Contribution of Education to Health and Life Satisfaction in Older Adults Mediated by Negative Affect

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Objectives: The authors developed a model of relationships between two enduring attributes (educational attainment and negative affect) and two indicators of successful aging (health and life satisfaction). **Methods**: A probability sample of 1,177 participants (age 55 and older) were interviewed four times at 6-month intervals. Structural equation models were developed based on the authors' hypothetical model proposing a mediating effect of negative affect between health and successful aging. **Results:** As predicted, education and negative affect both were directly related to health and life satisfaction. Also, as predicted, negative affect mediated the relationship between education and successful aging indicators. **Discussion**: Education appears to confer a lifelong advantage for healthy aging. Part of this advantage is accounted for by the relationship between education and trait negative affect. Higher educational attainment is related to lower levels of trait negative affect; lower negative affect results in better health and life satisfaction.

A common thread across many areas of gerontology is the attempt to identify factors that distinguish those older adults who age well from those who do not. Understanding successful aging has theoretical, practical, and policy implications. Research has led, in this decade,

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to the development of a variety of models for successful aging (e.g., Baltes & Baltes, 1990; Bond, Cutler, & Grams, 1995). These models share the fundamental assumption that successful aging is a result of a lifelong developmental process that involves the combination or interaction of traits or predispositions present at birth or in early life and cumulative life experiences. Successful aging builds on a life history of successful adaptation, which in turn, is a result of interactions among inherited and learned personality attributes and levels of adversity (or advantage) and resources. Tracking this adaptational process into late life, it becomes difficult to tease out contributions to successful aging by past life attributes or experience and contributions by late-life experiences. The present study focuses on lifelong attributes as represented by personality variables and education in their contribution to successful aging.

Two commonly used indicators of successful aging are health and life satisfaction (also frequently referred to as *subjective well-being*). Both of these indicators were included by Baltes and Baltes (1990) in their list of criteria for successful aging taken from the gerontology literature. Fries (1990) emphasized that the goal of successful aging should be optimizing life expectancy while minimizing morbidity. Berkman et al. (1993) used both physical and cognitive functioning as indicators in the MacArthur Foundation study comparing high functioning or successful aging older adults to those with "average" functioning. Rudinger and Thomae (1990) suggested that, historically, life satisfaction has been considered the most salient indicator of successful aging, citing earlier work by Havinghurst (1961) and Williams and Wirth (1965).

The specific predictors of life satisfaction and health used in this study were education and negative affect. Education was thought to represent a lifelong resource; negative affect was taken as a personality trait. The relationship of each of these factors to indicators of well-being or adjustment in late life has received strong empirical support. Based on a review of that empirical literature, we developed a hypothetical model representing the relationships among education, negative affect, and health and life satisfaction and tested that model using prospective data from a probability sample of middle-aged and older adults.

EDUCATION AND SUCCESSFUL AGING

Indicators of socioeconomic status, particularly education and income, are among the strongest correlates of both health and life satisfaction. Manton, Stallard, and Corder (1997) studied National Long Term Care Surveys from 1982 to 1991 and found that persons with 8 or more years of education function well longer and live longer than those with less than 8 years of schooling; at age 65, the education advantage for women was more than 7 years of life expectancy, and for men, it was about 2 years. Men and women with at least a high school education consistently rate their health as older adults as better than those who did not complete high school; this is particularly true for the 55-to-64 age group (Simonsick, 1995). Education level has been related to various medical conditions (e.g., Holme, Helgeland, Hjermann, Leren, & Lund-Larson, 1977; Pinsky, Leaverton, & Stokes, 1987) and to physical functioning (Berkman et al., 1993). Berkman et al. (1993) reported that whereas 91% of their low-functioning older adults had less than 12 years of education, 78% of their high-functioning older adults had this education level. They concluded that the most consistent finding and one of their major findings was the association of poverty and lower levels of education with poor functioning in older adults. Hirdes and Forbes (1993) found education to be related (= .58) to remaining in good self-reported health during a 10-year period for middle-aged males. Bosworth et al. (1999) found a correlation of .29 between education and self-reported health. Desirable functioning in older old adults (70 and older) was found by Smith and Baltes (1997) to be related to education, health, functional capacity, and survival (3-year mortality). Mulcahy, Hickey, Daly, and Graham (1984) reported finding that education had an independent inverse relationship to cardiovascular disease that was as strong in magnitude as the effects of cigarette smoking, high diastolic blood pressure, weight, and plasma cholesterol combined, suggesting that education operates as a strong protective factor against heart disease compared to these more widely publicized risk factors. Teri, McCurry, Edland, Kukull, and Larson (1995) found that the rate of cognitive decline in Alzheimer patients increased with years of education but suggested that this was because cognitive dysfunction is not observed

in more highly educated people until later in the progression of the disease. Teri et al. concluded that education is an important substantive variable in the etiology and natural progression of Alzheimer's disease and should not be treated simply as a control variable, which has been the case in most studies. Thus, the relationship between education level and health status is now well established. What is not established is the reason for this relationship.

A relationship between education and life satisfaction or subjective well-being is also a consistent finding. Larson (1978) concluded from a review of a wide variety of studies during a 30-year span that health had the strongest relationship to subjective well-being, followed by social class indicators of income, occupation, and education, with some indication of a curvilinear relationship with education (Clark & Anderson, 1967). Leonard (1981-1982) found education to be correlated .21 with life satisfaction. Markides and Martin (1979) in their path model found education to be related to life satisfaction in low-income older males (= .38).

