Variation by Course Subject in the **Association between Obesity and Grade Point Average**

Introduction

While a number of prior studies have investigated the causal direction of the association between The 1997 National Longitudinal Study of Youth (NLSY97) is a nationally representative sample of body mass and grade performance, key details about the association itself remain unexplored: namely, approximately 9,000 respondents between the ages of 12 and 16 on December 31, 1996 (Horrigan for whom the association holds, and in what contexts. Recent findings have suggested differences in and Walker 2001). The dependent variables of interest are grade point average (GPA) in English and the obesity-GPA association by race and sex, in which the association is strongest for White women math, taken from respondents' high school transcripts and standardized to have a mean of zero and and negligible for minorities (Sabia 2007). In this analysis I extend that line of work, drawing on edua standard deviation of one. The independent variable of interest is an indicator for whether a stucation research and feminist theory to suggest systematic differences between course subjects that dent was ever clinically obese in high school, with a second indicator for whether a student was ever overweight (but never obese) during high school included as a control. As only self-reported weight may result in differing associations between GPA and obesity by race and sex. and height are available in the NLSY97, true body mass index (BMI) is predicted using information It is well-established that course subjects are culturally gendered, with individuals of both genon the relationship between measured BMI and self-reported weight and height data in the National 2008; Lee and Sepanski 1995).

ders implicitly associating boys with science and math, and girls with arts and humanities (Kiefer and Sekaquaptewa 2007; Nosek, Banaji and Greenwald 2002). Dubbed "gender-math" and "gender-Health and Nutrition Examination Survey (NHANES) (CDC; Cawley 2004; Burkhauser and Cawley science" stereotyping, these preconceptions predict a "natural" penchant for higher performance in subjects associated with one's gender (Kiefer and Sekaquaptewa 2007). For assessing the relationship Control variables include a wide battery of sociodemographic factors hypothesized to influence between obesity and GPA, this gendering of course subjects is further complicated by the non-normaboth GPA and obesity, and respondents' Armed Services Vocational Aptitude Battery (ASVAB) score to control for cognition. The sample was defined as all Black, White, or Hispanic respondents for tive gendering of obesity itself, as obesity in women is judged "unfeminine" by girls and boys alike whom high school transcript data was available; students who were persistently underweight in high as early as age nine (Pine 2001). Following this, I hypothesize a larger negative association between school and girls who had ever been pregnant before or during high school were dropped from the obesity and GPA for girls in English, where femininity is privileged, than in math, where stereotypisample. Missing data was imputed in Stata 12.1 using 30 imputations. cal femininity is perceived to be a detriment (Pronin, Steele, and Ross 2002). This predicted pattern of associations would be expected if obesity is largely influencing GPA through social pathways such I estimate the conditional association between obesity and GPA using OLS regression, with modas discrimination and stigma, while posing a new explanatory challenges to alternative hypothesized els run separately by race and sex. In tables 1 through 3, model 1 is the bivariate association, net of a mechanisms. full set of indicators for census region and birth cohort; model 2 introduces all covariates except cog-

