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# Are Health and Happiness the Product of Wisdom? The Relationship of General Mental Ability to Educational and Occupational Attainment, Health, and Well-Being

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This study tested a structural model explaining the effects of general mental ability on economic, physical, and subjective well-being. A model was proposed that linked general mental ability to well-being using education, unhealthy behaviors (smoking and excessive drinking), occupational prestige, and health as mediating variables. The sample consisted of 398 individuals, from whom measures were collected across 4 periods. The results supported a model that includes direct and indirect (through unhealthy behaviors and occupational prestige) links from mental ability to physical well-being (i.e., health) and economic well-being. Furthermore, the results supported the relationships of economic well-being and physical well-being to subjective well-being. Overall, the study underscores the importance of general mental ability to work and nonwork outcomes, including physical, economic, and psychological well-being.

*Keywords:* general mental ability, intelligence, health, occupational attainment, well-being

Sixteen years ago, following the publication of *The Bell Curve* (Herrnstein & Murray, 1994) and the ensuing criticisms, *The Wall Street Journal* published a 25-item statement on what represented a broad scientific consensus on intelligence at that time (Arvey et al., 1994). The statement was signed by 52 prominent scientists from a wide spectrum of disciplines involved in the study of intelligence, including many industrial and organizational psychologists (see Gottfredson, 1997). The practical importance of intelligence was one of the issues addressed in this statement: "IQ is strongly related, probably more so than any other single measurable human trait, to many important educational, occupational, economic, and social outcomes" (Arvey et al., 1994, p. A18). Little has changed with respect to the state of science on the practical importance of intelligence since then (e.g., Deary, Strand, Smith, & Fernandes, 2007; Lubinski, 2004).

The enormous contributions of the intelligence literature notwithstanding, only relatively recently has general mental ability (GMA) been linked to one important outcome, namely, physical well-being, or health (e.g., Gottfredson & Deary, 2004; Singh-Manoux, Ferrie, Lynch, & Marmot, 2005). Less research still has concerned the influence of GMA on psychological well-being, and the little evidence that exists is somewhat inconclusive (Sigelman, 1981). Moreover, even though work has clear implications for health (Barling & Griffiths, 2003; Blustein, 2008), the role of work in the relationship of GMA to health and well-being is even less well understood.

In this study, we sought to contribute to the literature on the relationships between GMA, work, and health outcomes by proposing and testing several explanations for these relationships. Furthermore, we aimed to contribute to the broader literature on GMA by reevaluating the extent to which GMA influences psychological well-being and whether constructs that explain the effects of GMA on health and economic well-being—namely, education and occupational prestige—also influence subjective well-being. Importantly, we attempted to contribute to the literature on careers by examining multiple well-being outcomes of occupational prestige as an indicator of *occupational status*, sociology's "great empirical invariant" (Featherman, Jones, & Hauser, 1975, p. 331) and one of the most frequently used core (albeit partial) indicators of extrinsic career success (Judge, Higgins, Thoresen, & Barrick, 1999; Kammeyer-Mueller, Judge, & Piccolo, 2008; Sutin, Costa, Miech, & Eaton, 2009).

Toward achieving these goals, this article proceeds as follows. First, we review the literature linking GMA to behavioral, educational, occupational, economic, physical, and psychological outcomes. Second, we introduce a conceptual model explaining these links and review literature guiding the specific hypotheses that are included in this model. Third, we describe the study that tests our hypotheses and present its results. Finally, we conclude by discussing the psychological and social implications of our findings, as well as the ways in which this study informs theory and research on individual differences and career success.

## Conceptual Background, Theoretical Model, and Hypotheses

### GMA and Its Outcomes

After studying GMA for over 100 years, psychologists from a variety of disciplines have uncovered many important outcomes or

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correlates of this “very general mental capability that, among other things, involves the ability to reason, plan, solve problems, think abstractly, comprehend complex ideas, learn quickly and learn from experience” (Gottfredson, 1997, p. 13).[1] There is, for example, agreement that GMA predicts educational and occupational attainment, as well as performance within occupations or jobs (see Kuncel, Hezlett, & Ones, 2001; Schmidt & Hunter, 2004). There is also evidence that GMA is associated with physical and psychological health (e.g., subjective well-being), although the evidence for the former outcome is relatively recent and for the latter is tentative and mostly indirect (Campbell, Converse, & Rodgers, 1976; Gottfredson, 2004; Sigelman, 1981).

Perhaps the most impressive test of the relationship between GMA and health is the study that links the Scottish Mental Survey of 1932, which assessed intelligence in childhood, to health outcomes assessed later in life (see Deary, Whiteman, Starr, Whalley, & Fox, 2004; Gottfredson & Deary, 2004). This study found a clear connection between GMA and health: GMA scores collected at 11 years of age influenced survival and hospital admissions for illnesses up to age 65 (Deary et al., 2004). With respect to subjective well-being, though two studies are noteworthy for finding an association between intelligence and life satisfaction (Campbell et al., 1976; Diener & Fujita, 1995), Sigelman (1981) criticized the Campbell et al. (1976) study for using an interviewer-rated measure of “apparent intelligence” (that may be subject to various biases), and similar criticisms could be leveled at the Diener and Fujita (1995) study. Using a 10-item multiple-choice vocabulary test to measure intelligence, Sigelman found a small but significant correlation between intelligence and life satisfaction ($r = .13$, $p < .01$), but found that the correlation decreased to .04 when controlling for anomia.[2] Worth noting is that these analyses did not include constructs that might explain the relationship between GMA and subjective well-being (e.g., economic well-being) and, unlike studies linking GMA to health (see Gottfredson, 2004), did not consider the role of individuals' socioeconomic status (SES). These studies were therefore not able to eliminate the alternative explanation that the associations of SES with GMA and with the outcomes can account for the GMA–outcomes links (we discuss this alternative explanation in more detail below). Moreover, though studies have linked GMA to physical and psychological health, these two outcomes are often not included together in an integrated model, and rarely is the role of work and other processes considered.

Accordingly, our research represents an effort to assimilate various literatures linked to GMA by proposing and testing a model that incorporates SES, health-relevant behaviors, and educational and occupational attainments as explanatory factors linking GMA to economic, physical, and psychological well-being. This model is presented in Figure 1. This effort is positioned to contribute to the literature in several ways. First, and perhaps most importantly, our conceptual development effort concatenates multiple literatures focused on the effects of GMA on various outcomes in order to develop an integrated model. This model not only examines economic, physical, and subjective well-being simultaneously but also proposes several mechanisms that explain the effects of GMA on these three indicators of well-being, considers the interrelationship among these indicators, and controls for childhood SES. We believe this integrates and extends previous research on GMA and its outcomes by offering a more comprehensive and rigorous view of how GMA influences important life outcomes.

Second, we contribute specifically to the literature on GMA and health by considering both objective and subjective health indicators and, more importantly, by testing two explanatory mechanisms for the positive association between GMA and health—whereby individuals with higher GMA engage in less unhealthy behaviors and have more prestigious jobs—in an effort to identify the causal mechanisms for the relation between GMA and health, one of the “major challenges for future research” on GMA and health mentioned by Gottfredson and Deary (2004, p. 3). We also contribute to this literature by considering the role of education in explaining the links among GMA and its most proximal health outcome: health-relevant behavior.

Third, our study provides an empirical, methodological contribution to the literature linking GMA and its outcomes. This contribution is achieved by testing the model proposed herein with data that were collected at four distinct times, each 3 years apart, by using a battery of cognitive ability tests to measure GMA, interviewer-coded SES and occupational prestige, and objective health indicators. These features of the study minimize concerns about common method and rater bias and allow us to test the model by using variables collected with such timing as to satisfy the temporal precedence condition for establishing causality. In addition, we test the effects proposed in the model simultaneously using path analysis that controls for measurement error in the scores used to measure the variables.

As noted, another important feature of the model that we propose and test in this article is the inclusion of childhood SES as a control variable. SES in childhood has been related to cognitive development and GMA (see McLoyd, 1998), and has also been linked to a variety of educational, occupational, health, and economic outcomes (e.g., S. Cohen, Doyle, Turner, Alper, & Skoner, 2004; Luo & Waite, 2005; Sackett, Kuncel, Arneson, Cooper, & Waters, 2009; Strenze, 2007). Furthermore, SES offers an alternative explanation for the association between GMA and such outcomes whereby the links between cognitive tests and outcomes could be explained by the association of SES with both (see Sackett et al., 2009, for a discussion and test of this alternative explanation with respect to educational admissions tests and academic achievement outcomes); therefore, it is important to include it in the model.

