are robust to different model specifications and identifying assumptions.

JEL Classification: I12, I18

Keywords: bulimia nervosa, demographics, state dependence, instrumental variables, dynamic panel data estimation, addiction

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1 Introduction

In the United States, eating disorders are more common than Alzheimer's disease – as many as 10 million people have an eating disorder (ED) compared to 4.5 million with Alzheimer's (National Eating Disorders Association, 2008). Bulimia nervosa (BN), which disproportionately impacts women, is the most common form of an ED.[1] In the past decade 6 to 8.4% of female adolescents engaged in purging behaviors (National Youth Risk Behavior Survey, 2005). Females who engage in BN typically start when they are in their teens or early twenties, however the onset age appears to be dropping. Children are reporting bulimic behaviors at ever younger ages, where the behavior is increasingly seen in children as young as 10 (Cavanaugh and Ray, 1999).

Bulimia is characterized by recurrent episodes of "binge-eating" followed by compensatory purging.[2] There are serious health consequences from these binge and purge cycles including electrolyte imbalances that can cause irregular heartbeats, heart failure, inflammation and possible rupture of the esophagus from frequent vomiting, tooth decay, gastric rupture, muscle weakness, anemia, and malnutrition (American Psychiatric Association, 1993). The impact on adolescents and children is even more pronounced due to irreversible effects on physical development and emotional growth.[3]

Our work is motivated by the high incidence of BN and evidence that bulimics persist in their behaviors, which may have long-run effect on health outcomes and human capital accumulation. For example, only about half of the patients diagnosed with BN fully recover, many experiencing bulimic episodes for decades. However, it is not clear whether the persistence in BN is due to individual heterogeneity (i.e., some girls have persistent traits that make them more prone to bulimic behavior, but they are not influenced by past experience) or true state dependence (i.e., past BN behavior is an important determinant of current BN behavior) (Heckman, 1981). In this paper we exploit longitudinal data on individuals' history of bulimic behavior to separate state dependence from individual heterogeneity in BN persistence. We find that up to two-thirds of BN persistence is due to true state dependence, and the past four years of behavior positively and significantly impact current behavior after we control for individual heterogeneity. Also,

[1] Approximately 80% of BN patients are female (Gidwani, 1997).

[2] Binge-eating is the consumption of an unusually large amount of food (by social comparison) in a two-hour period accompanied by a loss of control over the eating process. Compensatory behavior includes self-induced vomiting, misuse of laxatives, diuretics, or other medications, fasting, or excessive exercise. BN is identified with frequent weight fluctuations.

[3] Irreversible risks include pubertal delay or arrest and impaired acquisition of peak bone mass resulting in growth retardation and increased risk of osteoporosis (Society for Adolescent Medicine, 2003).

the impact of past behavior on current behavior is four-fold higher among African American girls, and girls from low income households exhibit the highest persistence. Finally, we draw a link between true state dependence and the psychiatric and biological literatures on addiction, and we make the case for treating BN as an addiction, rather than only as a disorder.

These findings have important policy implications. Since true state dependence is the most important cause of persistence in BN, and this seems to reflect an addictive component, it is reasonable to expect that the longer an individual experiences BN the less responsive she will be to policy aimed at combatting the behavior. In this respect the timing of policy intervention is crucial: preventive educational programs aimed at instructing girls about the deleterious health effects of BN, as well as treatment interventions, will be most effective if provided in the early stages.[4] Moreover, since the role of state dependence is not the same across racial and income groups, early intervention should pay special attention to African Americans and girls from low-income families. Second, making the case for BN being an addiction would put those exhibiting BN on equal footing (from a treatment reimbursement perspective) with individuals abusing drugs or alcohol. In some states this is a current policy issue, since in several states treatment for alcoholism and drug addiction is covered but ED treatment is not covered or is covered less generously.[5] In fact, only 6% of people with bulimia receive mental health care (Hoek and van Hoeken, 2003), while a majority of states cover treatment for alcoholism and drug addiction (Center for Mental Health Services, 2008.)[6] Finally, there are potential long-run implications of ED behaviors on educational attainment given that eating disorders impact health outcomes. Recent work has shown that poor child health and nutrition reduces time in school and learning during that time. This suggests that policies aimed at improving health early in the process could also serve to improve educational attainment.[7]

In order to investigate the persistence of BN, we estimate dynamic linear, Tobit, Ordered Probit and Probit models that address the limited dependent nature of our measures of bulimic

[4] Our policy suggestions are consistent with recent findings in the psychiatric literature. For instance, Reas et al. (2000) report that the BN recovery rate is close to 80% if treatment is given with the first 5 years, but falls to 20% if treatment is delayed until after 15 years.

[5] Recently the Mental Health Parity Act of 2008 was implemented (in 2010). The act requires large employer-provided insurance policies that cover mental health or addictions must cover them at the same level as they cover other medical issues. Note that the act does not require policies to cover mental health issues per se. Also, policies that do offer mental health benefits don't have to cover every mental health issue (HR 6983: Wellstone Mental Health Parity and Addiction Equity Act of 2008). State mental health parity laws apply to privately insured plans offered through an employer. These laws vary significantly from state to state.

[6] Daly (2008) found that typical coverage by insurance companies for EDs failed to provide adequate reimbursement for the most basic treatment as recommended by the American Psychiatric Association.

[7] See the Handbook of Development Economics Chapter, "The Impact of Child Health and Nutrition on Education in Less Developed Countries," (Glewwe and Miguel, 2008) and references therein.

behavior. Patients diagnosed with BN are likely to have high levels of perfectionism, distrust, and feelings of ineffectiveness, as well as a poor body image.[8] It is important to allow for correlation between time-changing personality traits and unobserved factors that are persistent over time (that is, a fixed component in the error term), as some medical studies have found that genetic factors may play a role in BN incidence (Lilenfeld et al., 1998; Bulik et al., 2003). We examine whether a relationship between BN and the personality traits continues to hold after we control for genetic factors through a fixed effect. We also allow for the possibility that a transitory shock to bulimic behavior may affect future values of the personality traits. Our approach of allowing personality traits to impact bulimic outcomes is in the same spirit as the literature on the impact of non-cognitive skills and personality traits on economic outcomes (e.g., Borghans et al, 2008). Our estimates are robust to different estimation methods and identifying assumptions.

The outline of the paper is as follows. In section 2 we present an overview of the literature. In section 3 we describe the data and present basic statistics on BN persistence. In section 4 we present our methodology and results. In section 5 we interpret our results in light of the medical, biological, and epidemiological literatures to relate bulimic behavior to other behaviors usually considered addictive. We conclude in section 6.

2 Literature Review and Background

In the social science literature there are three papers on bingeing or purging behaviors. Hudson et al. (2007) and Reagan and Hersch (2005) focus on the prevalence of various types of ED behaviors among women and men. In a companion paper, Goeree, Ham, and Iorio (2011, hereafter GHI), we use data from the National Heart, Lung, and Blood Institute Growth and Health Study (hereafter NHLBI) to examine which adolescent females are most at risk for BN in a multivariate framework. The NHLBI Growth and Health survey was an epidemiological study conducted by Striegel-Moore et al. (2000); they examined univariate correlations between BN and race and between BN and parental education. GHI find that African-Americans are more likely to exhibit bulimic behaviors (consistent with Striegel-Moore et al., 2000) and that these effects remain after controlling for the education of the parent, family income and personality traits. However, GHI find a more subtle pattern from the interaction of income class and race: low and middle income African American girls, and low income White girls, are at substantially higher risk of bulimic behaviors than girls from other race-income groups.

[8] See the papers cited in Department of Health and Human Services (2006) and Borghans et al. (2008) for a discussion of the relevance of personality traits in predicting social and economic outcomes.

The work in this paper differs from previous studies in the economics and epidemiology literatures along many important dimensions. First, we consider dynamic aspects of BN and distinguish between persistence due to individual heterogeneity and true state dependence, where we allow for racial and income differences in persistence. Second, we examine the case for treating BN as an addiction by relating our results to those from the medical literature. Finally, (as in our companion paper) we consider nonlinear and fixed effects estimators appropriate for limited dependent variables.

The increasingly compulsive nature of ED behaviors suggests that BN may represent an addiction. The ED literature indicates that there is biological support for an addictive interpretation of BN. Specifically, the auto-addiction-opioid theory posits that ED is an addiction to the body's production of opioids (see Vandereycken 2006 for a survey). Starving, bingeing, purging, and exercise increase $\beta-$endorphin levels, resulting in the same chemical effect as that delivered by opiates. Medical research provides further support of this hypothesis. For instance, Bencherif et al. (2005) compare women with BN to healthy women of the same age and weight. They scan their brains using positron emission tomography after injection with a radioactive compound that binds to opioid receptors. The opioid receptor binding in bulimic women was lower than in healthy women in the area of the brain involved in processing taste, as well as the anticipation and reward of eating. This reaction has been found in other studies of addictive disorders, including drug addiction and gambling.[9]

The relative roles of state dependence and individual heterogeneity in explaining the persistence in BN has not been examined in the literature, even though persistence due to state dependence is important when considering the potential addictive nature of the behavior. Furthermore, given that genetic factors may contribute to BN, persistence due to individual heterogeneity is likely to be significant. In this respect, our work is related to the empirical literature on separating state dependence from unobserved heterogeneity and to the empirical literature on addiction (see, e.g., Becker, Grossman, Murphy, 1994[10] ; Baltagi and Griffin, 2001; Labeaga

[9] Patients diagnosed with BN are likely to suffer from other psychiatric conditions. In a six-year study, Fitcher and Quadflieg (1997) found that 80% of BN patients suffered from comorbid psychiatric conditions such as depression, anxiety, and substance abuse. We do not control for comorbidities when analyzing BN due to data limitations and because these conditions are likely to be endogenous.