A higher level of education clearly confers an advantage for successful aging, yet as Teri et al. (1995) imply, in psychological research education typically serves as a control variable and is paid relatively little attention as a construct. The mechanisms by which education may affect adjustment are important for both theoretical and practical considerations yet remain unclear. Level of education is likely to be influenced by the hereditary factor of general intelligence, by parental attitudes and influences toward educational attainment, and by availability of family resources that could provide opportunities for educational advancement. After young adulthood and after the typical maximum number of years of education is reached, those with more years of education would be expected, on the average, to have better occupational opportunities and corresponding better financial and social status through their young and middle adulthood years (i.e., to more likely be "successful" by society's standards). Thus, as a marker, education would encompass relative advantages of various kinds over the life span that would consequently provide a foundation for successful aging in older adulthood.

EDUCATION, NEGATIVE AFFECT, AND SUCCESSFUL AGING

A tendency to high negative affect is a presumed global predisposition similar to the "Big Five" personality trait of neuroticism (McCrae & Costa, 1987). Low negative affect, or happiness, has been found to be more strongly related to a long-term propensity for happiness in older adults than to current conditions such as housing, finances, health, and activity level (Stones & Kozma, 1986a, 1986b). Negative affectivity has generally been found to be related to perceived or self-reported health but not to objective health indicators (Costa & McCrae, 1987; Watson & Pennebaker, 1989) and to be related to well-being (Brief, Burke, George et al., 1988) or psychological health (Clark & Watson, 1991).

Negative affectivity has figured prominently in the "top-down" versus "bottom-up" views of subjective well-being (Diener, 1984), which is a heuristic formulation that can also be applied to successful aging. The top-down view proposes that individuals have an intrapsychic determinant that dictates their view of the world; those with a propensity for negative affectivity will interpret the world and see themselves in pessimistic and unhappy terms. The bottom-up view proposes that the individual's well-being results from a summation or synthesis of life experiences; if the preponderance of experiences has been happy, then the individual will have a high level of well-being (Brief, Butcher, George, & Link, 1993; Diener, 1984). To the extent that negative affectivity has a temperamental or genetic component, this trait would be expected to influence educational choices and accomplishments (a top-down view). From the bottom-up view, the resources and opportunities that the marker of education represents would influence the development of negative affectivity; less educational success and, consequently, less financial and social status would result in higher levels of negative affect late in life. Whereas these alternative hypotheses are difficult to differentiate in a late-life sample, either view predicts an inverse relationship between education and negative affectivity in late life.

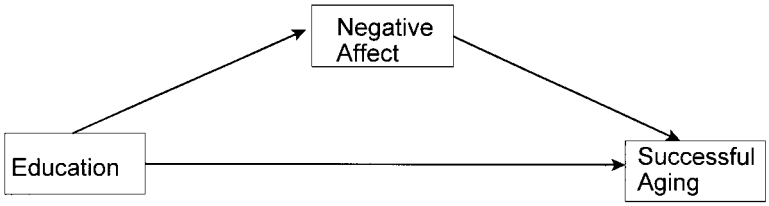

Figure 1. **Conceptual model illustrating relationship among education, negative affect, and successful aging.**

EDUCATION AND SUCCESSFUL AGING: A MEDIATIONAL MODEL

The foregoing review of the literature suggests that the established relationship between education and successful aging may be partially explained or mediated by personality characteristics such as negative affect. Lack of educational advantage may contribute to stable levels of negative affectivity, which then have adverse effects on health practices and expectations regarding satisfaction in later life. Rhodewalt and his colleagues (Rhodewalt & Agustsdottir, 1984; Rhodewalt & Zone, 1989; Smith & Rhodewalt, 1986) in their studies of hardiness suggested that nonhardiness may be a component of the trait of negative affectivity and that this trait may be part of a "stress-engendering" constellation that includes negative appraisals of self, others, and situations. Rhodewalt and Zone (1989) suggested that negative affect and negative appraisals lead to choices and evaluations of situations and the interpersonal behaviors of others that create highly stressful social worlds, including stressful and undesirable events, which in turn are detrimental to good health and high satisfaction with life.

Figure 1 illustrates the hypothesized relationships among the variables examined in this study. Education and negative affect were expected to have independent, direct effects on life satisfaction and health. In addition, education was expected to be related significantly to stable levels of negative affectivity. The inclusion of negative affect was expected to mediate or attenuate the impact of education on health and life satisfaction.

ANALYTIC APPROACH

Testing the model in Figure 1 presents an important dilemma related to our data set. Although this data set is prospective in later life, it is not prospective in the sense implied in Figure 1. The relationship between education and negative affect would have been established well before middle age, and therefore, we would not expect late-life change in negative affect to be affected by education. A test of the causal relationship between education and negative affect would require a prospective study beginning in late adolescence or early adulthood. Similarly, given that we would expect such personality variables to be stable in later life, their relationship to health and life satisfaction would primarily be accounted for by the lifelong relationship between personality factors and the general propensity to be healthy and happy—or "trait" health and "trait" life satisfaction. Typical path analytic approaches to testing similar models employ prediction of change in health or life satisfaction from one wave to another by entering previous levels of the same variables in hierarchical regression analyses, followed by the predictors. Such an approach has little to say about stable, trait relationships but rather speaks to prediction of residual state characteristics once the trait stability has been removed.