In the following sections, we present conceptual and logical support for the relationships portrayed in this model and develop formal hypotheses. We should note that though we discuss all the relationships included in the model, we do not offer hypotheses for every one of these links. For example, given the extant literature on the link between GMA and education, and the large body of empirical evidence supporting a positive relationship between the two constructs (Kuncel et al., 2001), we do not offer a formal hypothesis on this relationship. Furthermore, because the focus of

[1] This definition first appeared in the consensus statement published in *The Wall Street Journal* in 1994 (see Gottfredson, 1997).

[2] In Sigelman's (1981, p. 969) study, anomia is a construct measured with “items which tap feelings of rootlessness or normlessness, e.g., ‘You sometimes can't help wondering whether anything is worthwhile any more.’”

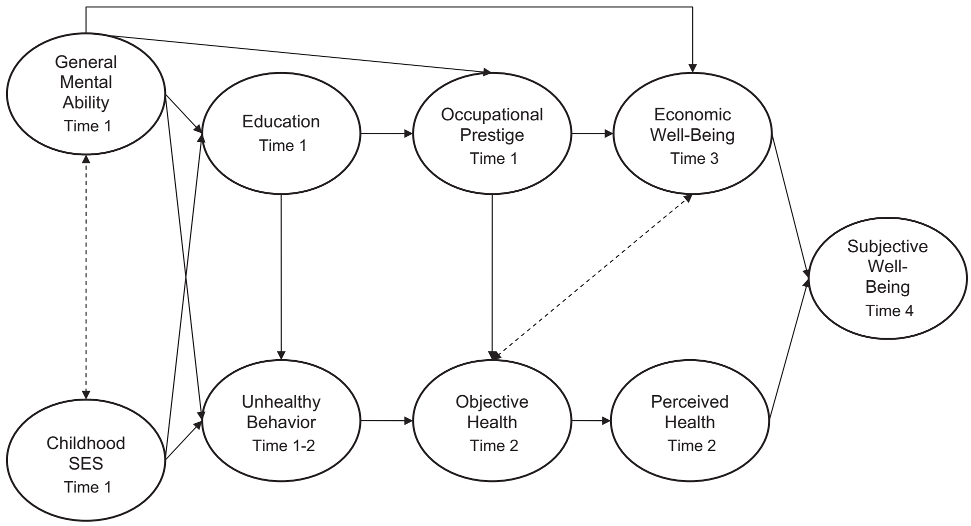


*Figure 1.* Conceptual model. Though not shown in the model, age and sex were used to predict each endogenous variable. SES = socioeconomic status.

this investigation is GMA and not SES, we do not make formal predictions with respect to the relationships of childhood SES with the other constructs included in the model. In addition, because the causality in the association between GMA and childhood SES is not clear, we model this association as a bidirectional link (which does mean that the effect of GMA on healthy behavior and education directly, and on the other endogenous variables indirectly, is net of childhood SES).

## GMA, Economic Well-Being, and Health

First, we examine the effects of GMA on economic well-being and health. We conceptualize economic well-being as indicated by one's economic self-sufficiency and economic outlook, which are, in turn, the result of individuals' economic output (e.g., income), their financial status (e.g., assets and debts), and their future choices and expectations with respect to their economic situation. This broader conceptualization should better reflect the quality of individuals' economic well-being and thus should be a better predictor of individuals' quality of life (an issue to which we turn shortly) than narrower constructs such as income.

If, as we have argued, economic well-being reflects both economic output (e.g., wages, benefits, other earnings) and financial status (e.g., the degree to which economic output is translated into financial security), there is reason to think that GMA influences both aspects of economic well-being. First, of all individual differences, GMA is the strongest and most consistent predictor of job performance, job complexity, and occupational status (Schmidt & Hunter, 2004; Wilk & Sackett, 1996); because these outcomes are all related to income, they can explain the robust relationship between GMA and income. Judge et al. (1999), for example, found that GMA assessed in childhood predicted income (and occupational status) in adulthood. Second, because higher GMA is associated with increased capacities for planning, solving problems, and understanding abstract situations, it should be associated with better economic management and planning. Because the task of managing one's finances can be considered a relatively complex job, GMA should also predict how well individuals perform this task (Schmidt & Hunter, 2004). For both reasons, then, GMA should affect economic well-being.

Physical well-being, or health, can be conceptualized and operationalized both objectively (e.g., the level of triglycerides, which is considered a risk factor for coronary heart disease; Abdel-Maksoud, Sazonov, Gutkin, & Hokanson, 2008) and subjectively (e.g., individuals' perceptions of the quality of their health). Each aspect offers a unique, albeit related, perspective on health. In this study and as shown in the theoretical model, we included both objective and subjective health. With respect to the effects of GMA, there are two conceptual explanations supporting an association with health, and, as noted earlier, there is some empirical support for this association (e.g., Deary et al., 2004). The first conceptual explanation concerns individuals' day-to-day health-related behaviors and choices. Gordon (1997, p. 203), for example, argued for "everyday life as an intelligence test" and provided many examples of ordinary life situations where higher GMA is associated with better outcomes (or lower probabilities for making mistakes), and made a case that aggregating the effects of mental ability over life situations results in substantial effects of intelligence on long-term outcomes. Similarly, Gottfredson (2004) explained that GMA is related to health behaviors (both positive, such as adopting healthy diets, and negative, such as lower rates of smoking), and thus health outcomes, because high-GMA individuals have superior health knowledge and health literacy.

In this study, we considered unhealthy behaviors such as those suggested by Gottfredson as an explanation for the link between GMA and objective health. Because we examined only unhealthy behaviors and did not include behaviors that promote good health (e.g., healthy diets, exercise), we propose a partial mediation role for unhealthy behaviors. In sum, our first two hypotheses concern the relationships of GMA to economic well-being and objective health (Hypothesis 1) and the mediating role of unhealthy behaviors in the GMA–health link (Hypothesis 2). Given the conceptual arguments presented above, and the supportive empirical evidence, we predict:

> *Hypothesis 1:* GMA will be positively related to (a) economic well-being and (b) objective health, such that those with higher GMA will achieve higher economic well-being and will have better health.

> *Hypothesis 2:* The relationship between GMA and objective health will be partially mediated by unhealthy behaviors.

Whereas the set of explanations for the GMA–health and GMA–economic well-being relationships posits a direct link between the constructs and an indirect link through unhealthy behaviors, a second explanation of the link between GMA and these outcomes involves occupational prestige. With respect to health, as noted by Fuchs (2004, p. 658), “some occupations are much less healthy than others.” Furthermore, more prestigious jobs routinely offer better benefits that are relevant to both economic (e.g., higher contributions to employees’ retirement plans, access to financial advising) and health factors (e.g., exercise facilities, health plans, wellness information), and those holding high-prestige jobs typically have higher income and may enjoy better health through access to safer transportation, exposure to fewer stressors, and access to more sophisticated health information (Fuchs, 2004).

Moreover, on-the-job health risks (e.g., accidents, exposure to harmful chemicals) are not evenly distributed across the occupational spectrum, with more prestigious occupations being typically less hazardous, which suggests another mechanism by which occupational prestige mediates the effect of GMA on health (see Gottfredson & Deary, 2004). Indeed, in a study conducted in 11 western European countries between the years 1985 and 1992, Mackenbach, Kunst, Cavelaars, Groenhof, and Geurts (1997) found that in all countries with available data, those employed in more prestigious occupations (conceptualized as nonmanual vs. manual) and having higher incomes enjoyed significantly lower levels of mortality and morbidity. Similarly, Batty et al. (2008) found that occupational prestige was negatively related to mortality in a sample of 4,316 Vietnam veterans. Finally, Eaker, Sullivan, Kelly-Hayes, D’Agostino, and Benjamin (2004), using data from the Framingham Offspring Study, found that occupational prestige was significantly related to decreased risk for mortality and heart disease for men (albeit not for women). Thus, though past research has not directly investigated these links, it supports the argument that high-GMA individuals should enjoy greater economic and physical well-being due, in part, to their occupations.