[10] Becker, Grossman and Murphy (1994) used the framework of Becker and Murphy (1988) to examine whether addiction to cigarettes is rational, i.e., whether individuals consider that, due to the addictive nature of the behavior, their actions today will affect their future behavior and utility. For addiction to be rational, both leads and lags of the behavior should (positively) affect current behavior after controlling for unobserved heterogeneity. We have too short a panel to consider a model of rational addiction. Dockner and Feichtinger (1993) extend the model of Becker and Murphy to allow for a more general addiction process where the addictive good accumulates to two stocks of consumption capital. Their model allows for cyclical consumption patterns over time, which could be applied to bingeing and purging behavior of bulimics. Since we do not have enough

and Jones, 2003; Gilleskie and Strumpf, 2005; for a survey see Chaloupka and Warner, 2000).

There is also a small literature examining whether addiction to food may be a contributing factor to the rise in obesity. For example, Cawley (2001) is concerned with addictive elements of caloric intake; Richards et al. (2007) of food nutrients; and Rashad (2006) of caloric intake, smoking, and exercise. These papers find evidence of a forward looking addiction to calories (Cawley, 2001) and to carbohydrates (Richards et al., 2007). The large and growing literature on obesity is related to our work in the broad sense that it pertains to food consumption, but is otherwise unrelated given that women suffering from BN are characterized by average body weight (Department of Health and Human Services, 2006). Our work is also related to the growing literature of using economic identification strategies and appropriate econometric methods to investigate public health issues, (see, e.g., Adams, et al., 2003; Engers and Stern, 2002; Heckman, et al., 2007; Hinton, et al., 2010; and Smith, 2007).

3 Data

We use data from the National Heart, Lung, and Blood Institute Growth and Health Study, which is a survey of 2379 girls from schools in Richmond, California and Cincinnati, Ohio, and from families enrolled in a health maintenance organization in the Washington, DC area.[11] The survey was conducted annually for ten years and contains substantial demographic and socioeconomic information such as age, race, parental education, and initial family income (in categories) as well as questions on BN behavior. The latter were first asked in 1990 when the girls were aged 11-12 (which was wave 3) and subsequently asked in waves 5, 7, 9, and 10. We present descriptive statistics in Table 1. We include clustered standard errors of the mean to account for the fact that for all demographic variables (except age) we have one observation per person, while for the other variables we have multiple observations per person. The survey is an exogenously stratified sample, designed to be approximately equally distributed across race, income, and parent's education level as the descriptive statistics in Table 1 confirm.

The questions regarding bulimic behaviors were developed to be easy to understand by young respondents and to be consistent with diagnostic criteria for BN.[12] In particular, for each re-

power to test Becker and Murphy (1988), it does not seem sensible to try to test their generalization.

[11] The data do not report the location of the participant due to confidentiality concerns. Schools were selected to participate in the study based on census tract data with approximately equal fractions of African American and White children where there was the least disparity in income and education between the two ethnic groups. The majority of the cohort was randomly drawn from families with nine (or ten) year-old girls that participated in the Health Maintenance Organization (HMO). A small percentage was recruited from a Girl Scout troop located in the same geographical area as the HMO population.

[12] Clinical criteria for BN, according to the Diagnostic and Statistical Manual of Mental Disorders fourth

Table 1: Descriptive Statistics

	Mean	Standard Deviation	Clustered Standard Error of Mean	Number of Waves
Age	14.363	2.991	0.014	All 10
White	0.480	0.499	0.010	1
Parents High School or Less	0.255	0.436	0.009	1
Parents Some College	0.393	0.488	0.010	1
Parents Bachelor Degree or More	0.352	0.477	0.010	1
Income less than $20,000	0.318	0.466	0.010	1
Income in [$20000, $40000]	0.315	0.465	0.010	1
Income more than $40,000	0.367	0.482	0.010	1
ED-BN Index	1.279	2.682	0.039	3,5,7,9,10
Clinical Bulimia	0.022	0.145	0.002	3,5,7,9,10
Body Dissatisfaction Index*	8.039	7.554	0.131	3,5,7,9,10
Distrust Index**	3.589	3.492	0.056	3,5,9,10
Ineffectiveness Index***	2.752	3.915	0.063	3,5,9,10
Perfectionism Index****	6.468	3.290	0.052	3,5,9,10

Notes: Income is in 1988$; * ranges from 0 to 27 (maximal dissatisfaction); ** ranges from 0 to 21 (maximal distrust); *** ranges from 0 to 29 (maximal ineffectiveness); **** ranges from 0 to 18 (maximal perfectionism). See Appendix for more detailed description of the variables.

spondent the data contain an Eating Disorders Inventory index developed by a panel of medical experts, which was designed to assess the psychological traits relevant to bulimia (Garner et al., 1983). Thus a major advantage of these data is that all sample participants are evaluated regarding BN behaviors, and a BN eating disorder index is developed for each participant independent of any diagnoses or treatment they have received. The survey reports an Eating Disorders Inventory Bulimia subscale for each respondent (hereafter the ED-BN index), which measures degrees of her behavior associated with BN. The ED-BN index is constructed based on the subjects responses ("always"=1, "usually"=2, "often"=3, "sometimes"=4, "rarely"=5, and "never"=6) to seven items: 1) I eat when I am upset; 2) I stuff myself with food; 3) I have

edition (American Psychiatric Assocation, 2000a), require the cycle of binge-eating and compensatory behaviors occur at least two times a week for three months or more and that the individual feel a lack of control during the eating episodes. Due to data restrictions, we cannot examine the prevalence of anorexia nervosa.

gone on eating binges where I felt that I could not stop; 4) I think about bingeing (overeating); 5) I eat moderately in front of others and stuff myself when they are gone; 6) I have the thought of trying to vomit in order to lose weight, and 7) I eat or drink in secrecy. A response of 4-6 on a given question contributes zero points to the ED-BN index; a response of 3 contributes 1 point; a response of 2 contributes 2 points; and a response of 1 contributes 3 points. The ED-BN index is the sum of the contributing points and ranges from 0 to 21 in our data. For instance, if a respondent answers "sometimes" to all questions, her ED-BN index will be zero.[13] As Table 1 indicates, the mean ED-BN index is 1.2.

A higher ED-BN score is indicative of more BN related problems that are characterized by uncontrollable eating episodes followed by the desire to purge. According to the team of medical experts that developed the index (Garner et al., 1983), a score higher than 10 indicates that the girl is very likely to have a clinical case of BN. The quantitative interpretation in terms of who is perceived to be suffering from clinical BN is motivated by results from surveys among women diagnosed with BN (by the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) criteria): the average ED-BN index among this subsample was 10.8.[14] For this reason, we will refer to a value of the ED-BN index of greater than 10 as clinical bulimia for the remainder of the paper. The ED-BN index is widely used in epidemiological and ED studies (Rush et al., 2008). As is shown in Table 1, approximately 2.2% of the girls (who are 14 years old on average) have a case of clinical BN, which is close to the national average reported from other sources.[15] However, in estimating some, but not all, of our models we will exploit the fact that we know the numerical value of the index rather than simply whether it is greater than 10; this tends to result in an efficiency gain but does not change the basic nature of our results.

The NHLBI Growth and Health survey also contains questions used to construct four other indices based on psychological criteria. These indices were developed by a panel of medical experts (see Garner et al., 1983 for a discussion of the association of these personality traits with EDs). The four additional indices measure a respondent's potential for personality traits/disorders, and below we refer to these indices collectively as the "personality indices." The first index is a measure of each girl's dissatisfaction with her body. This index is reported every year and is a sum of respondents answers to nine items intended to assess satisfaction with size and shape of specific parts of the body. Hereafter we refer to it as the body dissatisfaction index. We also use three additional indices that are based on psychological criteria, measuring

[13] Note that the answers to the individual questions are not available in the data.

[14] See Garner et al. (1983) for more details of the development and validation of the ED-BN index.

[15] See for instance, Hudson et al. (2007) and National Eating Disorders Association (2008).

tendencies toward: perfectionism (hereafter the perfectionism index), feelings of ineffectiveness (hereafter the ineffectiveness index), and interpersonal distrust (hereafter the distrust index). These indices are available in waves 3, 5, 9, and 10 and thus overlap with the ED-BN index availability, with the exception that the ED-BN index is also available in wave 7. For ease of exposition, we provide details on the questions used to form the personality indices in Appendix A. In all cases a higher score indicates a higher level of the personality trait.

Table 2: Mean of ED-BN Index and Incidence of Clinical Bulimia by Characteristics

Variable	ED-BN Index			Clinical Bulimia (BN)		
	Mean	Standard Deviation	Clustered Std. Error	Mean	Standard Deviation	Clustered Std. Error
Years:						
1989	1.814	3.287	0.070	0.038	0.191	0.004
1991	1.610	3.021	0.067	0.033	0.178	0.004
1993	1.098	2.342	0.054	0.014	0.117	0.003
1995	0.860	2.054	0.046	0.008	0.092	0.002
1996	0.955	2.279	0.050	0.013	0.113	0.002
White	1.042	2.437	0.051	0.017	0.130	0.002
African American	1.498	2.873	0.058	0.026	0.158	0.003
Parents High School or Less	1.648	3.136	0.096	0.033	0.178	0.005
Parents Some College	1.325	2.682	0.060	0.020	0.141	0.003
Parents Bachelor Degree or More	0.973	2.278	0.055	0.015	0.122	0.002
Household Income (in 1988$):						
Income less than $20,000	1.721	3.146	0.086	0.033	0.179	0.004
Income in [$20000, $40000]	1.198	2.633	0.072	0.021	0.144	0.003
Income more than $40,000	0.982	2.245	0.053	0.013	0.112	0.002

Correlations of ED-BN Index and Clinical Bulimia with Personality Characteristics

Personality Characteristic Index	ED-BN Index	Clinical Bulimia (BN)
Body Dissatisfaction Index	0.221	0.114
Distrust Index	0.213	0.107
Ineffectiveness Index	0.439	0.274
Perfectionism Index	0.229	0.145

Notes: The top panel reports clustered (by individual) standard errors of the mean. All correlations in the bottom panel are significant at the 1% level.