We chose to use a structural equation analysis strategy to deal with this analytic dilemma. Structural equation analyses allowed us to make good use of the prospective nature of our data while recognizing the stability or traitlike nature of our variables. Using measures from Waves 1 to 3, we constructed a measurement model of trait negative affect. The resulting latent variable represents the commonality in the measures of the variable at each wave; the residuals can be conceptualized as state measures of the variable or representing unique variance at Wave 1, 2, and 3, respectively. As with the residuals in regression models, these residuals contain some combination of measurement error and time-related fluctuations in negative affect that are unrelated to initial levels of the trait. Put another way, this approach essentially defines a trait by the variance shared by individuals' scores on the same measure across time. Any change in scores from one wave to the next that is unrelated to levels of the trait at other waves is residualized in the error terms. Similar measurement models of trait health and trait life satisfaction were constructed from those

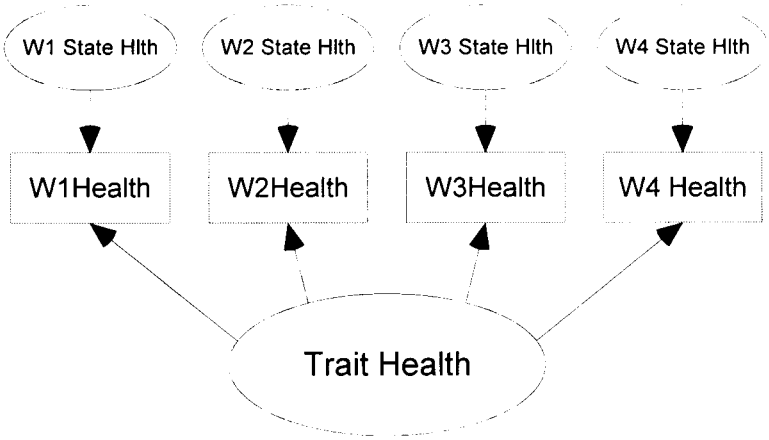

Figure 2. **Example of trait health latent variable using four waves of data.**
Note. W1 = Wave 1. W2 = Wave 2. W3 = Wave 3. W4 = Wave 4.

measures at Waves 1 through 4.[1] For illustrative purposes, Figure 2 shows the measurement model for health.

The stability of the traits in these models reflects the degree to which scores at any given wave are predictable by scores at other waves. This does not mean there is no change across waves, only that this change is not predictable by knowing scores at other waves. For example, there could be a steady decline in negative affect across waves, although all people measured retained the same rank orders. This would produce a highly stable trait in the sense of psychometric validity, which actually changes over time. Structural equation modeling (SEM) allows some limited exploration of the meaning of the residuals as well by relating them to one another or to other measured or latent variables.

The specific predictions of this study, then, were as follows:

1. Direct effects of education: Education would be significantly related to trait negative affect, trait health, and trait life satisfaction.
2. Personality mediator: Trait negative affect would mediate the relationships between education and trait health and trait life satisfaction.

Criteria for mediators. Baron and Kenny (1986) have discussed (in terms of path models) the conditions under which a variable may be

said to operate as a mediator. Essentially these conditions are as follows: (a) The independent variable must be significantly related to the dependent variable; (b) the independent variable must be significantly related to the presumed mediator; (c) the presumed mediator must be significantly related to the dependent variable; and (d) after the mediator is included, the previous significant relationship between the independent variable and the dependent variable is no longer significant. Baron and Kenny state that the strongest demonstration of a mediator is the case when the previous relationship between the independent and dependent variables is reduced to zero; this would be evidence for a single, dominant mediator. They note, however, that because most areas in psychology are concerned with phenomena that have multiple causes, a more realistic appraisal of mediators is that they significantly reduce the relationship between the independent and dependent variables. A significant reduction in that relationship would demonstrate that the mediator is clearly potent, although not so dominant that it is both necessary and sufficient for the explanation of the relationship between the independent and dependent variable. In this study, we expected that the predicted mediators described above would be potent but not exclusive mediators.

Baron and Kenny (1986) further note two assumptions for estimating a mediational model: that there is no measurement error in the mediator and that the dependent variable not cause the mediator. Neither of these assumptions can be unequivocally shown to be true. All measures have measurement error; however, SEM analyses do remove random measurement error from the latent variables and thus provide a better way to address this assumption than simple regressions. The assumption of reverse causality can only be addressed with a long-term longitudinal study; for this study, we have provided a conceptual rationale above that suggests how negative affect would affect health and life satisfaction rather than the other way around.

Method

The data set used for this study employed a prospective design that included five interviews conducted with the same participants in their homes with approximately 6-month intervals between inter-

views. Participants were drawn from a probability sample of people 55 years and older. Measures had been pretested on older adults and were found to be reliable (Himmelfarb & Murrell, 1983), appropriate, and comprehensible for older adults.