> *Hypothesis 3:* The relationship of GMA to (a) economic well-being and (b) objective health will be mediated, in part, by occupational prestige.

Thus far, we have hypothesized that GMA has positive relationships with both economic well-being and health, and these relationships are explained, in part, by occupational prestige and unhealthy behaviors. At this point, it is appropriate to note some other relationships in the model that are not reflected in formal hypotheses. For example, the model includes a direct link from GMA to education (a well-established finding; e.g., Deary et al., 2007). The model also assumes that the relationship of GMA to occupational prestige is mediated, in part, by education; increasing educational attainments are generally required for more prestigious jobs. Similarly, unhealthy behaviors should be predicted by GMA both directly and indirectly, through its effect on education. Higher educational attainments, which are clearly associated with higher GMA (Kuncel et al., 2001), generally involve the acquisition of larger amounts of knowledge in all life spheres, including health (Fuchs, 2004). In other words, those with higher GMA are better at health self-management not only because they understand complex and abstract issues better but also because their education provides them with a better understanding of the implications of unhealthy behaviors for their general health. Therefore, the model includes an indirect effect of GMA on unhealthy behavior through education.

Finally, as noted, we included both objective and perceived health in the model because these two aspects offer different perspectives on health. However, these two perspectives are related in that objective health should influence one’s health perceptions; therefore the model includes a link from objective to perceived health. In addition, objective health and economic well-being are likely to be related; however, when considering the causal direction of their relationship, good arguments can be made for both directions (those with high economic well-being can afford better health, yet poor health prevents people from achieving high economic well-being). Thus, the model includes a bidirectional link between objective health and economic well-being (meaning that the relations of objective health with other variables partial out [are net of] economic well-being, and vice versa).

Having proposed the relatively distal or left-hand portion of the model, next we turn to the effects of economic well-being and health on subjective well-being, or the right-hand part of the hypothesized model.

## Effects of Economic Well-Being and Health on Subjective Well-Being

Although popular wisdom suggests that “money can’t buy happiness,” there are conceptual and logical reasons suggesting the contrary, and recent empirical evidence does indeed support a fairly weak but positive relationship between income and subjective well-being (e.g., Diener, Oishi, & Lucas, 2003; Peiró, 2006; Schyns, 2002). Income is thought to be associated with subjective well-being because higher levels of income are typically associated with better living conditions and increased need satisfaction (see Diener et al., 2003; Howell & Howell, 2008). However, this relationship is thought to be nonlinear (the association is stronger at lower levels of income; Howell & Howell, 2008; Schyns, 2002), and social comparison processes diminish its strength (e.g., one compares oneself with those who earn similar incomes; see Watson, 2000).

In this study, however, we are not focusing on income but on economic well-being as indicated by economic self-sufficiency and economic outlook. Although income and economic well-being are likely to be strongly correlated, they represent different constructs. As noted earlier, we see economic well-being as reflecting both earnings and economic self-management. A high income level enables, but by no means guarantees, a high level of economic self-sufficiency and a bright economic outlook. For example, although there is a clear connection between low income and financial distress, people across a wide range of incomes can experience such distress and even declare bankruptcy because debt-to-income variables are better predictors of financial distress and bankruptcy than income (Domowitz & Sartain, 1999; Moorman & Garasky, 2008). Therefore, it is likely that economic well-being, reflecting economic self-sufficiency and economic outlook, relates more strongly to subjective well-being than a measure of pure income. There is also some emerging evidence in support of this expectation; using the 1995–1996 data from the World Values Survey, Peiró (2006) found that financial satisfaction ("How satisfied are you with the financial situation of your household," p. 363) showed strong positive correlations with life satisfaction, ranging between .40 and .71, across the 15 countries included in the survey. With respect to health, the literature is clearer, and better health has been consistently found to be associated with higher subjective well-being or happiness (e.g., Peiró, 2006; Wilson, 1967). Thus, we predict:

> *Hypothesis 4:* There will be positive effects from (a) health and (b) economic well-being to subjective well-being, such that those who report better health and higher economic well-being will also report higher subjective well-being.

# Method

## Participants and Procedure

Participants were individuals enrolled in the Swedish Adoption/Twin Study on Aging (SATSA), a study initiated in 1984 by the Karolinska Institute (Pedersen, 2005). The SATSA was designed to study the environmental and genetic influences on individual differences in aging. Three additional waves were conducted in 1987, 1990, and 1993. The questionnaire was initially sent to all twins from the Swedish Twin Registry who were separated at an early age and raised apart. There was also a control sample of twins who were raised together. All participants were surveyed on items that included health status, how they were raised, work environment, alcohol consumption, and smoking habits, as well as questions about personality and attitudes. Data were also collected starting with the second component from a subsample that was composed of 150 pairs of twins raised apart and 150 pairs of twins raised together. This subsample participated in four waves of in-person testing, which included a health examination, interviews, and tests on functional capacity, cognitive abilities, and memory.

Given the comprehensiveness and depth of the data set, researchers have used the SATSA in investigating various topics, including the heritability of intelligence (Finkel, Pedersen, Plomin, & McClearn, 1998), genetic and environmental influences on personality change (Pedersen & Reynolds, 1998), and biological sources of changes in memory (Reynolds, Jansson, Gatz, & Pedersen, 2006). We are aware of no study that has been published using the SATSA in industrial–organizational psychology, nor any SATSA study linking GMA to health and well-being.

Although there were 1,736 individuals in the SATSA database, various qualifying criteria limited the number of observations available in this study. First, the objective health measure includes some variables that were unusually intensive and invasive in their collection (see Measures section below), so that these measures were collected on only a portion of the sample. Second, like the health measures, measures of GMA were not collected for the entire sample. Third, because intelligence is highly heritable, as revealed by the substantial correlations in intelligence among twins (Bartels, Rietveld, Van Baal, & Boomsma, 2002), including both members of a twin pair in our analysis would mean that the intelligence scores of these individuals are not independent. Accordingly, of study participants who were either monozygotic (identical) or dizygotic (fraternal) twins, we ensured that only one member of the twin pair (chosen randomly) appeared in the data set used in our analyses. Finally, the longitudinal nature of the study meant that, naturally, some degree of sample attrition occurred. Although the attrition rate was relatively low—it was approximately 24% from Time 1 to Time 2—this obviously reduced the sample size further. In the end, 398 individuals met our qualifying criteria for inclusion in the study. For those study participants meeting the qualifying criteria, the average age was 55 years (meaning that the average age was 64 at Time 4), and 54% of participants were female.

## Measures

**GMA.** GMA was assessed with a battery of cognitive ability tests. First, participants completed a Swedish version of the Wechsler Adult Intelligence Scale Information subtest (Jonsson & Molander, 1964). The Wechsler Adult Intelligence Scale consists of 22 items assessing general knowledge (e.g., "What is the population of Sweden?"). Participants were allowed 20 s to answer each question. Second, participants completed a 30-item forced-choice vocabulary test from the Swedish Dureman–Sälde Battery (Dureman, Kebbon, & Osterberg, 1971). Participants were allowed 3.5 min to finish each 15-item section. Third, participants completed a 27-item analogies test (Westrin, 1969) in which they had 3.5 min to finish each of two sections. Fourth, participants completed a 30-item spatial ability test in which they selected one of five figures that differed from the other four (Dureman et al., 1971). Participants had 4 min to complete each 15-item section. Fifth, participants completed Koh's Block Design test, similar to the Wechsler Block Design subtest, in which respondents create designs using colored blocks (Dureman et al., 1971). Each of its seven items is scored (on a 0–6 scale) based on the amount of time the participant takes to correctly complete the design. Sixth, participants completed a figure identification test, a 60-item pattern-matching test assessing perceptual speed and attention (Dureman et al., 1971). Seventh, participants completed a symbol digit test in which they matched digits that correspond to symbols. They had 45 s to complete each of 10 groups of 10 items. Eighth, participants completed a memory test in which they matched names with faces after viewing them for 1 min (DeFries, Plomin, Vandenberg, & Kuse, 1981). Immediate and 30-min delayed recall performances were summed to create a total score. Finally, participants completed a numerical fluency test, which consisted of the sum of the highest number of digits the participant was able to repeat correctly in each direction, ranging from 3 to 9 forward and 2 to 8 backward (Jonsson & Molander, 1964). Respondents were given two trials of different strings of digits for each length span; correct performance on either string was counted toward their final score.