Table 2 shows the univariate relationship between the demographic variables, the ED-BN index (columns 1-3), and BN incidence (columns 4-6). Again, in each case we cluster the standard errors (by individual) for the means. The results indicate that as the girls age, both the ED-BN index and BN incidence fall. A notable point, that we examine in detail in our companion paper (Goeree, Ham, Iorio, 2011), is that African American girls have a statistically significant higher ED-BN index and incidence of clinical BN than White girls. Furthermore, both the ED-BN index and the incidence of clinical BN decrease as parental education and family income increase, and again these differences are statistically significant at standard confidence levels. These results suggest that BN is more problematic among African American girls, girls

from low income families, and girls from families with low parental education. As we discuss in Goeree, Ham, and Iorio (2011), these findings are not due to an incorrect interpretation of what the ED-BN index measures, i.e., the possibility that it might capture obesity (binge eating) instead of BN behaviors. Neither do these findings disappear once we condition on the other demographic variables or personality indices. The bottom panel of Table 2 shows that both the ED-BN Index and BN incidence are correlated with the indices measuring personality traits.

Table 3: ED-BN Index Transition Probabilities by SES

	ED-BN Index Range at t+1			
ED-BN Index Range at t	0	[1,5]	[6,10]	>10 (Clinical BN)
0	80.16	17.90	1.50	0.43
[1,5]	51.92	39.80	6.47	1.82
[6,10]	31.38	42.86	17.80	7.96
>10 (Clinical BN)	21.93	37.97	20.32	19.79
Race:				
African American	78.53	19.29	1.74	0.44
	52.69	38.77	6.58	1.96
	32.48	42.34	17.15	8.03
	22.03	38.14	22.03	17.80
Race:				
White	82.01	16.31	1.26	0.42
	50.28	41.64	6.40	1.68
	30.20	42.28	19.46	8.05
	20.90	38.81	16.42	23.88
Income:				
Less than $20,000	76.58	20.67	2.29	0.46
	52.06	38.41	6.69	2.84
	29.07	44.19	18.60	8.14
	18.60	33.72	24.42	23.26
Income:				
More than $40,000	81.97	16.86	0.87	0.31
	51.44	41.27	5.92	1.37
	34.71	35.54	21.49	8.26
	29.73	45.95	13.51	10.81
Parents Education:				
High School or Less	78.15	18.94	2.47	0.44
	53.95	37.03	6.77	2.26
	29.93	45.26	14.60	10.22
	20.83	36.11	20.83	22.22
Parents Education:				
Bachelor Degress or More	81.50	16.98	1.01	0.51
	50.99	41.73	5.92	1.37
	32.71	35.51	23.36	8.41
	21.43	40.48	14.29	23.81
Marginal Probability				
of ED-BN Index at t+1	68.57	25.59	4.17	1.67

Table 3 presents summary statistics on the persistence in the ED-BN index and the incidence

of clinical BN overall and across socioeconomic groups. We consider four categories: equal to 0, in the range $[1-5]$, in the range $[6-10]$, and greater than 10. Table 3 provides the transition rates across two year intervals for these categories. Note first that the higher is the ED-BN category the lower is the probability of having an index value of 0 two years later (i.e., at time $t+1$) across all demographic groups. Second, the higher the ED index in t, the more likely is the girl to be in the greater than 10 category at $t+1$, i.e., the more likely she is to have clinical bulimia. For instance, the conditional probability of having clinical BN in $t+1$ given that a girl has it in t is 20%, while the same probability for someone with a ED-BN index in the range $[1-5]$ in t is 2% and it is less than 0.05% for someone with an index equal to zero in t.[16] Across demographic groups, the conditional probability of having clinical BN in $t+1$ conditional on a girl that has it in t is 24% for girls from low-income families, while it is only 11% for girls from high-income families. If we simply look at the correlation between the index in t and the index in $t+1$, we estimate it to be 0.48, and, not surprisingly, this estimate is very statistically significant. We draw two conclusions from these results. First, there is substantial persistence in the ED-BN index and the incidence of clinical BN and this persistence differs among demographic groups. Second, the first set of transition rates indicates that knowing the value of the ED-BN index is important for predicting the incidence of clinical BN in $t+1$, so simply aggregating the ED-BN index into an incidence of clinical BN would discard valuable information. Indeed our results presented below show that coefficients are of the same sign when we analyze the ED-BN index and the incidence of clinical BN, but the former are much more precisely estimated.

4 BN Persistence: State Dependence or Individual Heterogeneity?

Our goal is to study the degree of persistence in bulimic behavior, and to decompose this persistence into that due to state dependence (i.e., BN behavior in the past has a causal effect on BN behavior this period) and that due to observed and unobserved heterogeneity (i.e., some girls have persistent traits that make them more prone to bulimic behavior). We then discuss racial and income differences in persistence.

4.1 Empirical Models

We consider four model specifications: i) a linear regression structure that treats a zero value of the ED-BN index as lying on the regression line; ii) a Tobit structure for the ED-BN index; iii)

[16] The same general pattern comes through when we consider a more narrow breakdown of the ED-BN index.

a linear probability model (LPM) for the incidence of clinical BN (i.e., a value for the ED-BN index greater than 10) and iv) a Probit model. We begin with the most basic model

$$y_{it} = \alpha_0 + \alpha_1 y_{it-1} + \widetilde{\delta}_i + v_{it}, \tag{1}$$

where y_{it-1} is the lag of the observed value of the ED-BN index and we drop the year dummies for ease of exposition.[17] The least squares estimate of α_1 will reflect both observed and unobserved heterogeneity as well as true state dependence. To account for observed heterogeneity we include current explanatory variables X_{it} to obtain

$$y_{it} = \gamma_0 + \gamma_1 y_{it-1} + \gamma_2 X_{it} + \delta_i + v_{it}. \tag{2}$$

The parameter γ_1 will reflect both unobserved heterogeneity and true state dependence, and we are particularly interested in the role of the latter in the persistence in equation (2). To address this issue we take three approaches. First, we assume that δ_i and v_{is} are independent of X_{it} for all t, s. It may be the case that δ_i and y_{it-1} are correlated, which we address by using X_{it-1} as excluded instrumental variables (IV) when estimating equation (2).[18] Given these assumptions we will obtain an estimate of γ_1 that reflects only state dependence.[19]

However, we noted above the possibility of genetic factors driving both BN and the personality traits, which would violate the assumption that δ_i is independent of X_{it} for any t. To account for these potential problems, we follow Anderson and Hsiao (1981) and Arellano and Bond (1991; hereafter AB), where we first difference equation (2) to obtain

$$\Delta y_{it} = \beta_0 + \beta_1 \Delta y_{it-1} + \beta_2 \Delta X_{it} + \Delta v_{it}. \tag{3}$$

In the second approach, we assume that v_{is} is independent of X_{it} for any t, s conditional on δ_i, i.e., X_{it} is strictly exogenous (Wooldridge, 2002, p. 253). Under this assumption we can

[17] If we add time dummies the only real change is that age becomes very insignificant.

[18] We could use additional lags of the explanatory variables as IVs in all periods but this would reduce our sample size considerably. Alternatively we could follow Arellano and Bond (1991) and use extra lags of X_{it} *only* in later periods since we do not lose any data doing this. The trade off is small sample bias (arising from potentially using too many IVs) versus greater effiiciency from more IV. We generally obtain significant results so we choose to err on the side of avoiding the small sample bias.

