The Heritability of Psychological Resiliency*

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* This paper will use data from the National Survey of Mid-Life Development in the U.S. (MIDUS). The analyses and interpretations of these data are made on the behalf of the authors. Direct all correspondence to: Jason D. Boardman, Department of Sociology and Population Program, Institute of Behavioral Science, Univesity of Colorado at Boulder, 327 UCB, Boulder, CO 80309-0327; phone: 303-735-0172; e-mail: boardman@colorado.edu.
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Abstract

This paper examines the role of unobserved genetic factors as important determinants of psychological well-being among a national sample of U.S. adults. Using sibling and twin-pair data from the National Survey of Mid-Life Development in the U.S. (MIDUS), this paper will examine the relative contribution of heritability to overall variance in psychological resiliency. Psychological resiliency is assessed as a function of adults' levels of psychological distress after considering life-time exposure to acute and chronic stressors. Several studies have found resiliency to be a heritable trait but no studies have used data from a national sample and none have examined the moderating role of the social environment in this process. The goal of this paper is to address these shortcomings. Results from these analyses are not yet available.

Introduction

Social scientists have recently engaged in ongoing discussions involving the role of genetic characteristics as contributing to our understanding of complex behaviors and health outcomes (Horwitz et al. 2003; Guo and Stearns 2002; Rodgers et al. 2001; Nielsen, in press). As an example, two leading social science journals have devoted entire issues to the discussion of genes and gene-by-environment interactions. In 2005, the *Journals of Gerontology: Series B* published a special issue including contributions from leading scholars from Sociology, Demography, Psychology, Epidemiology, Behavioral Genetics, and Genetics. This interdisciplinary approach is increasingly becoming the norm as researchers attempt to integrate data from the molecular level with data from broad social categories (Rowe 2005; Cleveland 2003). There is also an effort to ensure that specific disciplines collectively and uniquely engage in these important debates. For example, there was a recent call for submissions for a special issue of the *American Journal of Sociology* entitled "Genetics and Social Structure" where they asked for "submissions that take advantage of the opportunities afforded by genetic information to better explicate complex social processes or institutions and, thereby, advance sociological theory and research design" (AJS 2006).

Within this body of work, there has been a great deal of emphasis on genetic contributions to mental health and psychological well-being (Loehlin 1992) but to date most studies have relied on small community based samples which may limit the generalizability of the findings. Little work has obtained estimates of heritability for psychological well-being using nationally representative samples. The MIDUS study is one of few studies enabling researchers to examine various domains of psychological

well-being using a US based sample of adults. For example, using six aspects of psychological well-being, Kessler et al. (2004) report that heritability (broad sense) ranges from .11 to .43 (pp. 143). These estimates closely resemble those reported by other studies in which roughly 20-40% of the variance of loosely defined psychological well-being is considered to be heritable or to have a genetic basis (Heath et al. 1992; Loehlin 1992). Also using the same sex twin pairs from the MIDUS data, Johnson and Krueger (2004) find that roughly one-half of the variance in extraversion and neuroticism (.49 and .56, respectively) is due to common genetic effects. Importantly, the genetic component of other aspects of the Big Five Model of personality, including agreeableness, conscientiousness, and openness were described better as unique items rather than latent phenotypic constructs.

Psychological resiliency

Although measures of psychological well-being such as autonomy and self-efficacy tap into important notions of human agency (Bandura 1982), many researchers tend to focus on negative mental health rather than positive outcomes. Moreover, although social context and resources are known to be important predictors of individual functioning, these characteristics are rarely considered in the assessment of psychological well-being. This distinction is critical because it underscores an important aspect of social psychology that receives little attention from Sociologists and Social Demographers: psychological resiliency.

Building on the work of others (Masten, Best, and Garmezy 1990; Rutter 1987), Cicchetti and Rogosch (1997) define resiliency as an "individual's capacity for adapting successfully and functioning competently despite experiencing chronic stress or

adversity" (797). Researchers in this area focus on individuals who have been exposed to conditions that are known psychological risk factors (e.g., chronic strain or acute maltreatment) who demonstrate successful transitions. Masten et al. (1999: 144) state that the study of resilience requires investigators to clearly specify (a) "the threat to development," (b) "the criteria by which adaptation is judged to be successful," and (c) "the features of the individual or the environment that may help to explain resilient outcomes." In this paper, low socioeconomic status at different developmental periods and at different levels of aggregation are considered "threats" to psychological well-being and "successful adaptation" refers to the healthy psychological well-being despite these threats. The goal of this paper is to better understand Masten's (1999) third aspect. Namely, to examine the possibility that genetic characteristics may help to explain psychological resiliency in the face of persistent adversity. Previous research has explored similar phenomena among young children. Kim-Cohen et al. (2004) examined successful developmental outcomes despite persistent socioeconomic disadvantage among an epidemiological cohort (n = 1,116 pairs) of five-year old twin siblings and found roughly one-half (46%) of the variance in children's cognitive resiliency to be associated with additive genetic aspects. This is an important contribution because it suggests that human agency, an inherently individual-level characteristic, may also be conceptualized as a family-level characteristic. Families differ from one another in their access to coping resources or coping strategies to deal with stressful experiences, but it is also possible that resiliency, if considered a heritable trait, is one of the resources available to particular families because of the heritability of this important trait.