To determine whether a measure of GMA could be extracted from scores on these tests, we factor-analyzed the test scores. Using a principal component analysis with a varimax rotation, we derived a single factor with an eigenvalue greater than 1.0 (eigenvalue = 6.13), which explained 55.72% of the variance in the scales. Using an unweighted least squares analysis with an oblique rotation, we again derived a single factor (eigenvalue = 5.71), which explained 51.92% of the variance in the scales. The average factor loading in principal component analysis was .74; the average loading for the unweighted least squares analysis was .71. On the basis of these results, and following other research (Ree, Earles, & Teachout, 1994), we determined that an overall GMA factor does explain the relationship among the test scales. We computed the GMA factor by standardizing the scales and then averaging them. With the individual test scores as items, the reliability of the scale was $\alpha = .94$.

**Childhood SES.** Childhood SES was measured by a composite variable that reflected, at Time 1, participants' responses to, and interviewer coding of, questions about participants' parents and their household environment as children. Specifically, participants were asked about the highest education of their parents (1 = *elementary school*, 2 = *vocational high school*, 3 = *gymnasium*, 4 = *university or higher*), the prestige of their parents' occupations (averaged across both parents, and assessed on a scale of 1 = *work with no special skill or education* to 7 = *work with considerable responsibility or higher academic degree*), their household environment (household density, or size of house relative to family size), whether the family could afford luxuries such as a second home or cottage, and, finally, two questions about their economic status during childhood: family's economic situation compared with others (0 = *worse than others*, 1 = *about the same as others*, 2 = *better than others*) and how well family's income met their needs (0 = *badly*, 1 = *rather badly*, 2 = *rather well*, 3 = *very well*). A standardized SES variable was formed from these items. The reliability of this scale was $\alpha = .86$.

**Education.** Participants' educational attainment was measured with their responses to an interviewer question asking them about their level of education. Their education was coded as 1 = *elementary school*, 2 = *O level or vocational school or folk high school*, 3 = *gymnasium (A level)*, and 4 = *university or higher*.

**Sex.** In the first survey, participants were asked to report their gender, which was coded 1 = *male*, 2 = *female*.

**Age.** In the first survey, participants were asked to report their age as of January 1, 1985.

**Unhealthy behavior.** Unhealthy behavior was measured with a composite index of two behaviors both prevalent in the populace and generally deemed unhealthy: alcohol consumption and tobacco smoking. For both types of behavior, we considered degree or length of use and overuse–abuse.

Alcohol use was coded on the basis of two items: (a) To assess alcohol use, the total "quantity in grams of alcohol consumed per month," standardized by participants' weight, was assessed at Times 1 and 2 (these scores were then averaged). (b) To assess alcohol overuse–abuse, at Time 1, participants were asked, "How often do you consume more than five bottles of beer or more than one bottle of wine or more than one-half bottle liquor at one occasion?" Responses were coded as follows: 0 = *never*, 1 = *1–3 times a year*, 2 = *4–6 times a year*, 3 = *about once a month*, 4 = *a couple of times a month*, 5 = *once a week*, 6 = *a couple of times a week*, and 7 = *nearly every day*.

Smoking also was assessed with two items: (a) To assess tobacco use, participants were asked, at Time 1, whether they currently were a smoker and, if so, for how long (in years) they had smoked tobacco (cigarettes, cigars, or pipes)—thus this variable reflected length of tobacco use (nonsmokers received a score of zero). (b) To assess tobacco overuse–abuse, participants reported, at Time 1, the highest amount of tobacco smoked per day, and coded as follows: 0 = *none*, 1 = *low smoking* (1–8 cigarettes, 1–3 cigars, or 1–30 grams of pipe tobacco, per day), 2 = *moderate smoking* (9–14 cigarettes, 4–7 cigars, or 31–60 grams of pipe tobacco, per day), and 3 = *heavy smoking* (more than 14 cigarettes, more than 8 cigars, or more than 60 grams of pipe tobacco, per day).

Scores on the four variables were standardized, and an unhealthy behavior composite was computed by averaging them. The reliability of the four-item (comprising the two drinking and the two smoking items) scale was $\alpha = .71$.

**Occupational prestige.** Participants' occupational prestige was assessed by interviewers coding the participants' most recent occupation. Occupations were scored according to a scale of increasing prestige (1 = *unskilled manual laborer*, 2 = *skilled laborer*, 3 = *intermediate "white collar" worker*, 4 = *professional*). Because SATSA researchers found that this variable was positively skewed (i.e., fewer scores at the high end of the distribution than at the low end, or more jobs of lower prestige than those of higher prestige; SK = 0.526 [$SE_{SK} = 0.122$, $t = 4.31$, $p < .01$]), it was transformed by taking its natural log (Pedersen, 2005).

**Objective health.** Because health is a multidimensional construct, we assessed it with three major sources of data (collected at Time 2). First, individuals reported to interviewers whether they suffered from various illnesses and medical conditions, including cardiovascular disease, pulmonary problems (asthma, emphysema), cancer, diabetes, arthritis or other joint problems, glaucoma or other vision problems, ulcer or other gastrointestinal problems, kidney disease, migraines, allergies, back pain, hearing loss, and reproductive problems. Individuals also reported their use of prescription medications to treat 17 medical conditions (cortisone, blood pressure medication, insulin, thyroid medication, antidepressants, etc.). Second, blood samples were obtained from the participants who were identified and agreed to participate. From analysis of the blood samples, the level of triglycerides present in the blood sample was measured, as was the level of glucose. Evidence indicates that high levels of triglycerides are a strong and significant risk factor for coronary heart disease (Abdel-Maksoud et al., 2008). Similarly, high glucose level is an important marker for diabetes, in addition to other illnesses such as pancreatitis (Clemens, Siegel, & Gallwitz, 2004). Third, individuals' psychomotor functioning was assessed with a series of tests (upper and lower extremity coordination, arm strength, hand grip, hand coordination). These assessments were standardized and then averaged to form a health composite. The reliability of the scale was $\alpha = .77$.

**Perceived health.** Perceived health was measured at Time 2 with participants' responses to three subjective questions about their overall health. The three questions were "How would you rate your general health status?" (3 = *good*, 2 = *reasonable*, 1 = *bad*), "How would you rate your present health status compared to three years ago?" (3 = *better*, 2 = *about the same*, 1 = *worse*), and "Do you think your health prevents you from doing things you would like to do?" (3 = *not at all*, 2 = *partly*, 1 = *to a great extent*). Individuals' scores were computed by averaging their responses to the three items; the reliability of this scale was $\alpha = .72$.

**Economic well-being.** Participants' economic well-being was assessed at Time 3 by their responses to seven questions asking them about their economic self-sufficiency and economic outlook. Example questions include "How well does your money cover your needs?" (4 = *very well*, 1 = *quite badly*), "Do you believe that in the future you will have sufficient money to cover your needs?" (1 = *no*, 2 = *yes*), and "Do you regularly (every month) put aside a sum into a savings account, everyman savings, pension insurance, stocks, shares, etc.?" (1 = *no*, 2 = *yes*). Because these variables were measured with different response scales, the items were first standardized, and then a score was computed by averaging the standardized items. The reliability of this seven-item scale was $\alpha = .73$.

**Subjective well-being.** Subjective well-being was measured at Time 4 with participants' evaluation of eight items that described their happiness, satisfaction, and fulfillment in life. Sample items include "These are the best years of my life," "[I] have had more luck in my life than most," "This is [the] most boring time of my life," and "[I] am just as happy now as I was when I was younger." Individuals responded using the following scale: 1 = *completely agree*, 2 = *agree somewhat*, 3 = *neither agree nor disagree*, 4 = *disagree somewhat*, 5 = *completely disagree*. To make high scores reflect high levels of subjective well-being, we reverse-scored the appropriate items and then computed the scale by averaging participants' responses to the items. The reliability of this eight-item scale was $\alpha = .71$.

## Analysis

We tested the hypothesized and alternative models using covariance structure models, estimated with LISREL (Version 8.3; Jöreskog & Sörbom, 1993). Covariance structure models have several advantages relevant to this study, including the fact that they account for the effects of measurement error on the relationships among observed scores; allow estimation of direct, indirect, and total effects; and facilitate comparisons of hypothesized models with alternative models.