	Female						Male						
	English GPA			Math GPA			English GPA			Math GPA			
	1	2	3	1	2	3	1	2	3	1	2	3	
Obese	-0.167	-0.144	-0.060	-0.095	-0.035	0.040	0.081	0.118	0.109	-0.007	-0.011	-0.019	
	(0.115)	(0.118)	(0.110)	(0.116)	(0.121)	(0.116)	(0.102)	(0.101)	(0.097)	(0.103)	(0.105)	(0.101)	
Overweight	-0.288**	-0.288**	-0.268**	-0.117	-0.081	-0.063	0.096	0.123	0.105	0.037	0.044	0.027	
0	(0.108)	(0.108)	(0.100)	(0.111)	(0.115)	(0.108)	(0.104)	(0.102)	(0.098)	(0.111)	(0.111)	(0.108)	
Mother's Ed		0.010	-0.001		0.006	-0.003		0.027	0.015		-0.013	-0.025	
		(0.016)	(0.015)		(0.016)	(0.015)		(0.015)	(0.015)		(0.016)	(0.016)	
Father's Ed		0.034*	0.011		0.025	0.005		0.043**	0.024		0.042**	0.023	
		(0.016)	(0.015)		(0.016)	(0.016)		(0.014)	(0.014)		(0.015)	(0.015)	
Income (IHS)		0.005	0.002		-0.006	-0.008		-0.003	-0.005		-0.006	-0.008	
		(0.010)	(0.009)		(0.009)	(0.009)		(0.010)	(0.010)		(0.010)	(0.010)	
Net Worth (IHS)		0.012	0.008		0.009	0.005		0.007	0.004		0.007	0.004	
		(0.008)	(0.008)		(0.008)	(0.008)		(0.008)	(0.007)		(0.008)	(0.008)	
Urban		-0.275*	-0.224		-0.279*	-0.234		-0.233	-0.221		-0.223	-0.212	
		(0.136)	(0.127)		(0.138)	(0.131)		(0.130)	(0.126)		(0.136)	(0.133)	
US Born		-0.139	-0.209		-0.142	-0.204		-0.151	-0.145		-0.035	-0.030	
		(0.118)	(0.112)		(0.120)	(0.117)		(0.126)	(0.123)		(0.130)	(0.126)	
ESL at home		0.133	0.182		0.053	0.097		0.196	0.248*		0.034	0.084	
		(0.117)	(0.109)		(0.120)	(0.113)		(0.113)	(0.109)		(0.117)	(0.114)	
Sibship		-0.008	0.012		-0.005	0.013		0.029	0.030		-0.006	-0.005	
		(0.026)	(0.025)		(0.027)	(0.026)		(0.026)	(0.025)		(0.028)	(0.027)	
Obese mother		0.093	0.091		-0.075	-0.077		0.012	0.041		0.061	0.089	
		(0.111)	(0.102)		(0.109)	(0.104)		(0.100)	(0.096)		(0.107)	(0.105)	
Private school		0.153	0.106		0.145	0.103		0.320	0.125		0.585*	0.397	
		(0.230)	(0.208)		(0.230)	(0.220)		(0.301)	(0.293)		(0.290)	(0.284)	
Witness shooting		-0.207	-0.196		-0.027	-0.017		0.020	0.065		-0.074	-0.030	
		(0.121)	(0.115)		(0.124)	(0.119)		(0.091)	(0.089)		(0.097)	(0.093)	
Break-in		-0.041	-0.088		0.056	0.014		-0.208*	-0.252**		-0.071	-0.114	
		(0.101)	(0.096)		(0.104)	(0.101)		(0.095)	(0.092)		(0.099)	(0.097)	
ASVAB (std)			0.411***			0.366***			0.315***			0.303***	
			(0.048)			(0.051)			(0.049)			(0.052)	
Constant	0.048	-0.270	0.232	-0.071	-0.089	0.359	-0.540***	-1.094***	-0.656*	-0.409***	-0.432	-0.010	
	(0.093)	(0.269)	(0.256)	(0.094)	(0.277)	(0.273)	(0.087)	(0.266)	(0.265)	(0.089)	(0.277)	(0.279)	
R^2	0.035	0.126	0.290	0.015	0.078	0.217	0.026	0.153	0.284	0.021	0.100	0.222	
N	1442	1442	1442	1442	1442	1442	1595	1595	1595	1595	1595	1595	

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Data and methods

nition; and model 3 includes cognition. I then calculate differences between coefficients on obesity in the English GPA and math GPA models for each race-sex group using a series of Wald tests, presented in table 4.