This builds on an existing body of work that examines gene-by-environment (GE) interactions. Shanahan and Hofer (2005) provide a four-fold typology of gene-by-environment interactions that includes (a) triggering; (b) enhancement; (3) control; and (4) compensation. That is,

> Contexts can (1) trigger or (2) compensate for a genetic diathesis, contexts can (3) control phenotypes despite genetic propensities to the contrary, and contexts can (4) help actualize genetic potential (Shanahan and Hofer 2005: 70).

This typology is important but these four explanations structure the notion of GE interactions such that the social environment moderates the magnitude of some a priori genetic association. The notion of resiliency is somewhat different because it is only meaningful in particular environments. Said differently, genetic resiliency may seem akin to models of compensation where, rather than the social environment compensating for an otherwise genetic liability, a genetically oriented resource is only necessary in particularly stressful social environments. This is important because while genetically oriented resiliency can be considered to reside within this theoretical paradigm, it also avoids some of the methodological pitfalls of traditional G*E analyses that have been recently criticized (Eaves 2006).

Data

All data for these analyses uses the National Survey of Mid-Life Development in the U.S. (MIDUS). Data were collected from 1994 to 1995 on a national survey of over 7,000 Americans ages 25 to 74. The explicit purpose of the study was to "investigate the role of

behavioral, psychological, and social factors in understanding age-related differences in physical and mental health." Over-sampling of older people and of men was achieved by varying the probability of carrying out the interview at this stage as a joint function of the age and sex of the randomly selected respondent.

This paper relies on the sibling and twin over sample built in to the MIDUS study. Among those from the national sample who reported that they had one or more siblings, 529 members of the national sample were randomly selected. Then, among those with the same biological mother and father (n= 951) respondents were asked to provide interviewers with their sibling's contact information, and to assist in the location and participation of their siblings in the study prior to the time a recruiter made the contact attempt. The combined groups of 951 and 529 yielded 1,614 sibling pairs. In addition to sibling pairs, MIDUS contains 998 twin pairs.

Research questions and analytic strategy

The goal of this project is to answer the following two questions:

(1) To what extent is psychological resiliency a heritable characteristic?

(2) Is the heritability of psychological resiliency moderated by the social environment?

Using the full sample of the MIDUS I, I will use five of the six psychological well-being scales used by others to examine heritability estimates of well-being (Kessler et al. 2004; Keyes, Shmotkin, & Ryff 2002; Maier and Lachman 2000; Ryff and Singer 1998; Staudinger, Fleeson, & Baltes 1999). I will not consider the measure for "purpose in life" because of the relatively low Chronbach alpha reliability measure ($\alpha = .36$ -- this reliability estimate was obtained from online documentation (MIDUS 2004)). These

measures will be used independently and collectively as a standardized score ($\alpha = .77$ -- this reliability coefficient was calculated by myself using the full sample). This comprehensive perspective of psychological well-being includes (1) positive social relationships; (2) self-acceptance; (3) autonomy; (4) personal growth; and (5) environmental mastery.

Resource availability is conceptualized at the individual, family, and neighborhood-level. I plan to use information on respondents' perceived socioeconomic status when they were growing up and their current perceived SES in conjunction with two measures describing their current residential area. Preliminary results find a positive and significant association between psychological well-being and each aspect of socioeconomic resources considered ($r_{\text{family SES}} = .30$; $r_{\text{childhood SES}} = .11$; $r_{\text{perceived neighborhood quality}} = .34$).

Psychological resiliency is operationalized as the demonstration of relatively high levels of psychological well-being despite persistent disadvantages. That is, psychological well-being (WB) will be regressed on childhood SES (C) and current family SES (F), and current neighborhood quality (N) as well as interactions between these independent variables. In other words, positive error terms capture varying degrees of resiliency among individuals from the MIDUS study and negative values describe vulnerability.

$$(1) \qquad WB_i = a + b_1 C_i + b_2 F_i + b_3 N_i + b_4 C_i F_i + b_5 C_i N_i + b_6 F_i N_i + b_7 C_i F_i N_i + e_i$$

Using the individual residuals (e_i) obtained from this equation with the twins sample, I will calculate heritability estimates for resiliency using standard DeFries-Fulker (DF) regression techniques (DeFries & Fulker 1985). The DF model provides a relatively

simple way to calculate estimates describing the proportion of variance for a particular trait that is due to (1) genetic characteristics (broad sense heritability); (2) shared environment; and (3) unshared environment. In this case, the outcome of interest is the residuals obtained from equation 1. If the correspondence in residuals is significantly larger among identical (315 pairs) compared to same-sex fraternal (275 pairs), twins then there is evidence for a genetic basis for psychological resiliency (sample sizes obtained from Johnson and Krueger 2004). The DF model for resiliency (see equation 2) regresses the residual term for twin 1 (R_1) against the residual term for twin 2 (R_1), a measure of genetic association (G) coded 1 for identical twins and .5 for fraternal twins, and an interaction between the score for twin 2 and the measure of genetic association (GR_2). The value for the coefficients b_1 and b_3 provide estimates for the relative contribution of shared environment and heritability, respectively, to overall variation in resiliency.