Because the variables used in this study were measured with an assortment of methodologies including a battery of established cognitive ability tests (GMA), interviewer ratings on single-item scales (education and occupational prestige), multiple-item scales (e.g., economic well-being, perceived health, and subjective well-being), and physiological indicators (objective health), we tested the relationships proposed in our model using path analysis. That is, in estimating the hypothesized and alternative models, we treated the variables as manifest estimated with measurement error (see Hayduk, 1987, pp. 118–122). We corrected for measurement error by constraining the error term as $\theta_\varepsilon = \sigma_y^2 \times (1 - \alpha_y)$, where $\theta_\varepsilon$ is the error variance for endogenous variables, $\sigma_y^2$ is the variance of variable $y$, and $\alpha_y$ is the reliability of variable $y$. For the one exogenous variable estimated with measurement error—GMA—the formula is $\theta_\delta = \sigma_x^2 \times (1 - \alpha_x)$.

With covariance structure models, it is essential first to examine the overall fit of the model. If the model does not fit the data acceptably, the overall hypothesis that the model is an accurate representation of the data is rejected. In such cases, the coefficients estimated in the model can be biased due to relevant omitted causes (James, Mulaik, & Brett, 1982). We report what is perhaps the most widely used measures of model fit: chi-square, goodness-of-fit index, and adjusted goodness-of-fit index. To these traditional fit statistics, Hu and Bentler (1995) further suggested a combination of standardized root-mean-square residual and comparative fit index (Bentler, 1990). We also report the root-mean-square error of approximation (MacCallum, Browne, & Cai, 2006) and the normed fit index (MacCallum, Roznowski, Mar, & Reith, 1994). Finally, we also report the Akaike information criterion (Akaike, 1987) because it is useful for model comparisons (Tanaka, 1993) and because it adjusts for the parsimony of a model. As Mulaik et al. (1989) noted, the Akaike information criterion "penalizes a model for losses in degrees of freedom resulting from estimating more parameters, when comparing models according to their lack of fit to the data" (pp. 436–437).

# Results

## Descriptive Statistics and Correlations of Study Variables

Table 1 contains the descriptive statistics of and intercorrelations among the study variables. The correlations and standard deviations served as input into the LISREL program.

Table 1
*Means, Standard Deviations, and Intercorrelations Among Study Variables*

| Variable | *M* | *SD* | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. General mental ability (T1) | 0.02 | 0.91 | (.94) | | | | | | | | | | |
| 2. Childhood SES (T1) | −0.03 | 2.54 | .25** | (.86) | | | | | | | | | |
| 3. Sex[a] (T1) | 1.54 | 0.36 | −.04 | −.01 | — | | | | | | | | |
| 4. Age (T1) | 56.51 | 7.85 | −.22** | −.03 | .14** | — | | | | | | | |
| 5. Education (T1) | 1.54 | 0.82 | .44** | .40** | −.13* | −.06 | — | | | | | | |
| 6. Unhealthy behavior (T1–T2) | −0.10 | 0.70 | −.23** | −.07 | .28** | .14** | −.07 | (.71) | | | | | |
| 7. Occupational prestige (T1) | 0.45 | 0.40 | .43** | .24** | −.14** | −.02 | .46** | −.15** | — | | | | |
| 8. Objective health (T2) | 0.09 | 0.43 | .31** | .01 | −.03 | −.15** | .15** | −.15** | .26** | (.77) | | | |
| 9. Perceived health (T2) | 2.35 | 0.41 | .23** | .03 | −.04 | −.05 | .06 | −.04 | .13** | .34** | (.72) | | |
| 10. Economic well-being (T3) | 0.04 | 0.61 | .32** | .14** | −.02 | −.03 | .26** | −.10* | .31** | .26** | .23** | (.73) | |
| 11. Subjective well-being (T4) | 3.30 | 0.61 | .19** | .09 | −.13* | −.13* | .16** | −.05 | .16** | .16** | .26** | .29** | (.71) |

*Note*. Listwise $N = 398$. Where appropriate, coefficient alpha reliability estimates are listed on the diagonal. SES = socioeconomic status; T1 = Time 1; T2 = Time 2; T3 = Time 3; T4 = Time 4.
[a] Coded 1 = male, 2 = female.
* $p < .05$. ** $p < .01$.

## Covariance Structure Model Estimates: Hypothesized Model

Standardized parameter estimates for the hypothesized model are shown in Figure 2. Though not shown in Figure 2, sex and age were used as controls and thus were specified to predict each endogenous variable. Sex significantly and negatively predicted education, occupational prestige, and subjective well-being and positively predicted unhealthy behaviors, meaning that women, on average, had less education than men, worked in less prestigious occupations, engaged in more unhealthy behavior, and had lower levels of subjective well-being.[3] Age positively predicted unhealthy behavior and negatively predicted objective health, meaning that older individuals engaged in more unhealthy behavior and were less healthy.

As Figure 2 shows, GMA positively and significantly predicted education, and education, in turn, positively and significantly predicted occupational prestige. Unhealthy behavior was negatively predicted by GMA, though not by education or childhood SES. Childhood SES did positively and significantly predict education. Supporting Hypotheses 1a and 1b, GMA positively predicted economic well-being and objective health. Consistent with expectations, occupational prestige and unhealthy behavior positively and negatively predicted objective health, respectively. The mediation of unhealthy behavior on the GMA–objective health relationship was statistically significant (Sobel $t = 2.92$, $p < .01$), thus supporting Hypothesis 2.[4] Objective health, in turn, positively and significantly predicted perceived health. Occupational prestige positively predicted economic well-being. The mediated effects of GMA, through occupational prestige, on both objective health (Sobel $t = 3.53$, $p < .01$) and economic well-being (Sobel $t = 3.20$, $p < .01$) were statistically significant, thus supporting Hypotheses 3a and 3b. Perceived health and economic well-being positively and significantly predicted subjective well-being, supporting Hypotheses 4a and 4b, respectively.[5] Finally, both noncausal links, denoted by the bidirectional arrows in Figure 2, were significant: GMA and childhood SES were significantly related, as were objective health and economic well-being.

## Evaluation of Hypothesized Versus Alternative Models

The fit statistics for the hypothesized model are provided in Table 2. By conventional standards, the hypothesized model fit the data well. However, as noted earlier, we tested alternative models to determine whether they might provide a better fit to the data. The first alternative model—which posited full mediation of GMA (dropping direct links of GMA with occupational prestige, objective health, and subjective well-being)—fit the data significantly worse than the hypothesized model, as judged by the chi-square statistic, $\Delta\chi^2(3) = 78.24$, $p < .01$, as well as the Akaike information criterion and other fit statistics. Because Alternative Model 2b (adding a direct link from GMA to subjective well-being) and Alternative Model 3 (adding direct links from occupational prestige to perceived health and subjective well-being) did not fit the data better than the hypothesized model despite being less restrictive, $\Delta\chi^2(1) = 0.08$, *ns*, and $\Delta\chi^2(2) = 0.12$, *ns*, respectively, they also are not preferred over the hypothesized model. Conversely, Alternative Model 2a (adding direct links from GMA to objective and perceived health) did fit the data significantly better than the hypothesized model, $\Delta\chi^2(2) = 17.11$, $p < .01$. Accordingly, it is accepted as a better fit to the data and is used in the subsequent analyses that follow.

Under Alternative Model 2a, the link from GMA to objective health was $\gamma = .24$ ($p < .01$). The variance explained by each structural equation for Alternative Model 2a was as follows: education, $R^2 = 31\%$; unhealthy behavior, $R^2 = 21\%$; occupational prestige, $R^2 = 32\%$; objective health, $R^2 = 20\%$; perceived health, $R^2 = 23\%$; economic well-being, $R^2 = 20\%$; and subjective well-being, $R^2 = 24\%$.

## Total, Direct, and Indirect Effects of GMA on Endogenous Variables

To more clearly illustrate the effects of GMA in the model, in Table 3 we show the total, direct, and indirect effects of GMA on right-hand criterion variables. As shown in the table, the total effects of GMA on the endogenous variables are strongest for occupational prestige, economic well-being, and objective health. This follows the basic logic of the hypothesized model, with these variables being more proximal to GMA than the right-hand variables of perceived health and subjective well-being. However, even in the case of these latter variables, the total effects of GMA are statistically significant and far from trivial in magnitude.