	Female						Male						
	English GPA			Math GPA			English GPA			Math GPA			
	1	2	3	1	2	3	1	2	3	1	2	3	
Obese	-0.174*	-0.134	-0.109	-0.187*	-0.189*	-0.167	-0.049	-0.066	-0.086	-0.078	-0.105	-0.120	
	(0.086)	(0.086)	(0.081)	(0.089)	(0.091)	(0.088)	(0.095)	(0.097)	(0.096)	(0.100)	(0.104)	(0.104)	
Overweight	-0.140	-0.116	-0.060	-0.109	-0.109	-0.061	0.077	0.048	0.025	-0.015	-0.036	-0.053	
U	(0.096)	(0.093)	(0.089)	(0.099)	(0.098)	(0.095)	(0.102)	(0.102)	(0.099)	(0.108)	(0.110)	(0.110)	
Mother's Ed		0.069***	0.029	-0.318*	0.047*	0.012		0.055*	0.029		0.028	0.009	
		(0.021)	(0.020)	(0.153)	(0.021)	(0.021)		(0.022)	(0.022)		(0.024)	(0.025)	
Father's Ed		0.048*	0.023		0.007	-0.014		0.005	-0.007		0.003	-0.006	
		(0.021)	(0.020)		(0.021)	(0.020)		(0.021)	(0.021)		(0.024)	(0.024)	
Income (IHS)		0.002	-0.002		0.003	-0.000		0.001	-0.001		0.003	0.001	
		(0.009)	(0.008)		(0.010)	(0.010)		(0.009)	(0.010)		(0.010)	(0.011)	
Net Worth (IHS)		0.010	0.008		0.019*	0.017*		0.003	0.002		-0.005	-0.005	
		(0.006)	(0.006)		(0.007)	(0.007)		(0.007)	(0.007)		(0.008)	(0.008)	
U rban		-0.132	-0.161		-0.109	-0.134		0.242*	0.238*		0.079	0.077	
		(0.099)	(0.093)		(0.105)	(0.101)		(0.098)	(0.095)		(0.105)	(0.103)	
US Born		0.227	0.085		0.287	0.166		-0.017	-0.029		-0.370	-0.378	
		(0.281)	(0.268)		(0.302)	(0.294)		(0.474)	(0.463)		(0.500)	(0.492)	
ESL at home		0.152	0.075		0.000	-0.065		-0.029	-0.015		-0.035	-0.025	
		(0.183)	(0.175)		(0.201)	(0.195)		(0.026)	(0.025)		(0.028)	(0.027)	
Sibship		-0.035	-0.008		-0.065*	-0.043		0.037	0.049		0.073	0.082	
-		(0.024)	(0.023)		(0.026)	(0.025)		(0.087)	(0.084)		(0.096)	(0.095)	
Obese mother		-0.050	-0.049		-0.012	-0.012		0.183	0.082		0.402	0.330	
		(0.090)	(0.085)		(0.096)	(0.093)		(0.209)	(0.207)		(0.228)	(0.226)	
Private school		-0.061	-0.103		0.211	0.175		-0.156*	-0.133		-0.132	-0.116	
		(0.204)	(0.194)		(0.215)	(0.211)		(0.079)	(0.077)		(0.087)	(0.086)	
Witness shooting		-0.189*	-0.150		-0.110	-0.077		-0.021	-0.027		-0.075	-0.079	
		(0.089)	(0.084)		(0.094)	(0.091)		(0.081)	(0.079)		(0.087)	(0.086)	
Break-in		0.063	0.023		0.021	-0.013		-0.014	-0.004		0.063	0.070	
		(0.079)	(0.075)		(0.084)	(0.081)		(0.226)	(0.219)		(0.245)	(0.241)	
ASVAB (std)			0.376***			0.319***			0.278***			0.198**	
			(0.044)			(0.048)			(0.053)			(0.059)	
Constant	-0.162	-1.723***	-0.533	-0.327*	-1.224**	-0.215	-0.479**	-1.416*	-0.794	-0.410*	-0.429	0.014	
	(0.145)	(0.436)	(0.441)	(0.152)	(0.465)	(0.475)	(0.162)	(0.602)	(0.601)	(0.170)	(0.637)	(0.648)	
R^2	0.040	0.131	0.229	0.044	0.108	0.172	0.019	0.067	0.118	0.030	0.061	0.084	
N	702	702	702	702	702	702	663	663	663	663	663	663	