SAMPLE AND SAMPLING PROCEDURE

After blocking to ensure proportional sampling from different geographical regions of Kentucky (urban, rural, Appalachian) and different levels of housing density, geographical segments were randomly selected, averaging approximately 45 dwelling units per segment. All persons 55 and older in those dwelling units were contacted for interviews. The resulting sample for the first interview wave, when properly weighted, was quite similar to the U.S. population of that age in its age and sex distributions, marital status, and living arrangements. The sample did have less education: Two thirds of the U.S. population of this age had 8 years or more of education, whereas this was true for only one half of this Kentucky sample. The completion rates for each successive interview wave were as follows: Wave 1, 72%; Wave 2, 73%; Wave 3, 82%; Wave 4, 83%; Wave 5, 88%. Of the first-wave sample, 2% terminated the interview after it began, 4% completed interviews that were later found to be invalid by quality control procedures, 5% were never contacted or were repeatedly rescheduled but still not contacted, and 17% declined to participate. Of those who declined the interview, the reasons given were lack of interest (68%), health reasons (20%), and mental health reasons (6%). A very similar pattern held across subsequent waves.

As with any prospective design, the possible effects of attrition would be a concern. To estimate the effects of attrition, comparisons of the first wave sample to the fifth wave sample were made by Norris (1985). The two samples were quite similar, with the exception that the sample from the last wave was somewhat healthier (physically and psychologically) than the sample from the first wave (Norris, 1985). Thus, the attrition did not appear to seriously alter the representativeness of the sample. To estimate whether attrition might have affected the relationships among variables, a comparison of the fifth wave sample and the first wave sample on their respective correlation

matrices and in regression analyses was made, with the finding that attrition did not seriously affect the relationships among variables (Norris, 1987). To estimate the possible effects of repeated administrations of the same measures to the same participants, Himmelfarb and Norris (1987) compared a control group that was randomly selected prior to Wave 1 but not interviewed until Wave 2 with the sample that had been interviewed on both waves and found no evidence of testing effects.

The analyses for this article used data from Waves 1 to 4. Only those participants with complete data on the relevant variables were included; the sample *N* for this study was 1,177. Participants were 416 men (35.3%) and 761 women (64.7%) with a mean age of 67.4. They were predominantly White (92.6%). The majority were married (60.1%) or widowed (30.4%). A small number were never married (3.8%) or separated/divorced (5.7%).

MEASURES

Education. This was number of years of education. The mean for the Wave 1 sample was 9.28 years (*SD* = 4.05); 52.9% had 8 or fewer years of education, and 33.8% graduated from high school.

Health. The Health Status Questionnaire (HSQ) was a 20-item self-report scale revised from one developed by Belloc, Breslow, and Hochstim (1971), with internal consistency of .89 and test-retest stability over 6 months of .81. Participants were asked whether they had had a variety of symptoms or functional difficulties in the prior 6 months. Consistent components of this scale included the following factors: (a) *Ailments* included cramps in the legs, pain in the heart or tightness in the chest, trouble breathing or shortness of breath, swollen ankles, pain in the back or spine, frequent headaches, and swelling or aching of joints. Respondents indicated whether they had any of these in a yes/no format; (b) *Dysfunctions* included four items that asked about "activities that people sometimes have trouble with" and referred to trouble with dressing, moving around, climbing stairs, and trouble getting outdoors; (c) *Fatigue* included five items referring to being tired after a short time, being tired after 4 or 5 hours of sleep,

being worn out at the end of the day, trouble getting to sleep or staying asleep, and having less energy than others of the same age. In the analyses, higher scores on the total HSQ indicated better overall health.

Life satisfaction. This measure was a revised version of the Life Satisfaction Index–Z (LSIZ) developed by Wood, Wylie, and Sheafor (1969), which had an alpha of .81; the two-wave stability was .67. This version replaced the original true-false format with a 5-point response alternative from *strongly agree* to *strongly disagree*. A factor analysis of this scale yielded three factors, one of which was termed Age Satisfaction because its items seem to reflect degree of satisfaction with one's current life stage. This was the variable included in these analyses as reflecting level of successful aging specifically for this stage of life. Examples of items on this scale include "These are the best years of my life," and "As I look back on my life, I am fairly well satisfied." Its alpha for Wave 1 was .76; its two-wave stability was .63.

Negative affect. A factor analysis of items from the Bradburn Affect Balance Scale (Bradburn & Caplovitz, 1965), the DuPuy Well-Being scale (Ware, Johnson, Davies-Avery, & Brook, 1979), and the Spielberger Anxiety Trait Scale (Spielberger, Gorsuch, & Lushene, 1970) was conducted on the Wave 1 measures, and then a second factor analysis of the same items on Wave 2 yielded four consistent factors. The factor analysis used principle components extraction with the varimax rotation. For three of the factors, all items had a factor loading of .4 or greater for both waves on that factor and did not overlap with other factors. These three factors were labeled Negative Affect, Obsessiveness, and Positive Mood. The Negative Affect factor included eight items from the Well-Being scale whose content included sadness, anxiousness, being depressed, being blue, being tense, feeling nothing was worthwhile, being bothered by nerves, and feeling in low spirits generally. This factor appears similar in content to the high negative affect set of items of Watson, Clark, and Tellegen (1988) and the negative affect set from the Philadelphia Geriatric Center Scale (Lawton, Kleban, & Dean, 1993). This factor had an alpha coefficient of .87 on Wave 1; the two-wave stability was .69.