Concerning the role of occupational prestige and education in explaining the effects of GMA on economic well-being and health, an examination of Table 3 and Figure 2 is instructive. Specifically, whereas the entire mediational sequence for the links of GMA and occupational prestige to economic well-being and health is significant, supporting Hypothesis 3, the results are only partially sup-

[3] The correlation between gender and unhealthy behavior is not surprising with an understanding of gender differences in health and health behavior in Sweden. Even in a country renowned for its gender equality, Swedish women suffer from many health problems to a greater degree than men (Hemström, Krantz, & Roos, 2007). Indeed, a recent population-level study revealed that though the average differences were small, Swedish women were more likely to suffer from ill health at every education and age group studied (Batljan, Lagergren, & Thorslund, 2009). There is some evidence that these gender differences are produced by a greater propensity of Swedish women to engage in unhealthy behavior. For example, Swedish women are 22% more likely than Swedish men to smoke daily (Ali et al., 2009). Another study revealed that Swedish women were more likely to attempt suicide (Sjögren, Valverius, & Eriksson, 2006) and are more likely to use certain drugs such as stimulants, opiates, and tranquilizers (though less likely to use alcohol and marijuana; Byqvist, 2006). Finally, in the SATSA database, the alcohol use measure was standardized by weight.

[4] The results indicated that education had a small but significant indirect effect on objective health of .06 ($t = 2.17$, $p < .05$), meaning that unhealthy behavior and occupational prestige explain to some degree why educated people enjoy somewhat better health (net of the effects of GMA on health).

[5] Hypothesis 4a was stated in general terms—from health (meaning both objective and subjective health) to subjective well-being. The results in Figure 2 support the link from subjective health to subjective well-being. As for objective health, we show in Figure 2 that objective health has an indirect effect on subjective well-being through subjective health. Thus, the results support Hypothesis 4a in linking health to subjective well-being, but also suggest, as might be expected, that objective health affects subjective well-being through perceived health.

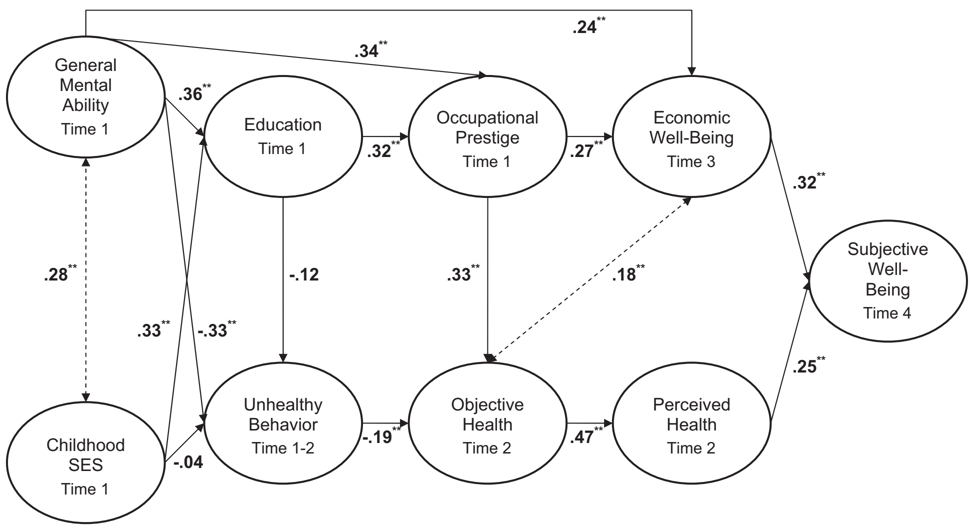


*Figure 2.* LISREL parameter estimates testing hypothesized operational model ($N = 398$). Age and sex were control variables in each structural equation (used to predict every endogenous variable). SES = socioeconomic status. $^{**}$ $p < .01$.

portive for education. Specifically, whereas the mediational sequence for GMA, education, occupational prestige, and economic well-being is significant, the link from education to objective health is not significant.

## Effect Size Estimates

To illustrate the bottom-line total effects of GMA, we used the binomial effect size display (BESD; Rosenthal & Rubin, 1982; Rosnow & Rosenthal, 2008), which calculates differences in achieving a threshold (in this case, above-average levels of the endogenous variables) as a function of above- and below-average scores on the explanatory variable. As noted by Rosenthal, Rosnow, and Rubin (2000, p. 17), the BESD reveals a differential "success rate" as a function of the explanatory variable, meaning that, in this case, the percentage of individuals who would be classified as above or below average on each endogenous variable as a function of being above or below average on GMA. The BESD is a conjecture—a prediction of what would happen if the results of a study hold into the future (Grissom & Kim, 2005). However, by providing a practical effect size estimate, the BESD makes, as J. Cohen (1988, p. 533) noted, "a valuable contribution to the understanding of [effect size]."

As shown in Table 4, the BESD results for GMA suggest large criterion differences between high (above average) and low (below average) levels of GMA. For example, one would predict that 72.5% of high-GMA individuals would have above-average levels of occupational prestige, compared with just 27.5% of low-GMA individuals. Of the endogenous variables in Table 4, the smallest difference is for subjective well-being, but even there, 60% of high-GMA individuals would be expected to have above-average levels of subjective well-being, compared with 40% of low-GMA individuals. The BESD results for childhood SES and education, though impressive for occupational prestige and not trivial for every criteria, are much smaller in magnitude. In most cases, they result in a small percentage point difference (e.g., 51% of individuals who had above-average SES as children are predicted to have

Table 2
*Fit Statistics of Hypothesized and Alternative Models*

| Model | $\chi^2$ | *df* | $\chi^2/df$ | GFI | AGFI | CFI | NFI | SRMR | RMSEA | AIC |
|---|---|---|---|---|---|---|---|---|---|---|
| Hypothesized | 41.83 | 36 | 1.16 | .98 | .96 | .99 | .94 | .04 | .02 | 101.83 |
| Alternative 1 | 120.07[a] | 39 | 3.08 | .95 | .91 | .86 | .82 | .08 | .07 | 174.07 |
| Alternative 2a | 24.72[a] | 34 | 0.73 | .99 | .98 | 1.00 | .96 | .03 | .01 | 88.72 |
| Alternative 2b | 41.75 | 35 | 1.19 | .98 | .96 | .99 | .94 | .04 | .02 | 103.75 |
| Alternative 3 | 41.71 | 34 | 1.23 | .98 | .96 | .99 | .94 | .04 | .02 | 105.71 |

*Note.* Alternative 1: Full mediation: Drop direct links from general mental ability (GMA) to occupational prestige, objective health, and subjective well-being. Alternative 2a: Direct effects (GMA–health): Add direct links from GMA to objective and subjective health. Alternative 2b: Direct effects (GMA–subjective well-being): Add direct link from GMA to subjective well-being. Alternative 3: Direct effects (prestige): Add direct links from occupational prestige to perceived health and subjective well-being. GFI = goodness-of-fit index; AGFI = adjusted goodness-of-fit index; CFI = comparative fit index; NFI = normed fit index; SRMR = standardized root-mean-square residual; RMSEA = root-mean-square error of approximation; AIC = Akaike information criterion.
[a] Difference in chi-square from hypothesized model is significant at $p < .05$.

Table 3
*Direct, Indirect, and Total Effects of General Mental Ability on Endogenous Variables*

| Variable | Direct effect | Indirect effect | Total effect | % mediated |
|---|---|---|---|---|
| Unhealthy behavior | $-.31^{**}$ | .04 | $-.27^{**}$ | 11.43[a] |
| Occupational prestige | $.33^{**}$ | $.12^{**}$ | $.45^{**}$ | 26.67 |
| Objective health | $.24^{**}$ | $.12^{**}$ | $.36^{**}$ | 33.33 |
| Perceived health | $.13^{*}$ | $.15^{**}$ | $.28^{**}$ | 53.57 |
| Economic well-being | $.28^{**}$ | $.11^{**}$ | $.39^{**}$ | 28.21 |
| Subjective well-being | | $.20^{**}$ | $.20^{**}$ | 100.00 |

*Note*. $N = 398$. Results are from Alternative Model 2a (direct effects of general mental ability on health). Direct, indirect, and total effects are from completely standardized solution for Alternative Model 2a (and thus may provide slightly different results from hypothesized model test results in Figure 2). Percent mediated is calculated by dividing the indirect effect by the total effect. Direct effect from general mental ability to subjective well-being is not included in this model.
[a] Because the direct and indirect effects were in opposite directions, the mediation of the total effect was based on the range between direct and indirect effects (which may otherwise be interpreted as a suppression effect).
$^{*} p < .05$. $^{**} p < .01$.

above-average objective health, compared with 49% of children who had below-average SES; of course, this is controlling for GMA and education).