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Results

For White girls (table 1), the larger penalty of obesity hypothesized in English versus math is indeed observed. In English, obesity is associated with a one-quarter standard deviation lower GPA than girls of normal weight, even net of all controls; as presented in table 4, this association is about one-fifth of a standard deviation larger than the near-zero and non-significant association between obesity and math GPA. For White boys, the relationship between obesity and GPA remains significant net of all controls in both English and math, but the magnitude of the effect is constant across both subjects, amounting to between one-fifth and one-sixth of a standard deviation lower GPA for White boys who are obese relative to those who are normal weight. Comparing coefficient magnitudes across models, the penalty on English GPA is larger for White girls than for White boys, while the penalty of obesity on math GPA is larger for White boys than for White girls, although neither of these differences reaches significance in this sample.

Following Sabia (2007), it is unclear that we should expect any penalty of obesity for minorities of either sex. For Black and Hispanic students of both sexes (tables 2 and 3), we see no significant association between of obesity and GPA in either English or math even in the bivariate models. For Black boys and Hispanic boys and girls, the coefficients on obesity are also substantively small, reducing the concern that the significance on the associations for White students results solely from differences in sample size. Even were the effects for minorities significant, for no group does there appear a difference in the obesity-GPA coefficients by subject such as is observed for White girls.

Table 2 Ordina	ma Lagat Car		arian Mada	1	. Deen en	lanta' En ali	ah an d Math	CDA an (
Table 3. Ordina	iry Least Squ	Female					Sh and Math GPA on Obesity Male						
		English GPA	•		Math GPA			English GPA			Math GPA		
	1	2	3	1	2	3	1	2	3	1	2	3	
Obese	-0.167	-0.144	-0.060	-0.095	-0.035	0.040	0.081	0.118	0.109	-0.007	-0.011	-0.019	
	(0.115)	(0.118)	(0.110)	(0.116)	(0.121)	(0.116)	(0.102)	(0.101)	(0.097)	(0.103)	(0.105)	(0.101)	
Overweight	-0.288**	-0.288**	-0.268**	-0.117	-0.081	-0.063	0.096	0.123	0.105	0.037	0.044	0.027	
	(0.108)	(0.108)	(0.100)	(0.111)	(0.115)	(0.108)	(0.104)	(0.102)	(0.098)	(0.111)	(0.111)	(0.108)	
Mother's Ed		0.010	-0.001		0.006	-0.003		0.027	0.015		-0.013	-0.025	
		(0.016)	(0.015)		(0.016)	(0.015)		(0.015)	(0.015)		(0.016)	(0.016)	
Father's Ed		0.034*	0.011		0.025	0.005		0.043**	0.024		0.042**	0.023	
		(0.016)	(0.015)		(0.016)	(0.016)		(0.014)	(0.014)		(0.015)	(0.015)	
Income (IHS)		0.005	0.002		-0.006	-0.008		-0.003	-0.005		-0.006	-0.008	
		(0.010)	(0.009)		(0.009)	(0.009)		(0.010)	(0.010)		(0.010)	(0.010)	
Net Worth (IHS)		0.012	0.008		0.009	0.005		0.007	0.004		0.007	0.004	
		(0.008)	(0.008)		(0.008)	(0.008)		(0.008)	(0.007)		(0.008)	(0.008)	
Urban		-0.275*	-0.224		-0.279*	-0.234		-0.233	-0.221		-0.223	-0.212	
		(0.136)	(0.127)		(0.138)	(0.131)		(0.130)	(0.126)		(0.136)	(0.133)	
US Born		-0.139	-0.209		-0.142	-0.204		-0.151	-0.145		-0.035	-0.030	
		(0.118)	(0.112)		(0.120)	(0.117)		(0.126)	(0.123)		(0.130)	(0.126)	
ESL at home		0.133	0.182		0.053	0.097		0.196	0.248*		0.034	0.084	
		(0.117)	(0.109)		(0.120)	(0.113)		(0.113)	(0.109)		(0.117)	(0.114)	
Sibship		-0.008	0.012		-0.005	0.013		0.029	0.030		-0.006	-0.005	
		(0.026)	(0.025)		(0.027)	(0.026)		(0.026)	(0.025)		(0.028)	(0.027)	
Obese mother		0.093	0.091		-0.075	-0.077		0.012	0.041		0.061	0.089	
		(0.111)	(0.102)		(0.109)	(0.104)		(0.100)	(0.096)		(0.107)	(0.105)	
Private school		0.153	0.106		0.145	0.103		0.320	0.125		0.585*	0.397	
		(0.230)	(0.208)		(0.230)	(0.220)		(0.301)	(0.293)		(0.290)	(0.284)	
Witness shooting		-0.207	-0.196		-0.027	-0.017		0.020	0.065		-0.074	-0.030	
		(0.121)	(0.115)		(0.124)	(0.119)		(0.091)	(0.089)		(0.097)	(0.093)	
Break-in		-0.041	-0.088		0.056	0.014		-0.208*	-0.252**		-0.071	-0.114	
		(0.101)	(0.096)		(0.104)	(0.101)		(0.095)	(0.092)		(0.099)	(0.097)	
ASVAB (std)			0.411***			0.366***			0.315***			0.303***	
			(0.048)			(0.051)			(0.049)			(0.052)	
Constant	0.048	-0.270	0.232	-0.071	-0.089	0.359	-0.540***	-1.094***	-0.656*	-0.409***	-0.432	-0.010	
	(0.093)	(0.269)	(0.256)	(0.094)	(0.277)	(0.273)	(0.087)	(0.266)	(0.265)	(0.089)	(0.277)	(0.279)	
R^2	0.028	0.090	0.223	0.019	0.052	0.158	0.047	0.120	0.197	0.058	0.100	0.168	
N	527	527	527	527	527	527	588	588	588	588	588	588	
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* p<0.05, ** p<0.01, *** p<0.001 Standard errors in parentheses