DATA ANALYSES

In each equation, education was a measured variable, taken from Wave 1. Negative affect, health, and life satisfaction were latent variables described previously. Control variables, age and sex, were measured at Wave 1.

All analyses were accomplished using the AMOS structural equation modeling package (Arbuckle, 1995) and maximum likelihood estimates. A series of structural equation analyses was conducted according to suggestions by Holmbeck (1997) for testing a hypothesis of a mediating effect. Establishing mediation of the effects of an independent variable (A) on a dependent variable (C) by an intervening variable (B) requires testing of models in three steps. The first step establishes the relationship between A and C, in this case between education (A) and health (C) and between education and life satisfaction (C). The second step tests the model A B C. The third step tests the second step model again while constraining the relationship between A and C to zero. Evidence of dominant mediation requires that the third model not be significantly different than the second; that is, the relationship of A to C can be explained entirely by relationships with B. Following from the discussion of Baron and Kenney (1986) that reducing the relationship between independent and dependent variables to zero may be unrealistic considering the likelihood of multiple mediators, the amount of the reduction in the A to C relationship was considered here.

We tested the mediation effects of negative affect in this three-step series with health and then with life satisfaction as the successful aging indicators, resulting in six models altogether.

Results

Table 1 shows the sample means and standard deviations for the study variables. Table 2 contains the correlation matrix for variables included in the structural equations. As these tables indicate, the sample was relatively healthy in terms of both psychological and physical health and showed significant stability across waves on all variables (stability coefficients are shown in bold type in Table 2).

Table 1
*Wave 1 Sample Means and Standard Deviations for Study Variables (*N = *1,177)*

Variable	*Mean*	*Standard Deviation*
Age	67.40	8.16
Education	9.28	4.05
Income (n = 597)	11,312	12,101
Negative affect	6.34	1.43
Health	17.76	7.15
Life satisfaction	31.46	7.00

MODELS RELATED TO HEALTH

The results of the structural models with health as the dependent variable are shown in Tables 3 and 4.[2] Table 3 contains the fit indices of all the structural models. Table 4 contains the parameter estimates for these models. Models 1a and 1b represent the direct effects of education on trait health (A C). In Model 1a, education was also correlated with the residuals or "state health" factors; Model 1b eliminates those correlations. As a fit index, ^{2} should be small and nonsignificant; however, with large sample sizes, ^{2} rarely meets this test (Bentler, 1995), and other fit indices are generally used instead. As indicated by fit indices well above .90 (Arbuckle, 1995; Bentler, 1995), shown in Table 3, both Models 1a and 1b provided good fit to the data, and the regression weight of .45 shown in the first line of Table 4 demonstrated a moderately strong relationship between education and trait health. The ^{2} difference between Models 1a and 1b is small, and none of the correlations between education and the health residuals was significant. For this reason, these correlations were dropped from later models.

Models 2a through 2c included negative affect as a mediator (A B C). Model 2a did not include correlated residuals. In Model 2b, residual or state negative affect at each wave was correlated with state health for the next wave to examine the possibility that fluctuations in affect in a given wave may have a short-term impact on health at the next wave. Fit indices for both of these models were strong, and the paths from education to trait negative affect, and negative affect to trait health, were significant, as shown in Table 4. In each model, the path

Table 2
Correlation Matrix of All Variables Included in Subsequent Analyses

Variable	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*
1. Age														
2. Education	–.19													
3. Sex	*.01*	*.06*												
4. Income	–.27	.46	–.16											
5. Wave 1 negative affect	*.05*	–.28	.11	–.16										
6. Wave 2 negative affect	*.05*	–.25	.07	–.17	**.51**									
7. Wave 3 negative affect	*.02*	–.24	.08	–.15	**.45**	**.57**								
8. Wave 1 health	–.11	.42	–.13	.32	–.48	–.42	–.38							
9. Wave 2 health	–.13	.40	–.10	.30	–.44	–.48	–.40	**.81**						
10. Wave 3 health	–.11	.40	–.10	.30	–.42	–.48	–.47	**.79**	**.83**					
11. Wave 4 health	–.11	.39	–.11	.26	–.41	–.43	–.40	**.77**	*.78*	*.83*				
12. Wave 1 life satisfaction	–.10	.40	*–.01*	.35	–.45	–.39	–.40	.52	.47	.45	.44			
13. Wave 2 life satisfaction	–.12	.41	*–.04*	.31	–.42	–.48	–.40	.52	.58	.52	.49	**.64**		
14. Wave 3 life satisfaction	–.08	.40	*–.07*	.30	–.41	–.48	–.51	.54	.55	.60	.55	**.64**	**.72**	
15. Wave 4 life satisfaction	–.11	.40	*–.07*	.31	–.44	–.45	–.45	.53	.52	.53	.61	**.61**	**.68**	**.72**

Note. Bold coefficients show cross-wave stability. Sex was coded 1 = male, 2 = female.
All correlations significant at $p < .01$ except for those in italics.