## Common Method or Source Variance

Common method or source variance is one of the more focal problems in correlational research. Though we consider some of the methodological means through which we attempted to mitigate common method variance in the Limitations section of the Discussion, here we undertake two statistical analyses reviewed by Podsakoff, MacKenzie, Lee, and Podsakoff (2003) as means of addressing the issue. First, we used Harman's single-factor test, whereby we subjected the study variables to an exploratory factor analysis and then examined the unrotated factor solution. To the extent that common method variance is substantial, a single factor will emerge. When performing the analysis in our study, 10 factors emerged, with the strongest factor accounting for only 20.77% of the variance in the items. This first factor actually was the GMA factor (average loading of the GMA scales on this factor = .690)—the average unrotated loading for the non-GMA items on this factor was only .193. The second factor also was apparently not a strong method factor—the average factor loading was .111 (.231 excluding the GMA items). These pieces of evidence suggest that a strong general method factor does not exist in these data.

Because the Harman test has numerous limitations, we undertook another statistical analysis reviewed by Podsakoff et al. (2003). Specifically, we performed a partialing analysis, wherein the researchers "obtain a measure of the presumed cause of the method biases (e.g., social desirability, negative affectivity) and compare the differences in the partial correlation between the predictor and criterion variables with their zero-order correlation" (Podsakoff et al., 2003, p. 889). For our measure, we used a 14-item (e.g., "Often worry too long," "Often anxious") measure of neuroticism ($\alpha = .80$), which both Brief (1998) and Watson (2000) have argued is equivalent to negative affectivity (Judge, Heller, and Klinger, 2008, reported a corrected correlation between neuroticism and negative affectivity of .84).[6] Using a measure of neuroticism, we conducted a path analysis with and without the neuroticism measure included. In comparing the results between the two models, no coefficient changed in significance, and the average difference in coefficient estimates was only .009 (range: .00–.05). The correlation between the two vectors of estimates was .99. Thus, if one can say that neuroticism or negative affectivity represents a "nuisance factor" (Burke, Brief, & George, 1993) that might reflect method variance, then partialing out this nuisance factor has very little effect on the path coefficients in the model.

# Discussion

In this study, we found support for a model linking GMA to a variety of outcomes ranging from occupational prestige and economic well-being to health and subjective well-being. With respect to predicting subjective well-being, the end outcome in our model, although we did not formally hypothesize a relationship between GMA and subjective well-being, an indirect effect has been implicit in our theorizing linking mental ability to occupational level, to economic well-being, and to health, and these three outcomes to subjective well-being. This effect was supported by the data. At a glance, this finding may seem surprising. From Ernest Hemingway's famous quote, "Happiness in intelligent people is the rarest thing I know," to folk wisdom reflected in such statements as "Ignorance is bliss," there is no shortage of anecdotal evidence favoring a *negative* relationship between general cognitive ability and subjective well-being. Our findings suggest that popular wisdom does not reflect reality, at least in this case. Shortly, we reflect further on this apparent contradiction.

Beyond the effect of GMA on subjective well-being, we found clear support for the links of GMA to both economic and physical well-being (both objective and subjective health assessments). Thirty years ago, Jensen (1979, p. 313) boldly proclaimed, "IQ has more behavioral correlates than any other psychological measurement." Our findings provide important support for this assertion, and further suggest the presence of education and occupation as linking mechanisms explaining how mental ability translates into economic, physical, and psychological well-being. Not only did we find support for the effects of GMA on the indicators of well-being, but our results suggest that the practical implications of GMA for well-being are substantial. That is, the effect size estimates that we present in the Results section show that the effects of GMA on important life outcomes are practically, as well as statistically, significant. For example, our results indicate that one should expect 68% of individuals with above-average GMA to have above-average levels of objective health, compared with just 32% of individuals with below-average GMA.

Cumulatively, our findings are important because they show that GMA influences wide-ranging aspects of human well-being, and it

[6] As Podsakoff et al. (2003) noted, and as Williams, Gavin, and Williams (1996) and Spector, Zapf, Chen, and Frese (2000) commented with specific reference to negative affectivity, a problem with the partialing approach is that it may partial out substantively valid variance. Although this concern is well noted, it is at least of interest to determine what effect, if any, such partialing procedures have on a model test.

Table 4
*Percentage of Individuals With Above-Average Criterion (Endogenous Variable) Scores Based on Above-Average Scores for Explanatory Variables (General Mental Ability, Childhood Socioeconomic Status [SES], and Education)*

| | General mental ability | | Childhood SES | | Education | |
|---|---|---|---|---|---|---|
| Endogenous variable | Above average | Below average | Above average | Below average | Above average | Below average |
| Unhealthy behavior | 36.5 | 63.5 | 49.5 | 50.5 | 44.0 | 56.0 |
| Occupational prestige | 72.5 | 27.5 | 55.3 | 44.7 | 66.2 | 33.8 |
| Objective health | 68.0 | 32.0 | 51.2 | 48.8 | 52.8 | 47.2 |
| Perceived health | 64.0 | 36.0 | 50.5 | 49.5 | 51.2 | 48.8 |
| Economic well-being | 69.7 | 30.3 | 51.4 | 48.6 | 54.1 | 45.9 |
| Subjective well-being | 59.9 | 40.1 | 50.6 | 49.4 | 51.6 | 48.4 |

*Note*. Results are based on binomial effect size display (Rosenthal & Rubin, 1982; Rosnow & Rosenthal, 2008), calculated from total effects from Alternative Model 2a.

does so through multiple pathways (health-relevant behaviors, education, and occupational prestige). By proposing and supporting these mediating pathways, and incorporating three aspects of well-being in the model, this study integrates and extends previous research that has linked GMA to single well-being outcomes (e.g., health). Importantly, the effects of GMA on the mediators and outcomes were estimated while controlling for childhood SES, thus eliminating the "third variable" alternative explanation for the association between GMA and its correlates. We believe this is an important contribution particularly with respect to predicting subjective well-being, because previous research on GMA and subjective well-being (e.g., Campbell et al., 1976; Diener & Fujita, 1995) did not consider this alternative explanation.

In more specific terms, we found support for the mediated links that we hypothesized. Importantly, unhealthy behaviors mediated the effect of GMA on objective health, thus supporting Gottfredson's (2004) explanation based on the link between GMA and health-relevant behaviors. It is interesting that although education did not significantly predict unhealthy behaviors, it had a small but significant indirect effect on objective health through occupational prestige, which speaks to the importance of occupational differences in influencing health. It is also possible that education would predict a broader measure of health-relevant behaviors, but such a measure was not available for the current study (we discuss this in more detail below).

With respect to the interrelations among the economic, physical, and psychological well-being outcomes, our results clearly show that even though health and economic well-being are related, they independently predict subjective well-being. In the context of our methodology for measuring health (we used both objective and subjective measures), we believe this finding contributes to the literature on subjective well-being by going beyond typical investigations that estimate the extent to which people's subjective satisfaction with various aspects of their lives (including health) influences their life satisfaction or subjective well-being (see Heller, Watson, & Ilies, 2004).

## Implications for Theory and Practice

These findings have implications for theoretical models of subjective well-being and happiness. Although subjective well-being theory acknowledges the role of stable individual differences, it focuses mostly on differences in personality traits and does not consider GMA (see Heller et al., 2004). Our findings clearly suggest that a comprehensive theoretical account of personological influences on subjective well-being should include GMA. Furthermore, this study not only provides empirical evidence for the existence of a positive relationship between GMA and various aspects of well-being, but does so by anchoring these results within a theoretical model that was tested with longitudinal data, and these features have been underscored as important future directions by Diener et al. (2003) in a review of the well-being literature.