[19] As in any empirical study, it is possible some of the X_{it} are measured with error. If this occurs in one of the personality indices then the IV estimator of γ_1 will be biased through the correlation of the predicted y_{it-1} and the mismeasured variable. The bias will not be made any worse if the lagged value of the personality index is measured with error as long as the measurement error is uncorrelated over time; for example if each period's score for one of the personality indexes equals the true score plus an independent shock. Of course, there will be further bias if the measurement error in the personality index is correlated over time, since the the predicted y_{it-1} will be directly correlated with the error term in (2).

treat ΔX_{it} as exogenous in equation (3), and since we also assume that v_{it} is independent over time, we use y_{it-2} and ΔX_{it} as our excluded IV. (Below we test the null hypothesis that v_{it} is independent over time and cannot reject it.) However, there may be feedback effects from v_{it} to future values of X_{it}. In this case strict exogeneity would no longer hold. To address this potential issue, in our third approach we only assume sequential exogeneity i.e., that v_{is} is independent of X_{it} only for $s \leq t$ conditional on δ_i (Wooldridge, 2002, p. 299). Under the sequential exogeneity assumption we estimate the parameters of equation (3) by 2SLS while also treating ΔX_{it} as endogenous; we use y_{it-2} and X_{it-1} as our excluded IV. (Again we cannot reject the null hypothesis that v_{it} is independent over time). Taken together, the results of these three approaches should provide considerable evidence on the robustness of our estimates to different identifying assumptions.[20]

For the Tobit model, we start by considering the simplest latent variable equation

$$y_{it}^{*} = \lambda_0 + \lambda_1 y_{it-1} + \widetilde{\mu}_i + e_{it}, \tag{4}$$

where $\widetilde{\mu}_i$ are (unobserved) individual-specific random effects and e_{it} is an uncorrelated (over time) error term, both of which are normally distributed. The estimate of λ_1 will capture observed and unobserved heterogeneity and true state dependence. To account for observed heterogeneity we add explanatory variables X_{it} to obtain

$$y_{it}^{*} = \theta_0 + \theta_1 y_{it-1} + \theta_2 X_{it} + \mu_i + e_{it}, \tag{5}$$

where the estimate of θ_1 will reflect unobserved heterogeneity and true state dependence. To capture only the latter, we follow Wooldridge (2005) and assume that

$$\mu_{i} = \varphi_3 \overline{X}_i + \varphi_4 y_{i0} + c_i, \tag{6}$$

where $\overline{X_i}$ denotes the mean value of the explanatory variables, y_{i0} the initial condition, and c_i an individual specific error term. We now have

$$y_{it}^{*} = \varphi_0 + \varphi_1 y_{it-1} + \varphi_2 X_{it} + \varphi_3 \overline{X}_i + \varphi_4 y_{i0} + c_i + e_{it}. \tag{7}$$

We estimate the model by following Wooldridge (2005) in assuming strict exogeneity for the X_{it} (with respect to e_{it}) and then using MLE; in this case the estimate of φ_1 reflects only true

[20] To allow for genetic factors to play different roles at different ages we estimated a model with both a fixed effect and a fixed effect interacted with a trend. In a linear model this leads to the Heckman-Hotz (1989) random growth model, which can be estimated by double-differencing and using IV procedures. However, given our limited number of observations, this model was too rich for our data; we obtained a coefficient roughly the size of our other IV estimates, but its standard error was so large that was not statistically significant.

state dependence. Restricting the initial condition to depend on the initial observation of the ED-BN index is less of a problem in our sample because we have data on the respondents when they are young, and hence it seems reasonable to assume that y_{i0} captures initial conditions.

As a robustness check we also estimate a dynamic Probit model (using the Wooldridge procedure) and a dynamic LPM for the incidence of the ED-BN index being greater than 10. For the LPM, we proceed in a manner analogous to the linear regression model, and for the Probit we proceed in a manner analogous to the Tobit. See Appendix B for the details.

4.2 Results for the Linear Model

Table 4 contains our parameter estimates for the linear model. In column (1) we consider a model where the only explanatory variable is the (assumed to be exogenous) lagged dependent variable; its coefficient is estimated at 0.44 and, not surprisingly, it is very statistically significant. Regarding the effect of past ED-BN experience on current behavior, the coefficient can be interpreted as an elasticity since we would expect the mean of a variable and its lag to be equal. We obtain a relatively large estimate of the elasticity of 0.44. To look at the magnitude of the coefficient in another way, an individual with a lagged ED-BN index of 5 would have a current ED-BN index over two points higher than someone with a lagged index of 0; this difference is almost 150% of the mean value of the ED-BN index. After we add the demographic variables and the personality indices in column (2) the lag coefficient drops to 0.35 and is insensitive to including body dissatisfaction in column (3). This demonstrates substantial persistence in BN behavior that can be due to both unobserved heterogeneity and true state dependence. To focus on the latter, in columns (4) to (7) we treat the lagged dependent variable as endogenous, and we estimate the levels equation by 2SLS treating X_{it} as exogenous and using X_{it-1} as the excluded IV in the level equation. As noted above, this will produce consistent results if X_{it} are uncorrelated with δ_i and v_{is} (for any s, t). Column (4) reports a lagged coefficient of a little less than 0.19, suggesting that over half the variation in persistence attributed to unobserved heterogeneity and state dependence is actually due to the latter.[21] This essentially suggests an elasticity of 0.2 for the effect of lagged BN on current behavior. To put this another way, the expected ED-BN index for someone who has a lagged value of the ED-BN index equal to 5 compared to someone who has a lagged value of 0 would be higher by 1, approximately 80% of the mean value of 1.2. This result does not change when we include body dissatisfaction in column (5).

[21] Some girls in our sample may receive treatment once they begin bulimic behavior, although we cannot identify who they are. If this treatment is even partially effective, it will reduce the degree of true state dependence, so our estimates are lower bounds on the degree of true state dependence in untreated BN.

Table 4: Linear Regression Estimates of the Persistence of ED-BN Index

Variables				Two Stage Least Squares				Arellano-Bond			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Lagged ED-BN Index	0.444***	0.355***	0.349***	0.190***	0.188***	0.149***	0.131***	0.192***	0.189***	0.177***	0.172***
	(0.028)	(0.027)	(0.027)	(0.062)	(0.059)	(0.048)	(0.046)	(0.038)	(0.038)	(0.042)	(0.041)
White		-0.038	-0.081	-0.105	-0.174	-0.134*	-0.201***				
		(0.085)	(0.084)	(0.123)	(0.121)	(0.084)	(0.084)				
Age		-0.051***	-0.063***	-0.021	-0.032	-0.065***	-0.080***	-0.092***	-0.114***	-0.068***	-0.084***
		(0.016)	(0.016)	(0.022)	(0.022)	(0.018)	(0.018)	(0.117)	(0.118)	(0.015)	(0.017)
Parents Some College		0.073	0.073	0.017	-0.006	-0.066	-0.089				
		(0.101)	(0.101)	(0.154)	(0.153)	(0.097)	(0.100)				
Parents Bachelor Degree or more		0.122	0.131	-0.009	-0.011	-0.035	-0.040				
		(0.110)	(0.110)	(0.167)	(0.167)	(0.105)	(0.108)				
Income in [$20000, $40000]		-0.236**	-0.238**	-0.524***	-0.539***	-0.240***	-0.248***				
		(0.102)	(0.102)	(0.154)	(0.154)	(0.097)	(0.100)				
Income more than $40,000		-0.207**	-0.221**	-0.463***	-0.486***	-0.288***	-0.296***				
		(0.104)	(0.103)	(0.159)	(0.159)	(0.094)	(0.096)				
Distrust Index		-0.019	-0.018	-0.040**	-0.041**	-0.002	-0.002	-0.002	-0.006	-0.018	-0.016
		(0.014)	(0.014)	(0.019)	(0.019)	(0.015)	(0.015)	(0.019)	(0.019)	(0.039)	(0.039)
Ineffectiveness Index		0.205***	0.188***	0.258***	0.229***	0.230***	0.206***	0.178***	0.158***	0.169***	0.149***
		(0.020)	(0.020)	(0.029)	(0.028)	(0.022)	(0.021)	(0.026)	(0.027)	(0.034)	(0.032)
Perfectionism Index		0.097***	0.095***	0.129***	0.125***	0.096***	0.093***	0.123***	0.120***	0.120***	0.121***
		(0.013)	(0.013)	(0.019)	(0.019)	(0.013)	(0.013)	(0.020)	(0.020)	(0.029)	(0.028)
Body Dissatisfaction Index			0.027***		0.040***		0.036***		0.050***		0.041**
			(0.005)		(0.008)		(0.005)		(0.011)		(0.019)
Constant	0.597***	0.592*	0.657**	0.515	0.538	1.138***	1.233***	1.154***	1.190***	0.828**	0.794**
	(0.037)	(0.304)	(0.303)	(0.379)	(0.375)	(0.330)	(0.333)	(0.315)	(0.316)	(0.353)	(0.350)
Interpolated Indices	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Autocorrelation Test								0.495	0.570	0.495	0.570
								(0.620)	(0.568)	(0.620)	(0.568)
First Difference	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes
Sample Size	4151	3938	3928	2285	2273	5426	5384	3612	3586	3612	3586

Notes: Standard errors robust to heteroskedasticity and intra-group correlation are reported in parenthesis. * indicates significant at 10%; ** significant at 5%; *** significant at 1%. Instruments are one-period lags of: all personality indices in columns (5) and (7); all indices including body dissatisfaction in columns (4) and (6). In columns (8) and (9), in the difference equation, instruments are two-period lags of the ED-BN index and the first difference of personality indices. In columns (10) and (11) instruments are two period lags of the ED-BN index and the available lags of the personality characteristics. Regarding the autocovariance test in the AB specifications, we reject the null hypothesis of no autocorrelation in the idiosyncratic error term in all specifications. Columns (6)-(11) use interpolated values of personality indices in wave 7.