Table 3
Summary of Model Fit Indices for Structural Equation Models Testing Mediation of the Relationship Between Education and Health by Negative Affect and Life Events

Model	^{2}	df	*CFI*	*NFI*	*AGFI*
1a. Education to trait and state health	35.83	2	.99	.99	.91
1b. Education to trait health only	41.91	5	.99	.99	.96
2a. Education to negative affect to health (education to health path not constrained)	144.46	18	.98	.98	.94
2b. Education to negative affect to health (cross-lag residuals correlated)	143.96	15	.98	.98	.93
2c. Education to negative affect to health (same-wave residuals correlated)	62.16	15	.99	.99	.97
3. Education to negative affect to health (education to health path constrained to 0; same-wave residuals correlated)	149.15	16	.98	.98	.93

Note. CFI = comparative fit index; NFI = normed fit index; AGFI = adjusted (by degrees of freedom) goodness-of-fit index.
All ^{2}s significant at $p < .001$.

from education to health was also significant, but the standardized weight was smaller by almost a half than the path between education and health in Model 1a (.24 vs. .45). Adding cross-lagged correlations between the residuals did not improve the model significantly. However, in Model 2c we correlated the same-wave residuals, and this substantially improved the model, reducing the ^{2} from 144.46 in Model 2a to 62.16 in Model 2c (Model 2c is shown in Figure 3). This finding suggests that the relationship between residual negative affect and residual health is specific to each wave, and is perhaps best explained as method variance. That is, if the cross-lag residuals between negative affect and health were significant, this would suggest that state changes in negative affect at one wave were significantly influencing state changes in health at another. Because only same-wave residuals were significantly related, this suggests that their relationship is coincidental to other factors at each wave. The usual explanation for such coincidental covariance is error or method variance.

Model 3 was the final test of mediation, in which the path from education to health was constrained to be 0. A comparison of the

Table 4
Parameter Estimates, Standard Errors, and Critical Ratios for Models 1 to 3, Mediation Effects of Negative Affect on the Education-Health Relationship

Model	*Path*	*Parameter Estimate*	*Standard Error*	*Critical Ratio*	*Standardized Regression Weight*
1a.	Education trait health	.67	.05	14.37	.45
	Education Wave 1 state health	1.00[a]			.07
	Education Wave 2 state health	–.03	.65	–.04	–.00
	Education Wave 3 state health	–.37	.65	–.57	–.03
	Education Wave 4 state health	–.16	.66	–.24	–.01
1b.	Education trait health	.69	.04	16.02	.45
2a.	Education negative affect	–.08	.01	–10.32	–.35
	Education health	.37	.04	9.19	.24
	Negative affect health	–3.85	.25	–15.74	–.59
2b.	Education negative affect	–.08	.01	–10.34	–.35
	Education health	.37	.04	9.18	.24
	Negative affect health	–3.84	.25	–15.67	–.59
	Wave 1 state negative affect Wave 2 state health	0.03	.12	–.27	–.01
	Wave 2 state negative affect Wave 3 state health	–.06	.11	–.61	–.03
	Wave 3 state negative affect Wave 4 state health	.02	.12	.20	.01
2c.	Education negative affect	–.08	.01	–10.28	–.35
	Education health	.38	.04	9.57	.25
	Negative affect health	–3.69	.23	–15.85	–.57
	Wave 1 state negative affect Wave 1 state health	–.84	.14	–6.23	–.23
	Wave 2 state negative affect Wave 2 state health	–.25	.11	–2.20	–.09
	Wave 3 state negative affect Wave 3 state health	–.53	.11	–4.73	–.19
3.	Education negative affect	–.10	.01	–12.26	–.41
	Education health	0			
	Negative Affect health	–4.49	.24	–18.50	–.69
	Wave 1 state negative affect Wave 1 state health	–.80	.14	–5.94	–.22
	Wave 2 state negative affect Wave 2 state health	–.24	.11	–2.08	–.08
	Wave 3 state negative affect Wave 3 state health	–.53	.11	–4.73	–.19

a. This parameter was constrainted to 1.00 to identify the model.
Critical ratios (parameter estimate divided by its standard error) greater than 2 are significant at $p < .05$.

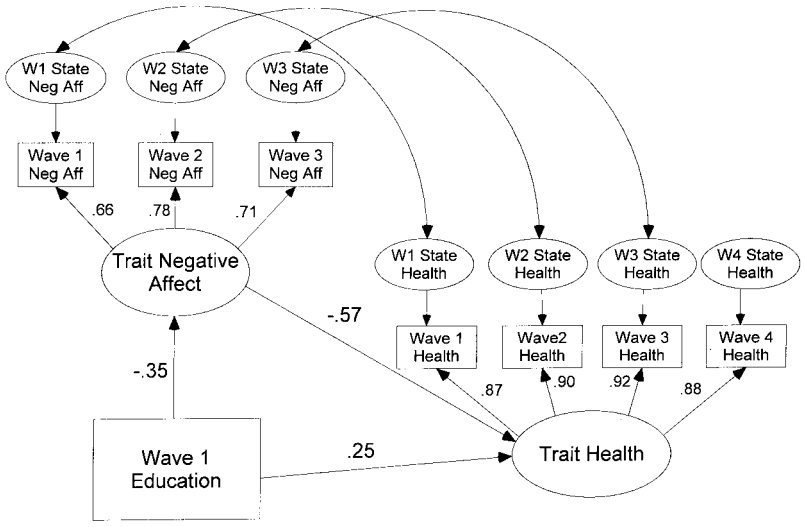

Figure 3. **Model 2c: Structural model incorporating mediating effects of negative affect on the education-health relationship.**

Note. Rectangles indicate measured variables; ellipses indicate latent variables. Coefficients shown are standardized regression weights (see also Table 4). W1 = Wave 1. W2 = Wave 2. W3 = Wave 3. W4 = Wave 4.

model ^{2} in Model 3 to the ^{2} for Model 2c suggests that Model 2c is significantly better than Model 3, ^{2} difference (df = 1) 86.99, $p <$ .001. Thus, although there was a clear indirect effect of education negative affect health, we cannot say that negative affect entirely explains the education to health relationship. From the Baron and Kenney (1986) criterion, negative affect would appear to be a potent mediator but not the single, dominant mediator.