Our finding of a positive relationship between GMA and subjective well-being (through the mediating processes illustrated in our model) may seem surprising given the conventional wisdom suggesting a negative relationship between these two variables. Science, of course, does not always hew to line of conventional thought. The empirical evidence with respect to the association between GMA and specific indicators of subjective well-being has been either inconclusive (e.g., Ganzach, 1998) or supportive of a positive relationship (Campbell et al., 1976; Judge et al., 1999; Sigelman, 1981). Our results, though confirming that the relationship is not strong, also suggest that the association does not disappear when controlling for other relevant influences, including education and SES in childhood.

In addition to informing theory, the findings presented in this article can have implications for employees and employers. Employee health is an important issue for organizations; average health care premiums for employers in 2008 were $4,704 for single coverage and $12,680 for family coverage, and these premiums have been steadily rising every year (Claxton et al., 2008). Moreover, health-related absenteeism leads to substantial costs due to lost productivity. On the basis of these findings, employers might be tempted to reduce health care costs by selecting employees on the basis of GMA. Although our results suggest the benefits of such a practice, the rationale behind it is unlikely to pass legal muster. Fortunately, the productivity advantages of GMA mean that its use in personnel selection can be justified on those grounds. In short, employers are free to benefit from a healthier work force produced by selecting on the basis of GMA, but they are not free to justify the use of GMA on those grounds.

A second implication of these findings is on a more macro scale. Though between-individual variations in GMA are substantially genetic (Bouchard, 1996; Jensen, 1998; Plomin & Neiderhiser, 1991), this does not mean that GMA is wholly exogenous to the environment. Indeed, both maternal nutrition and early child-rearing environment appear to play a role in the "Flynn Effect" (Flynn, 1987)—increases in measured intelligence over the past 80 years (Lynn, 2009). By showing that GMA matters to many types (both objective and subjective, and both work and life) of outcomes, societal investments in maternal nutrition, early child rearing, and other early human capital investments may provide manifold benefits to their recipients and, ultimately, to employers and society. The benefits of intelligence are not limited to economic ones, and investments in intelligence may produce economic, health, and social benefits.

## Limitations

As with any study, this research has important limitations to acknowledge. First, our behavioral mediator for the relationship between GMA and objective health included only two unhealthy behaviors. It would have been desirable to include more unhealthy behaviors and also to consider health-promoting choices that are associated with higher GMA, such as adopting healthy diets, exercising, and reducing sun exposure. Future research considering a broader array of health-relevant behaviors would probably find that those behaviors have a stronger effect on objective health than what we found and that the behaviors perhaps fully mediated the effect of GMA on objective health. However, we cannot substantiate this speculation with our data because such broader indicators of health-relevant behaviors were not available in this data set.[7]

Second, some of the constructs included in the model (e.g., economic well-being, self-reported health, subjective well-being) were self-reported, which raises the question of whether common source bias explains, at least in part, our results. In addition, the correlational nature of study does not support strong causal inferences. However, that the core variables (GMA, objective health, occupational prestige) were not assessed solely with self-report instruments, that the model is longitudinal with four successive waves of data collection spanning over 9 years (making the estimates, arguably, conservative), and that even those self-reported variables were assessed with interviews (rather than surveys) all should alleviate, though admittedly not entirely eliminate, these concerns. For example, because GMA was measured with a comprehensive battery of tests, and health was measured with a multifaceted objective approach in addition to the subjective reports, the associations of GMA and objective health to subjectively measured variables cannot be influenced by common source or method bias.[8] We also present statistical analyses that address this issue in Common Method or Source Variance in the Results section. Nevertheless, we recognize that common source bias was not eliminated for all the relationships included in the model and that temporal precedence is a necessary but not sufficient condition for establishing causality.

A third limitation relates to the generalizability of the findings; as mentioned, our data were collected in Sweden. Because Sweden's cultural values (of all countries studied on Hofstede's, 2001, cultural values, Sweden scores the lowest on masculinity), health of its populace (the life expectancy of its citizens is among the world's highest; World Bank, 2009), and health care system (Sweden's health care expenditures as a percentage of gross domestic product are among the lowest in western Europe and North America; World Factbook, 2008) are unusual, our results may not be applicable to other national and cultural contexts. Nevertheless, GMA findings in other areas have been generalized (such as job performance; see Schmidt & Hunter, 2004). Furthermore, the nature of the construct itself suggests that the processes reflected in individual differences in GMA (comprehension, learning from experience, dealing with complexity) are likely to operate in a similar fashion when predicting the outcomes discussed in this study in other contexts.

Finally, although we demonstrated the importance of occupational prestige in predicting objective health and economic well-being, we must acknowledge that occupational prestige is neither the sole nor a perfect and complete measure of career success. Including other aspects of career progress such as salary and ascendancy (or promotions received) would certainly add to the completeness of our model.

## Directions for Future Research

As we mentioned above, we examined only a set of specific unhealthy behaviors in our article. There could be substantial value in examining a more varied set of health-relevant behaviors, including behaviors that have positive (such as exercise, adoption of healthy diets, and seeking preventative health care) as well as negative (such as sedentary lifestyle, various high-risk behaviors, and inadequate sleep) effects on an individual's health. Such an approach could provide a more complete understanding of the relationship between GMA and health by identifying which behaviors could potentially be of greater importance in explaining this link, and whether GMA equally or differentially predicts various types of health-related behaviors.

Moreover, we previously mentioned the importance of our findings for conducting interventions at the organizational and societal level to improve health through promoting activities positively

[7] A reviewer noted that high-GMA individuals may report engaging in fewer unhealthy behaviors so as to maintain an image of good health or wise choices (even if their actual choices were no better). One indirect way of addressing this issue is to determine whether GMA correlates more strongly with the self-reported (participants reported to interviewers) objective health items (e.g., whether the individual suffered from cardiovascular disease and other specific illnesses) compared with the objective health items produced by blood or physical tests (e.g., blood glucose level or arm strength). In general, the correlations of GMA with the test-based items (e.g., $r = .25$, $p < .01$, with the manual dexterity test) were slightly stronger than the correlations of GMA with the interviewer-reported objective health items (e.g., $r = .15$, $p < .01$, with the illness checklist), casting some doubt on this interpretation.

[8] It is true that some of the items in the objective health scale were self-reported in that, for some items, individuals reported whether they suffered from specific health conditions (angina, asthma, phlebitis, etc.). However, if these items were removed from the measure, the correlation of the scale with GMA was .36 ($p < .01$), compared with the correlation for the full measure, .31 ($p < .01$), as reported in Table 1.

related to health, and providing information about activities negatively related to health that should be avoided. Future research could examine the effectiveness of such interventions in altering health-related behaviors, what types of interventions are more effective, and who benefits more from interventions aimed at changing health-relevant behaviors. Furthermore, such investigations can examine whether changes in levels of behavior can ultimately weaken, or even eliminate, the links between GMA and health-related behavior.

Finally, Gottfredson (2004) underscored the importance of functional and health literacy in predicting health and economic outcomes (and thus, individual well-being). Examining the relationship of GMA with both types of literacy can provide an important complimentary approach to the investigations of behavior discussed above. That is, investigating whether GMA predicts the possession of knowledge needed by individuals to function in their daily environment and to make informed choices about economic and health matters, can explain the subsequent behaviors they engage in and provide a more comprehensive examination of the causal chain presented in this article.

## General Contribution

Besides the specific areas of contribution discussed earlier, at a broader level, we believe this study contributes to the literatures on individual differences in career success and well-being by proposing and supporting an integrated model that illustrates the importance of GMA for economic, occupational, physical, and subjective well-being, even when controlling for differences in childhood SES. Importantly, this model includes mediating mechanisms (unhealthy behaviors, education, and occupational prestige) that explain the effects of GMA on well-being, which may suggest potential interventions aimed at reducing inequalities in various aspects of well-being. The findings with respect to the outcomes of occupational prestige also contribute to the literature on careers by showing just how encompassing are the implications of this (admittedly incomplete) aspect of extrinsic career success for individuals (occupational prestige had significant effects on all indicators of well-being, including objective health; see Table 4). Finally, we contribute to the literature on subjective well-being by showing that economic and physical well-being independently influence individuals' self-assessment of their psychological well-being.

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