Our sample size is limited by the fact that the personality indices are not available in wave 7, and this limitation is especially important in our AB analysis.[22] However, we can increase our sample size if we assume that the personality index values vary smoothly from wave 5 to 9, and use interpolated values wave 7, which doubles our sample size. The 2SLS estimates of our basic model using the imputed data (with and without body dissatisfaction) are in columns (6) and (7). Comparing the results in columns (6) and (7) to those in columns (4) and (5) respectively, indicates that using the imputed data diminishes the role of true state dependence

[22] Specifically, in the AB analysis we lose the independent variables ΔX_{it} when the dependent variable is $y_{i9} - y_{i7}$ and when the dependent variable is $y_{i10} - y_{i9}$.

by about one fifth, but that the coefficient on the lagged value is still highly significant.[23]

Table 5: First Stage Estimates for Table 4

	Estimates Corresponding to Columns (4)-(7) of Table 4			
	(1)	(2)	(3)	(4)
Instruments for Lagged ED-BN Index				
Lagged Perfectionism Index	0.154 ***	0.154 ***	0.165 ***	0.165 ***
	(0.019)	(0.019)	(0.014)	(0.014)
Lagged Ineffectiveness Index	0.262 ***	0.228 ***	0.250 ***	0.220 ***
	(0.018)	(0.019)	(0.013)	(0.014)
Lagged Distrust Index	0.017	0.013	-0.002	-0.006
	(0.020)	(0.020)	(0.015)	(0.015)
Lagged Dissatisfaction Index		0.060 ***		0.053 ***
		(0.011)		(0.007)
Other Regressors				
White	-0.221 *	-0.194	-0.249 ***	-0.282 ***
	(0.130)	(0.130)	(0.080)	(0.080)
Age	-0.060 **	-0.083 ***	-0.078 ***	-0.106 ***
	(0.027)	(0.027)	(0.018)	(0.019)
Parents Some College	-0.181	-0.212	-0.171 *	-0.198 **
	(0.155)	(0.155)	(0.095)	(0.095)
Parents Bachelor Degree	-0.407 **	-0.428 **	-0.266 **	-0.276 ***
or More	(0.175)	(0.174)	(0.107)	(0.107)
Income in [$20000, $40000]	0.026	-0.021	-0.227 **	-0.231 **
	(0.159)	(0.158)	(0.096)	(0.095)
Income more than $40,000	0.013	-0.041	-0.248 **	-0.263 ***
	(0.171)	(0.170)	(0.103)	(0.102)
Distrust Index	0.040 **	0.051 ***	0.023	0.031 **
	(0.019)	(0.019)	(0.015)	(0.015)
Ineffectiveness Index	0.053 ***	0.051 ***	0.032 **	0.028 **
	(0.017)	(0.018)	(0.013)	(0.014)
Perfectionism Index	0.005	0.005	-0.019	-0.020
	(0.018)	(0.018)	(0.014)	(0.014)
Body Dissatisfaction Index		-0.020 *		-0.012 *
		(0.010)		(0.006)
Constant	0.619	0.829 *	1.350 ***	1.640 ***
	(0.453)	(0.452)	(0.327)	(0.328)
Weak IV Test Statistic*	143	165	222	265
Overidentification Test	1.796	2.005	2.736	3.096
Interpolated Values	No	No	Yes	Yes
Sample Size	2285	2273	5426	5384

Notes: Standard errors robust to heteroskedasticity and intra-group correlation are reported in parenthesis. * indicates significant at 10%; ** significant at 5%; *** significant at 1%. Regarding the weak IV test, Hansen, Hausman, and Newey (2008) suggest that, in the presence of heteroskedasticity in the first stage equation, the test statistic should be greater than 32. Regarding the overidentifying test, under the null hypothesis that the overidentifying restrictions are satisfied the test statistic should be distributed Chi-Squared (2) (Chi-Squared (3)) in columns (1) and (3) (columns (2) and (4)).

As is standard practice, we consider two diagnostics for our 2SLS estimates in columns (4) to (7). Table 5 presents the reduced form estimates to investigate the issue of weak instruments. There will be heteroskedasticity in the first-stage regression equation for a censored dependent

[23] We also investigate if the results are robust when we control for depression. We have self-reported information on depression in two waves. Using this subsample we estimate the model with and without depression. The coefficient of the lagged ED-BN index is virtually the same and statistically significant in both cases.

variable, therefore the widely used rule of thumb for the first-stage F-statistic of excluded instruments (from Staiger and Stock (1997) and Stock and Yogo (2005)) will be inappropriate. Instead we use the conjecture by Hansen, Hausman, and Newey (2008) that in the presence of heteroskedasticity in the first-stage equation, the Wald statistic for the null hypothesis that the excluded instruments are zero in the first stage, minus the number of instruments, should be greater than 32. Note first that we pass the weak IV test in all specifications, and that the perfectionism, ineffectiveness and body dissatisfaction (when used) indices are always individually significant, suggesting that they are not simply driven by a single (genetic) factor.[24] Further, when we consider the instruments on an individual basis, we pass the weak IV test for the perfectionism, ineffectiveness, and body dissatisfaction indices.[25]

Our second diagnostic pertains to the overidentification restrictions. We present a Wald statistic to test the overidentification restrictions that the instruments are valid, which is suitable with heteroskedasticity and clustering; here the critical value is $\chi^2(l)$, where l is the degree of overidentification. Intuitively the test can be thought of as assuming that one of the instruments is valid, and then examining whether the other instruments have zero coefficients in the structural equation. Also, we specifically test the validity of body dissatisfaction as an instrument, conditional on the other personality indices being valid, by entering its lagged value as an explanatory variable in column (5) and testing whether its coefficient is significantly different from zero. We can not reject the null hypothesis that the overidentifying restriction with respect to restricting lagged body dissatisfaction is valid. Thus, overall the diagnostics show that our instruments are not weak and the overidentifying restrictions, including that for body dissatisfaction in column (5), are not rejected.

The 2SLS estimates in columns (4) to (7) of Table 4 are consistent if we assume that v_{is} and δ_i are independent of X_{it} for all s, t. As noted above, to relax this assumption we also present the results using the AB approach of differencing before using 2SLS to allow for the personality indices to be correlated with δ_i. We first assume that the personality traits are strictly exogenous with respect to v_{it} in equation (2) (i.e., that the personality traits are uncorrelated with v_{is} at all s, t) In this case we treat ΔX_{it} as exogenous and use y_{it-2} and ΔX_{it} as excluded IV under the assumption that the v_{it} are independent over time. The results are in columns (8) and (9) of Table 4 when we exclude and include body dissatisfaction, respectively. The results in column (8) show a highly significant lag coefficient of around 0.19 and the coefficient estimates remain

[24] We also consider only the perfectionism and ineffectiveness indices as IV in column (5) of Table 4. We obtain an estimate for the lagged coefficient of the ED-BN index of 0.163, suggesting that the results are robust to the exclusion of the distrust index (which is the only IV that is not significant in the first stage results).

[25] We present the additional first-stage estimates in Table B1 in Appendix B.

the same when we include body dissatisfaction as an explanatory variable in column (9).[26] The test of the null hypothesis of no serial correlation is essentially a test of the overidentifying restriction on the lagged dependent variable (after allowing for heteroskedasticity). From the bottom of columns (8) and (9) we see that we cannot reject the null hypothesis, indicating that values of the ED-BN index lagged two periods (or more) are valid instruments in the equations in first differences, and our AB estimates are consistent.

Next we relax the strict exogeneity restriction by assuming that the personality traits are sequentially exogenous in the sense that we only assume $E(X_{it}v_{is}) = 0$ for $t \leq s$ to allow for feedback from current v_{is} to future X_{it}. Note that this implies we must treat ΔX_{it} as endogenous in equation (3), and we use y_{it-2} and X_{it-1} as excluded IV in the first-differenced equation. The AB results for this case are in columns (10) and (11) when we exclude and include body dissatisfaction, respectively. Again, the test for serial correlation suggests that lagged two periods (or more) value of the ED-BN index is a valid instrument.[27] The coefficient of the lagged dependent variable is estimated at 0.18 in columns (10) and (11).

When carrying out IV estimation, it is not possible to test if a model is identified (although it is possible to test over-identifying restrictions). However, the results from diagnostic and robustness checks help us to add support to the notion that our model specification and identifying assumptions are appropriate. The estimates obtained in columns (4)-(11) are robust to a number of different identification strategies in terms of our assumptions on the independence of the personality traits X_{it} with respect to δ_i and v_{it} in equation (2), and with respect to whether or not we include body dissatisfaction in the model. Further, in terms of diagnostics, each of the different specifications passes weak IV and overidentification tests. Note in particular that our results are robust to allowing for the possibility i) that personality indices are driven by a genetic component in δ_i, i.e., all personality traits are driven by one factor and ii) that there may be feedback from current shocks to future values of personality indices.

In summary, we first find that there is substantial persistence in BN, and second that about half of this persistence is due to true state dependence. Further, the magnitude of the effect suggests that state dependence is quite important. Finally these results are robust to changes in the explanatory variables and identification strategy.

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[26] Weak instruments are not an issue because of the lagged dependent variable.

[27] We also estimated a specification of the model in which we use both y_{it-2} and y_{it-3} as instruments. The results are robust and a serial correlation test shows that the IV are valid. Further, our results are similar when we change the number of lagged X to include as IV. All robustness checks are available upon request.

Table 6: Racial and Income Class Differences in the Persistence of BN

	Two-Stage Least Squares Estimates		
	(1)	(2)	(3)
White	-0.134*	0.058	-0.129*
	(0.084)	(0.093)	(0.069)
Age	-0.065***	-0.062***	-0.067***
	(0.018)	(0.016)	(0.016)
Parents Some College	-0.066	-0.066	-0.024
	(0.097)	(0.082)	(0.082)
Parents Bachelor Degree or More	-0.035	-0.052	-0.012
	(0.105)	(0.093)	(0.092)
Income in [$20000, $40000]	-0.240***	-0.226***	0.067
	(0.097)	(0.083)	(0.124)
Income more than $40000	-0.288***	-0.259***	0.255**
	(0.094)	(0.089)	(0.123)
Lagged ED-BN Index	0.149***	0.206***	0.318***
	(0.048)	(0.036)	(0.042)
Interaction with Lagged ED-BN Index:			
White		-0.146***	
		(0.050)	
Income in [$20000, $40000]			-0.145**
			(0.058)
Income more than $40000			-0.362***
			(0.057)
Sample Size	5426	5426	5426

Notes: Results in all columns are with interpolated values of the indices and include all control variables as in Table 4 column (6). Standard errors robust to heteroskedasticity and intra-group correlation are in parenthesis. * significant at 10%; ** at 5%; *** at 1%.