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Conclusion

The pattern of associations observed in this analysis would be expected if obesity is largely influencing GPA through social pathways such as discrimination and stigma, while posing new explanatory challenges to alternative hypothesized mechanisms. The specific pathways driving grade reduction remain unclear and merit further study, as teacher discrimination in grading and student underperformance due to stress from real or perceived differential treatment could both contribute to the between-subject difference in the association between obesity and GPA observed for White girls. Regarding the differences in the association between obesity and GPA by race, Cawley (2004) points to racial differences in the adverse psychological impact of obesity: minority girls have been found to maintain a higher and more stable self-worth than do White girls in early adolescence, particularly with respect to BMI (Brown et al. 1998). In addition, it has been established that for skin color, more phenotypical variation is perceived among individuals of one's own race than among individuals of a different race (Hill 2002); if this phenomenon holds for obesity as well, given that 84% of public school teachers in the United States are White, obesity could be more readily seen by educational gatekeepers in White students than in students outside the teacher's own race.

This study adds to a growing literature framing the obesity crisis as a social problem, where negative health and socioeconomic consequences associated with obesity may result in large part from how institutions interact differently with bodies of different sizes (Saguy 2013). While reducing obesity levels would be one method of addressing the GPA differential between obese and non-obese White students, the findings presented suggest that social interventions, such as increased sensitivity training for teachers along with mental health support for obese students, would be also expected to reduce the GPA gap even absent any change in body mass.

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	Girls	Boys
White	-0.192*	-0.026
	(0.084)	(0.063)
Black	0.059	0.033
	(0.081)	(0.100)
Hispanic	-0.100	0.128
	(0.108)	(0.101)