MODELS RELATED TO LIFE SATISFACTION

Overall, the results for life satisfaction, more specifically satisfaction with one's current stage of life, were quite similar to those for health. The results of the models using life satisfaction as the dependent variable are shown in Tables 5 and 6. All fit indices are shown in Table 5. As with health, all models provided good fit to the data. Findings regarding correlations among residuals were virtually identical to those with health. Again, education and negative affect were found to

Table 5
Summary of Model Fit Indices for Structural Equation Models Testing Mediation of the Relationship Between Education and Life Satisfaction by Negative Affect

Model	^{2}	df	*CFI*	*NFI*	*AGFI*
4a. Education to state and trait life satisfaction	4.38*	2	1.00	1.00	.99
4b. Education to trait life satisfaction only	12.04	5	1.00	1.00	.99
5a. Education to negative affect to life satisfaction (education to life satisfaction path not constrained)	105.31	18	.98	.98	.96
5b. Education to negative affect to health (cross-lag residuals correlated)	104.42	15	.98	.98	.95
5c. Education to negative affect to health (same-wave residuals correlated)	39.45	15	.99	.99	.98
6. Education to negative affect to life satisfaction (education to life satisfaction path constrained to 0)	141.84	16	.97	.97	.93

Note. CFI = comparative fit index; NFI = normed fit index; AGFI = adjusted (by degrees of freedom) goodness-of-fit index.
$p = .11$. All other ^{2}s significant at $p < .05$.

be significantly related to life satisfaction. Inclusion of negative affect substantially reduced the size of the education life satisfaction path coefficient (Model 5c), but the mediating effect of negative affect was not shown to be exclusive by the model constraining education effects to be 0 (Model 6); the ^{2} difference between Models 5c and 6 was significant. As with health, however, negative affect appeared to be a potent mediator.

The question arises whether the education benefits are continuous or discrete. Does attaining a certain level of education confer the advantage, or is it the case that the more education we have the better off we are? In a post hoc analysis, we addressed this question by computing three correlations between education and negative affect, between education and health, and between education and life satisfaction: one with education dichotomized at 8 years, one at 11 (graduating from high school), and one at 12 years (higher education). The correlations related to achieving an eighth-grade education and graduating from high school were nearly the same (1 to 2 point difference), and

Table 6
Parameter Estimates, Standard Errors, and Critical Ratios for Models 4 to 6, Mediation Effects of Negative Affect on the Education/Life Satisfaction Relationship

Model	*Path*	*Parameter Estimate*	*Standard Error*	*Critical Ratio*	*Standardized Regression Weight*
4a.	Education trait life satisfaction	.63	.05	13.54	.49
	Education Wave 1 state life satisfaction	1.00[a]			.05
	Education Wave 2 state life satisfaction	–.43	1.09	–.40	–.03
	Education Wave 3 state life satisfaction	–1.42	1.08	–1.32	–.09
	Education Wave 4 state life satisfaction	–.34	1.05	–.32	–.02
4b.	Education trait life satisfaction	.69	.04	16.02	.45
5a.	Education negative affect	–.08	.01	–10.32	–.35
	Education trait life satisfaction	.33	.03	9.71	.26
	Negative affect trait life satisfaction	–3.64	.23	–16.02	–.66
5b.	Education negative affect	–.08	.01	–10.34	.35
	Education trait life satisfaction	.33	.03	9.69	.26
	Negative affect trait life satisfaction	–.366	.23	–15.92	–.66
	Wave 1 state negative affect Wave 2 state life satisfaction	–.05	.17	–.27	–.01
	Wave 2 state negative affect Wave 3 state life satisfaction	.13	.14	.93	.04
	Wave 3 state negative affect Wave 4 state life satisfaction	–.02	.15	–.13	–.01
5c.	Education negative affect	–.08	.01	–10.29	–.35
	Education life satisfaction	.34	.03	10.21	.27
	Negative affect trait life satisfaction	–3.44	.21	–16.13	–.62
	Wave 1 state negative affect Wave 1 state life satisfaction	–.82	.17	–4.74	–.17
	Wave 2 state negative affect Wave 2 state life satisfaction	–.38	.16	–2.45	–.10
	Wave 3 state negative affect Wave 3 state life satisfaction	–.75	.15	–5.07	–.21
6.	Education negative affect	–.10	.01	–12.66	–.43
	Education trait life satisfaction	0			

(continued)

Table 6 Continued

Model *Path*	*Parameter Estimate*	*Standard Error*	*Critical Ratio*	*Standardized Regression Weight*
Negative affect trait life satisfaction	–4.19	.23	–18.21	–.76
Wave 1 state negative affect Wave 1 state life satisfaction	–.77	.17	–4.45	–.15
Wave 2 state negative affect Wave 2 state life satisfaction	–.33	.16	–2.08	–.08
Wave 3 state negative affect Wave 3 state life satisfaction	–.72	.15	–4.81	–.20

a. This parameter was constrained to 1.00 to identify the model.
Critical ratios (parameter estimate divided by its standard error) greater than 2 are significant at $p < .05$.

correlations achieved with the latter (graduating from high school) were within 2 points of the correlations achieved with the full range of education reported in Table 2. The third correlation was quite a bit lower in each case. These findings suggest that the primary advantage in education is achieved by graduating from high school rather than from higher education or lifelong learning.