So far we have focused on models where state dependence is constant across race and income class. Table 6 presents 2SLS estimates describing the racial and income differences in the persistence of BN when we address the endogeneity of past behavior. We use interpolated values for wave 7 (since we are estimating a richer model) and exclude body dissatisfaction as an explanatory variable. To facilitate the comparison with these results, column (1) repeats the results of Table 4 column (6), where the lag is not interacted with race or income. In the remaining columns we use the socioeconomic indicator of focus interacted with the lag of the perfectionism and ineffectiveness indices as IV. For example, in column (2) we allow the persistence to differ by race, where the IV are race interacted with the lagged personality indices. Column (2) indicates that much of the persistence in the overall sample is driven by the behavior of African American girls. Indeed, the estimate for persistence among Whites is very small and significant (0.05), while it is substantial and significant for African Americans (0.21). In column (3), where we consider income differences in persistence, we observe that

the strongest persistence is in low income families, as the estimated coefficient on the lagged behavior is significant and very large at 0.32 (given we are instrumenting and imputing personality indices). It falls to 0.17 for middle income families and is essentially zero for girls from high income families. These results show interesting race and income effects of the persistence in BN behaviors, complementing our results from the static models.[28]

4.3 Results for the Tobit and other Nonlinear Models

The Tobit partial effect estimates are given in Table 7. Column (1) presents estimates where the only explanatory variable is the lagged dependent variable, and the estimated partial effect is 0.27. In column (2) we control for observable heterogeneity by including demographic variables and personality indices (except for body dissatisfaction), and the partial effect of the lagged dependent variable falls to 0.20. Column (3) includes body dissatisfaction as an explanatory variable, and the lag coefficient does not change.[29] In order to control for unobserved heterogeneity in columns (4) and (5) we include correlated random effects using the C/W approach, where we exclude and include body dissatisfaction, respectively. The estimates of 0.19 and 0.18 capture true state dependence, and represent about two-thirds of BN persistence, estimated at 0.27 in column (1), which reflects observed heterogeneity, unobserved heterogeneity, and true state dependence. Further, the persistence estimates in columns (4) and (5) are approximately equal to those in columns (2) and (3) respectively, suggesting that state dependence plays a much larger role than unobserved heterogeneity.

The estimated partial effects from the Probit and LPM models are of similar sign to the linear and Tobit estimates (see Tables B2 and B3 in Appendix B), but fewer estimated coefficients are statistically significant. This is expected since the Probit and LPM use much less information per person. Indeed, our estimates illustrate the importance of not focusing only on whether an individual has BN for understanding the determinants of the disorder.

[28] The data are not rich enough for a model with race-income interactions in the levels and in the persistence.

[29] We also estimated the model for column (3) using the interpolated data, and these results (not shown) were very close to those for the non-imputed data presented in column (3).

Table 7: Tobit Partial Effects Estimates for the Persistence of the ED-BN Index

	(1)	(2)	(3)	(4)	(5)
Lagged ED-BN Index	0.270***	0.200***	0.184***	0.190***	0.180***
	(0.013)	(0.012)	(0.009)	(0.013)	(0.013)
White		-0.077	-0.104**		
		(0.070)	(0.060)		
Age		-0.041***	-0.036***		
		(0.013)	(0.067)		
Parents Some College		0.096	0.035		
		(0.083)	(0.067)		
Parents Bachelor Degree or More		0.127	0.065		
		(0.095)	(0.079)		
Income in [$20000, $40000]		-0.224***	-0.160***		
		(0.076)	(0.065)		
Income more than $40,000		-0.169**	-0.160***		
		(0.086)	(0.065)		
Distrust Index		-0.007	-0.001	-0.015	-0.015
		(0.010)	(0.009)	(0.012)	(0.012)
Ineffectiveness Index		0.123***	0.118***	0.114***	0.099***
		(0.010)	(0.009)	(0.011)	(0.011)
Perfectionism Index		0.066***	0.060***	0.092***	0.044***
		(0.009)	(0.008)	(0.013)	(0.018)
Body Dissatisfaction Index			0.019***		0.033***
			(0.003)		(0.007)
Interpolated Indices	No	No	No	No	No
Chamberlain/Wooldridge Fixed Effects	No	No	No	Yes	Yes
Sample Size	4151	3938	3928	3938	3928

Notes: Standard errors robust to intra-individual correlation are reported in parenthesis.
* indicates significant at 10%; ** significant at 5%; *** significant at 1%.

5 BN State Dependence: Does it Reflect an Addiction?

As discussed previously, this is the first quantitative attempt to separate individual heterogeneity from state dependence in bulimic behaviors. We find that up to two-thirds of persistence in the behavior is due to true state dependence. Measuring addiction has a long tradition in economics. In this section, we further examine the potential addictive nature of BN as it relates to the medical definition of addiction. We believe that this is an interesting issue per se; moreover this discussion has substantial policy relevance.

We start by examining the medical definition of addiction and document a number of aspects of BN behavior that are consistent with it. According to the DSM-IV, in order to be classified as an addiction, a behavior or substance abuse must satisfy at least three of seven criteria in a

given year: 1) experiencing a persistent desire for the substance or behavior or an inability to reduce or control its use, 2) use of the substance or behavior continuing despite known adverse consequences, 3) withdrawal, 4) tolerance (more is needed for the same effect), 5) taking a larger amount of the substance or taking the substance for a longer period, than was intended, 6) spending much time seeking or consuming the substance or recovering from its effects, and 7) use of the substance or behavior interfering with important activities.[30]

We focus on the first four criteria. It is straightforward to note that BN fulfills criterion 1 (inability to control its use) as one of the diagnostic criteria for BN involves loss of control over the eating process.[31] Regarding criteria 2, we document that young women persist in their behaviors. Due to data limitations we are not able to determine if the respondents are aware of the negative consequences of their behavior, however a number of the adverse health effects will be readily apparent to anyone who continues with BN behavior, such as inflamed and irritated esophagus, tooth decay, muscle weakness, gastric rupture, and anemia. In this sense the continued behavior is consistent with addiction criterion 2 (i.e., use continues despite known adverse consequences). There is separate scientific evidence of withdrawal symptoms (criterion 3) in laxative use, which is a purging behavior (Colton et al., 1998).

Finally, an important finding of our study is that true state dependence plays a large role in the persistence in BN. The presence of true state dependence in BN is necessary for BN to fulfill criterion 4 (tolerance).[32] It is important to stress that one could not reach this finding without using appropriate econometric techniques to distinguish between persistence due to true state dependence and that due to unobserved heterogeneity.[33] However, there may be competing explanations that generate state dependence in BN, but that do not involve tolerance

[30] Further, note that to be diagnosed with a physiological dependence it is necessary that either criteria 3 or 4 be met; thus physiological dependence is neither necessary nor sufficient for the medical definition of addiction.

[31] Corwin and Grigson (2009) note that other diagnostic criteria for bingeing related disorders approximate the DSM-IV criteria for addiction. These include binge-type consumption, (i.e., criterion 5); bingeing is followed by inappropriate compensatory behavior (i.e., criterion 2); bingeing occurs at least twice a week for 3 months (i.e., criteria 5). Their argument is not based on an empirical analysis, but rather on their interpretation of the relation between the DSM-IV addiction and BN criteria.

[32] Increased behavior could either indicate that individuals are engaging more in the behavior to obtain i) the same effect over time (tolerance) or ii) stronger effects over time. Thus we say increased use is a necessary condition for tolerance, but not a sufficient one.

[33] As noted in Becker, et al. (1994), finding a positive and significant coefficient on past experience (after using instrumental variables to purge any effect of unobserved heterogeneity) is consistent with the hypothesis that the behavior under consideration is addictive. They study cigarette consumption and find an estimated coefficient on lagged behavior that is significant, positive, and less than 1 in an AR(1) process using IV techniques to address the endogeneity of lagged behavior. Note that this finding is neither necessary nor sufficient to satisfy the medical definition of addiction. Many other interesting theories of addiction have appeared in the literature, but we would need more information than we have in the data to empirically test them.

or increased use over time. For instance, it may be the case that individuals are initially uncertain of the deleterious side effects associated with bulimia, but they slowly learn through experimentation that BN is harmful. The slow learning explanation for state dependence has the implication that the longer girls have experienced bulimic behavior in the past the less likely they are to experience it in the future. To explore the potential for slow learning in explaining state dependence, we first consider an AR(2) process and then construct an "intensity" stock variable that is the sum of the ED-BN index over all previous periods. We also consider an alternative "threshold" stock in which past behavior contributes to the stock only if the girl engaged in more intense BN behavior in the past (defined as a value of the ED-BN greater than 6).[34] The threshold stock reflects the idea that a person learns the harmful consequences of BN only when the intensity of the past behavior is relatively high. Note that while such stock measures could be problematic in samples with older individuals (as earlier BN behavior would be out of sample and thus unobserved), this is not an issue in our sample since the girls are quite young when first interviewed.