(2) $$R_{1j} = a + b_1 R_{2j} + b_2 G_j + b_3 G_j R_{2j} + e_j$$

The DF model is useful because additional control variables can be included to adjust for average differences across sibling pair types but also the heritability estimates can be moderated by these characteristics as well. For example, using these same data, Kessler et al. (2004) find that heritability estimates associated with psychological well-being are different in magnitude for men compared to women. Similarly, Neiss and Almeida (2004) find significantly lowered heritability in daily affect among older adults suggesting that age is an important sociodemographic moderator (both methodologically and theoretically) in describing the relative contribution of heredity to overall differences among individuals.

This question will be addressed simply by including several interaction variables in the DF model. Equation 3 presents a simple extension of the DF model to include these interactions. For example, the interaction term b_5 assesses the possibility that the shared environment estimate (b_1) is moderated by gender (S). Likewise, it is also possible that heritability of resiliency is moderated importantly by gender. This possibility is considered by including an interaction between the heritability estimate and gender. The estimate for b_6 will provide information about the direction and significance of this moderation effect.

(3) $$R_{1j} = a + b_1 R_{2j} + b_2 G_j + b_3 G_j R_{2j} + b_4 S_j + b_5 S_j R_{2j} + b_6 S_j G_j R_{2j} + e_j$$

Results

This project has just begun and I do not have results (not even preliminary results). I am confident that the results will be available well before the time of the meetings and I will provide these as soon as they are ready. In the case of genetic associations with mental health, even null results will build upon our understandings of population dynamics related to mental health and well-being.

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Table 1. Variables to be used in the analyses: MIDUS I

Topic	Measure	Item(s)	Question	Response options	alpha
Psychological well-being*	Positive relations	PWBPR			
			"Maintaining close relationships has been difficult and frustrating for me."	1 Strongly Agree; 2 Somewhat Agree; 3 A Little Agree; 4 Don't Know; 5 A Little Disagree; 6 Somewhat Disagree; 7 Strongly Disagree	0.58
			"People would describe me as a giving person, willing to share my time with others."	""	
			"I have not experienced many warm and trusting relationships with others."	""	
	Self-acceptance	PWBSA			
			"I like most parts of my personality."	""	0.59
			"When I look at the story of my life, I am pleased with how things have turned out so far."	""	
			"In many ways I feel disappointed about my achievements in life."	""	
	Autonomy	PWBAU			
			"I tend to be influenced by people with strong opinions."	""	0.48
			"I have confidence in my own opinions, even if they are different from the way most other people think."	""	
			"I judge myself by what I think is important, not by the values of what others think is important."	""	
	Personal growth	PWBPG			
			"For me, life has been a continuous process of learning, changing, and growth."	""	0.55
			"I think it is important to have new experiences that challenge how I think about myself and the world."	""	
			"I gave up trying to make big improvements or changes in my life a long time ago."	""	
	Environmental mastery	PWBEM			
			"The demands of everyday life often get me down."	""	0.52

			“In general, I feel I am in charge of the situation in which I live.” “I am good at managing the responsibilities of daily life.”	"" ""	
	Well-being		Sum of standardized measures of well-being above		0.73
Personal Socioeconomic Status	Childhood SES	SE9	“When you were growing up, was your family better off or worse off financially that the average family at that time?”	1 A Lot Better Off; 2 Somewhat Better Off; 3 A Little Better Off; 4 Same As Average Family; 5 A Little Worse Off; 6 Somewhat Worse Off 7 A Lot Worse Off	
	Family SES (adult)		Sum of standardized scores of SJ6 (reversed) and SJ7		0.77
		SJ6	"In general, would you say you (and your family living with you) have more money than you need, just enough for your needs, or not enough to meet your needs?"	1 More Money Than You Need 2 Just Enough Money 3 Not Enough Money	
		SJ7	"How difficult is it for you (and your family) to pay your monthly bills?"	1 Very Difficult 2 Somewhat Difficult 3 Not Very Difficult 4 Not At All Difficult	
Neighborhood Characteristics	Neighborhood SES (Adult)	MEDINC	Median income for the local area	Mean = $38,532 Min = $10,217 Max = $117,940	
	Perceived inequality near home	PIHOME	Please indicate how much each of the following statements describes your situation.	1 A lot; 2 Some; 3 A little; 4 Not at all	0.80
			“I live in as nice a home as most people.”	“”	
			“I’m proud of my home.”	“”	
			“Most people live in a better neighborhood than I do.”	“”	
			“I don’t like to invite people to my home because I do not live in a very nice place.”	“”	
			“I feel very good about my home and neighborhood.”	“”	
			“It feels hopeless to try to improve my home and neighborhood situation.”	“”	
	Zygosity	ZYGCAT	Measure of zygosity and sex of sibling pair	1 MZ Twins; 2 DZ Twins (same sex)	