Table 8: Explaining State Dependence -- Two-Stage Least Squares Regression Estimates

	(1)	(2)	(3)	(4)
Number of Periods Lagged ED-BN Index				
One Period	0.149***	0.120*	0.140***	0.136***
	(0.048)	(0.065)	(0.042)	(0.045)
Two Periods		0.111***		
		(0.037)		
Bulimic Stock Variables				
Intensity Stock (sum of ED-BN Index)			0.007	
			(0.017)	
Threshold Stock (sum of binary if ED-BN Index > 6)				0.138
				(0.269)

Notes: Results in all columns are with interpolated values of the indices and include all control variables as in Column (6) of Table 6. Standard errors robust to intra-individual correlation are reported in parenthesis. * indicates significant at 10%; ** at 5% and *** at 1%.

The results in Table 8 provide strong evidence against the slow learning interpretation of state dependence in BN. All results are based on 2SLS estimation where we treat the lagged ED-BN index as endogenous, include demographics and personality indices, exclude body dissatisfaction, and use interpolated values in wave 7. For comparison purposes, in the first column we repeat the results from column (6) of Table 4 , which includes the first lag of ED-BN index.

[34] There is not enough variation to consider an alternative stock in which past behavior contributes to the stock only if the ED-BN index is greater than 10.

Column (2) specifies an AR(2) process where one and two lags of the personality indices are used as IV. Further, column (3) includes one lag of the ED-BN index and the intensity stock, while column (4) replaces the intensity stock with the threshold stock. In columns (3) and (4) we use the lag and the sum over all previous waves of each personality index as IV.

Our results in column (2) show that the first and second lag coefficients (recall that each lag is two years) are both statistically significant and equal to 0.12 and 0.11, respectively.[35] These results cast doubt on slow learning as a driving force in state dependence, as the latter suggests that experiencing BN for four years would most likely reduce current behavior. Further evidence against the learning interpretation comes from columns (3) and (4). If learning was important we would expect the coefficients on the stock variables to be negative and statistically significant, but instead they are both positive and insignificant. Thus we conclude that learning does not explain state dependence in the persistence of BN.

Based both on our findings and medical evidence we argue that BN fulfills at least three of the medical criteria necessary to be classified as an addiction. This case can be made even stronger by noting that BN presents important similarities to drug and alcohol abuse. First, as noted above, medical research has found that starving, bingeing, and purging produces the same chemical effect as opiates. Second, again as noted above, opioid receptor binding in the area of the brain involving the anticipation and reward of eating in bulimic women is lower than in healthy women, and this reaction has been found in other studies of addictive behavioral disorders, including drug addiction and gambling (Bencherif et al. 2005). Third, treatment for individuals with BN is most effective if given early in the illness. Indeed, the recovery rate is close to 80% if treated within the first 5 years; the rate falls to 20% if treatment is delayed until after 15 years (Reas et al. 2000). Finally, patients with BN seem to respond to treatment initially aimed at combatting drug and alcohol abuse. First, Naltrexone, an anti-addiction opioid antagonist normally used in the treatment of alcohol dependence, has shown signs of success in normalizing eating patterns in those suffering from anorexia and bulimia (Marrazzi 1995). Second, there are 12-step groups, such as Overeaters Anonymous, based on the recovery program of Alcoholics Anonymous.

Interpreting BN as an addiction has important policy implications. First, preventive educational programs should be targeted at young girls and coupled with more intense (rehabilitation) treatment at the early stages of bingeing and purging behaviors. Second, BN is currently considered a disorder, not an addiction. In the majority of the states treatment for alcoholism and drug addiction is covered (either by public or employer provided insurance) whereas treatment

[35] The data are not rich enough to allow us to estimate an AR(3).

for ED is not covered in as many states (Center for Mental Health Services, 2008).[36] However, it is difficult to see a reasonable justification for the different views of BN given our results.

6 Conclusions

This is the first study that quantifies the role of true state dependence and individual heterogeneity in bulimia nervosa and examines the potentially addictive nature of BN among adolescent girls. We use a panel data set, the NHLBI Growth and Health Survey, that is uniquely suited for studying these issues. A major advantage of these data is that all sample participants were evaluated regarding bulimic behaviors for ten years, starting when they were young (aged 11-12 years), independent of any diagnoses or treatment they had received. For each respondent the data contain i) an Eating Disorders Inventory index, developed by medical experts; ii) information on SES, and iii) information on time-changing personality traits.

Our use of these data produces a number of important results. First, and perhaps most importantly, we find that much of the persistence in bulimic behavior is due to true state dependence after controlling for individual heterogeneity, and that this result continues to hold when we allow for the possibility that the personality traits are driven by a genetic factor and the possibility that there is feedback from the current shock in BN to future values of the personality indices. Indeed we find that up to two-thirds of the persistence in BN is due to the true state dependence, and that the past four years of behavior positively and significantly impact bulimic behavior in the current period. We provide evidence that state dependence is not explained by slow learning about the harmful effects of BN. We combine our results with other evidence in the medical literature to make the case that BN should be considered an addiction.

Further, we show that African Americans are more likely to persist in bulimic behavior. Indeed, the estimates suggest that the impact of past behavior on current behavior is four-fold higher among African Americans. In addition, the incidence of BN is decreasing in income, and the strongest persistence (among income groups) is present in low income families.

Our results have several important policy implications. First, since state dependence is the most important cause of BN persistence, it is reasonable to expect that the longer an individual experiences BN the less responsive she will be to policy aimed at combatting it. In this respect it is important to instruct a wide range of young women on the deleterious effects of BN and the importance of getting help, especially at the initial stages of bulimic behaviors. Second,

[36] Families frequently have to fight to get the necessary treatment, and it is not uncommon to spend thousands of dollars out of pocket to pay for counseling and drugs (NEDA 2008). Treatment involves individual and family therapy, behavior modification, nutritional rehabilitation and antidepressants (APA 2000b).

our results strongly suggest that BN should be treated as an addiction, rather than only as a disorder. This change would put those exhibiting BN on equal footing (from a treatment reimbursement perspective) with individuals abusing drugs or alcohol. Finally, to the extent that poor health is linked with lower educational attainment, policy aimed at combatting the onset of bulimic behaviors among young girls could also serve to improve educational attainment.

Appendix

A Data Variable Definitions

We describe the construction of the ED-BN index in the main text of the paper. The body dissatisfaction index is based on subject responses to nine items: 1) I think that my stomach is too big, 2) I think that my thighs are too large, 3) I think that my stomach is just the right size, 4) I feel satisfied with the shape of my body, 5) I like the shape of my buttocks, 6) I think my hips are too big, 7) I think that my thighs are just the right size, 8) I think that my buttocks are too large, 9) I think my hips are just the right size. This index ranges from 0 to 27, and responses are scored such that a higher score indicates more dissatisfaction.[37]

The perfectionism index is based on subject responses to six items: 1) In my family everyone has to do things like a superstar; 2) I try very hard to do what my parents and teachers want; 3) I hate being less than best at things; 4) My parents expect me to be the best; 5) I have to do things perfectly or not to do them at all; 6) I want to do very well. The subjects are offered the same responses, and the responses are scored in the same way as the ED-BN index.

The distrust index is based on subject responses to seven items: 1) I tell people about my feelings; 2) I trust people; 3) I can talk to other people easily; 4) I have close friends; 5) I have trouble telling other people how I feel; 6) I don't want people to get to know me very well; and 7) I can talk about my private thoughts or feelings. The scoring rule is as follows: "always"=1, "usually"=2, "often"=3, "sometimes"=4, "rarely"=5, and "never"=6 in questions 5 and 6; and "always"=6, "usually"=5, "often"=4, "sometimes"=3, "rarely"=2, and "never"=1 in questions 1, 2, 3, 4, and 7. A response of 4-6 on a given question contributes zero points to the distrust index; a response of 3 contributes 1 point; a response of 2 contributes 2 points; and a response of 1 contributes 3 points. The distrust index is a sum of all contributing points.

The ineffectiveness index is based on subject responses to ten items: 1) I feel I can't do things very well; 2) I feel very alone; 3) I feel I can't handle things in my life; 4) I wish I were someone else; 5) I don't think I am as good as other kids; 6) I feel good about myself; 7) I don't like myself very much; 8) I feel I can do whatever I try to do; 9) I feel I am a good person; 10) I feel empty inside. The scoring rule is as follows: "always"=1, "usually"=2, "often"=3, "sometimes"=4, "rarely"=5, and "never"=6 in questions 1,2,3,4,5,7, and 10; and "always"=6,

[37] The scoring rule is as follows: "always"=6, "usually"=5, "often"=4, "sometimes"=3, "rarely"=2, and "never"=1 in questions 3, 4, 5, 7, and 9 and "always"=1, "usually"=2, "often"=3, "sometimes"=4, "rarely"=5, and "never"=6 in questions 1, 2, 6, and 8. Again a response of 4-6 on a given question contributes zero points to the body image index; a response of 3 contributes 1 point; a response of 2 contributes 2 points; and a response of 1 contributes 3 points. The body image index is the sum of the contributing points.

"usually"=5, "often"=4, "sometimes"=3, "rarely"=2, and "never"=1 in questions 6,8, and 9. A response of 4-6 on a given question contributes zero points to the ineffectiveness index; a response of 3 contributes 1 point; a response of 2 contributes 2 points; and a response of 1 contributes 3 points. The ineffectiveness index is a sum of all contributing points.

Table A1 provides more details on the variables used in the paper.

Table A.1: Variable Definitions

Variable	Description	Coding	Waves
ED-BN Index	Eating Disorders Bulimia Subscale	Categorical Variable; Range 0-21	3,5,7,9,10
Clinical Bulimia	Case of Clinical Bulimia	=1 if ED-BN Index >10; =0 Otherwise	3,5,7,9,10
Body Dissatisfaction Index	Measures Poor Body Image Concerns	Categorical Variable; Range 0-27	3,5,7,9,10
Perfectionism Index	Measures Driveness for Perfection	Categorical Variable; Range 0-18	3,5,9,10
Ineffectiveness Index	Measures Feelings of Ineffectiveness	Categorical Variable; Range 0-29	3,5,9,10
Distrust Index	Measures Interpersonal Distrust	Categorical Variable; Range 0-21	3,5,9,10
Age	Respondent Age		All 10
White	Respondent Race is White	=1 if Race is White; =0 if African American	1
Parents High School or Less	Highest Education of Parents	Dummy Variable Highest Education High School or Less	1
Parents Some College	Highest Education of Parents	Dummy Variable Highest Education Some College	1
Parents Bachelor Degree or More	Highest Education of Parents	Dummy Variable Highest Education College Degree or More	1
Income less than $20,000	Household income (in 1988$)	Dummy Variable Household Income is Less than $20,000	1
Income in [$20000, $40000]	Household income (in 1988$)	Dummy Variable Household Income is in Range [$20,000,$40,000]	1
Income more than $40,000	Household income (in 1988$)	Dummy Variable Household Income is Higher than $40,000	1

B Additional Regression Results

Table B1 presents the reduced form estimates to investigate the issue of weak instruments. There will be heteroskedasticity in the first-stage regression equation for a censored dependent variable, therefore the widely used rule of thumb for the first-stage F-statistic of excluded instruments (from Staiger and Stock (1997) and Stock and Yogo (2005)) will be inappropriate. Instead we use the conjecture by Hansen, Hausman, and Newey (2008) that in the presence of heteroskedasticity in the first-stage equation, the Wald statistic for the null hypothesis that the excluded instruments are zero in the first stage, minus the number of instruments, should be greater than 32. The estimates in Columns (1)-(3) consider the instruments on an individual basis. We pass the weak IV test for the perfectionism and ineffectiveness.[38]

[38] We also estimated the specification in column (5) of Table 4 using separate instruments including body dissatisfaction. The results are very similar and are available upon request.

Table B1: Additional First Stage Estimates for Table 4 (Persistence of ED-BN Index)

	Estimates For Specification from Column (4) of Table 4 using Separate Instruments		
	(1)	(2)	(3)
Instruments for Lagged ED-BN Index			
Lagged Perfectionism Index	0.212 ***		
	(0.020)		
Lagged Ineffectiveness Index		0.286 ***	
		(0.017)	
Lagged Distrust Index			0.108 ***
			(0.020)
Lagged Dissatisfaction Index			
Other Regressors			
White	-0.300 **	-0.350 ***	-0.388 ***
	(0.135)	(0.129)	(0.137)
Age	-0.105 **	-0.055 **	-0.074 ***
	(0.028)	(0.027)	(0.028)
Parents Some College	-0.205	-0.150	-0.182
	(0.163)	(0.157)	(0.165)
Parents Bachelor Degree	-0.626 ***	-0.350 **	-0.553 ***
or More	(0.184)	(0.177)	(0.185)
Income in [$20000, $40000]	-0.251	-0.038	-0.276 *
	(0.167)	(0.161)	(0.168)
Income more than $40,000	-0.180	-0.064	-0.182
	(0.180)	(0.173)	(0.182)
Distrust Index	0.063 ***	0.050 ***	0.034 *
	(0.019)	(0.019)	(0.020)
Ineffectiveness Index	0.170 ***	0.044 ***	0.171 ***
	(0.016)	(0.017)	(0.016)
Perfectionism Index	-0.020	0.063 ***	0.055 ***
	(0.019)	(0.017)	(0.018)
Body Dissatisfaction Index			
Constant	1.842 ***	1.231 ***	1.979 ***
	(0.458)	(0.441)	(0.475)
Weak IV Test Statistic*	135	452	28
Interpolated Values	No	No	No
Sample Size	2309	2303	2308

Notes: Standard errors robust to heteroskedasticity and intra-group correlation are reported in parenthesis. Regarding the weak IV test, Hansen, Hausman, and Newey (2008) suggest that, in the presence of heteroskedasticity in the first stage equation, the test statistic should be greater than 32.
* indicates significant at 10%; ** significant at 5%;

The dynamic LPM and Probit model estimates are in Tables B2 and B3, respectively. These results suggest that the dynamic model is too rich for the zero-one data, since the IV regression coefficient on the lagged dependent variable is only significant if we difference the data and use the AB approach. Further, the Probit partial effects for the lagged incidence of BN are not significant once we include the fixed effects. The insignificant partial effects on the lagged incidence of BN in columns (4) and (5) have large confidence intervals; in other words they are imprecisely estimated 'zero' coefficients.

Table B2: Linear Probability Estimates of the Persistence of Clinical Bulimia

Variables				Two Stage Least Squares				Arellano-Bond	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Lagged Clinical Bulimia	0.196***	0.150***	0.149***	0.034	0.005	0.017	-0.008	0.093**	0.093**
	(0.043)	(0.041)	(0.041)	(0.090)	(0.062)	(0.089)	(0.060)	(0.050)	(0.051)
White		-0.005	-0.005	-0.007	-0.004	-0.009	-0.005	-0.017**	-0.019**
		(0.005)	(0.005)	(0.008)	(0.004)	(0.008)	(0.004)	(0.008)	(0.008)
Age		-0.002**	-0.003**	-0.002	-0.003***	-0.002	-0.003***		
		(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)		
Parents Some College		0.001	0.001	-0.004	-0.005	-0.004	-0.005		
		(0.006)	(0.006)	(0.010)	(0.005)	(0.010)	(0.005)		
Parents Bachelor Degree		0.006	0.006	0.002	-0.001	0.002	-0.001		
or More		(0.007)	(0.007)	(0.011)	(0.006)	(0.011)	(0.006)		
Income in [$20000, $40000]		-0.007	-0.007	-0.009	-0.008*	-0.010	-0.009*		
		(0.007)	(0.007)	(0.010)	(0.005)	(0.010)	(0.005)		
Income more than $40,000		-0.009	-0.009	-0.010	-0.012**	-0.011	-0.012**		
		(0.006)	(0.006)	(0.010)	(0.005)	(0.011)	(0.005)		
Distrust Index		-0.001	-0.001	-0.002*	-0.001	-0.002*	-0.000	-0.002**	-0.002**
		(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Ineffectiveness Index		0.008***	0.008***	0.011***	0.008***	0.010***	0.008***	0.006**	0.006**
		(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
Perfectionism Index		0.003***	0.003***	0.005***	0.004***	0.005***	0.004***	0.003***	0.003***
		(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Body Dissatisfaction Index			0.001			0.001**	0.001**		
			(0.000)			(0.001)	(0.000)		
Constant	0.016***	0.023	0.024	0.010	0.031*	0.011	0.033*	0.027*	0.028*
	(0.002)	(0.020)	(0.020)	(0.026)	(0.017)	(0.027)	(0.017)	(0.016)	(0.016)
Interpolated Indices	No	No	No	No	No	Yes	Yes	Yes	Yes
First Difference	No	No	No	No	No	No	No	Yes	Yes
Sample Size	4151	3938	3928	2285	2273	5426	5384	3437	3411

Notes: Standard errors robust to heteroskedasticity and intra-group correlation are reported in parenthesis. NA denotes not applicable; * indicates significant at 10%; ** significant at 5%; *** significant at 1%. Instruments are one-period lags of: all personality indices in columns (5) and (7); all indices excluding body image in columns (4) and (6). Columns (6)- (9) use interpolated values of personality indices in wave 7.

Table B3: Probit Partial Effects for the Persistence of Clinical Bulimia

Variables	(1)	(2)	(3)	(4)	(5)
Lagged Clinical Bulimia	0.196***	0.074***	0.070***	0.017	0.017
	(0.044)	(0.025)	(0.024)	(0.016)	(0.016)
White		-0.009**	-0.011***	-0.005	-0.006*
		(0.004)	(0.004)	(0.003)	(0.003)
Age		-0.003***	-0.003***	-0.002**	-0.002***
		(0.001)	(0.001)	(0.001)	(0.001)
Parents Some College		0.001	0.000	0.001	0.000
		(0.005)	(0.005)	(0.004)	(0.004)
Parents Bachelor Degree		0.006	0.005	0.005	0.004
or More		(0.007)	(0.007)	(0.005)	(0.005)
Income in [$20000, $40000]		-0.007	-0.007	-0.005	-0.005
		(0.004)	(0.004)	(0.003)	(0.003)
Income more than $40,000		-0.008*	-0.008*	-0.004	-0.005
		(0.004)	(0.004)	(0.003)	(0.003)
Distrust Index		-0.001	-0.001	-0.001	-0.001
		(0.001)	(0.001)	(0.001)	(0.001)
Ineffectiveness Index		0.003***	0.003***	0.002***	0.002***
		(0.000)	(0.001)	(0.001)	(0.001)
Perfectionism Index		0.002***	0.002***	0.001**	0.001**
		(0.001)	(0.001)	(0.001)	(0.001)
Body Dissatisfaction Index			0.001***		0.001
			(0.001)	(0.007)	(0.001)
Chamberlain/Wooldridge	No	No	No	Yes	Yes
Fixed Effects					
Constant	-2.137***	-0.653*	-1.500***	-1.437***	-1.812***
	(0.050)	(0.385)	(0.429)	(0.442)	(0.576)
Sample Size	4151	3938	3938	3938	3928

Notes: Standard errors robust to intra-individual correlation are in parenthesis. * indicates significant at the 10% level; ** at 5%; *** at 1%.

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