Discussion

The findings reported here largely supported our specific predictions. Education did have direct effects on negative affect, trait health, and trait life satisfaction, as predicted. Negative affect, in turn, attenuated the relationship between education and trait health and the relationship between education and trait life satisfaction. Education appears to be an enduring resource for the successful aging of older adults; the partial overlap between education and negative affect suggests a mediational explanation for that relationship. Consistent with well-established relationships in the literature, years of education were strongly and positively related to trait or stable health and life satisfaction, interpreted here as the enduring propensity to be healthy and happy with one's life. Education also showed a strong indirect effect on these successful aging indicators through its relationship with negative affect. That is, higher educational attainment is associated with

lower levels of enduring negative affect, which in turn, is related to better health and greater life satisfaction in late life. Education was not directly related to state aspects of successful aging, interpreted here as levels of health and life satisfaction that fluctuated over the 6-month measurement waves.

The findings regarding mediating effects suggest that negative affect is not a single dominant mediator, because the education-successful aging relationship was not reduced to zero and, as Baron and Kenny (1986) have described, cannot be claimed to be both necessary and sufficient in explaining the relationship between education and successful aging. As was expected, there appear to be multiple mediators of the education-successful aging relationship; however, because this relationship was reduced by half with negative affect as a mediator, this seems to meet the criteria of Baron and Kenny for a potent mediator.

Thus, these findings do not provide a complete picture of the phenomena, but they do suggest a heretofore unexamined piece of the picture. Our mediation findings are consistent with, although somewhat different in focus, to those of Saudino, Pedersen, Lichtenstein, McClearn, and Plomin (1997), who found that a group of personality dimensions, including neuroticism (related to negative affectivity), mediated genetic influences on both desirable and undesirable life events. Saudino et al. found that personality characteristics as a group were dominant in the Baron and Kenny (1986) sense. To the extent that education may be a marker for genetic advantages such as intelligence, our findings are parallel. Degree of educational attainment appears to represent the kind of start the individual has in life, which then, in a sense, escalates over the life span. A good start contributes to desirable personal characteristics and accomplishments that further contribute to opportunities in later life, whereas a poor start makes undesirable characteristics and experiences more likely, which then extend into late life.

If education as reported by these participants in the present is a reliable measure of their educational attainment typically occurring over 40 years previously, and this does seem highly plausible, then educational attainment and its lifetime consequences have considerable long-term benefits for successful aging. The development of negative affectivity, if it does function as a personality trait, could be expected

to have been formed by age 30 or so (Costa & McCrae, 1994) and thus would also have enduring effects as well as being a strong contemporary factor in the successful aging of this sample of older adults whose mean ages were in their mid-60s.

A question that might arise concerning these data is the relationship between education and income; income would be a reasonable additional mediator in the education-successful aging relationship. As shown in Table 2, income also correlated significantly with all the study variables. However, the income item received responses from only about half the sample, so inclusion of income in the analyses would have resulted in a significantly smaller and systematically unrepresentative sample. We did compute partial correlations between education and negative affect, health, and life satisfaction controlling for income and between income and the same dependent variables controlling for education. Whereas partialling education out of income significantly reduced the relationships, partialling income out of education did not affect the relationships to the same magnitude. In other words, education appears to have predictive power that includes, but goes beyond, income; the reverse does not appear to be the case.

It may be noted that the correlations found here between education and health and between education and life satisfaction are somewhat higher than those found in some other studies. In our view, the most likely explanation for such differences lies in the differences in samples. This was a probability sample, whereas many studies use nonrandom convenience samples. Furthermore, as described earlier, this sample as a whole had lower education levels than the national population of this age. Perhaps having a larger proportion of participants with lower education (53% with an eighth-grade education or less) in this sample contributed to somewhat stronger associations with education.

What are the implications of these findings for the bottom-up and top-down formulations regarding subjective well-being and successful aging? Consistent with findings by others (Brief et al., 1993; Deiner, 1984; Feist, Bodner, Jacobs, Miles, & Tan, 1995), there is support here for either formulation or their combination. The opportunities and resources related to educational attainment could be expected to produce accumulated success experiences, consistent with the bottom-up view, and contribute to superior functioning in later life. Negative

affect, as a predisposition for unfavorable evaluations of self and experiences, could be expected to persevere into later life, which is a contribution that would be consistent with the top-down view. Furthermore, negative affectivity may be the result of a combination of both the personality predisposition and less successful education experiences earlier in life.

In interpreting these findings, it is important to recognize that these data are longitudinal over a relatively short period of time. Although multiple waves were used in creating the latent variables, what is actually measured is the stability of constructs over this 2-year period, and this stability very likely had been maintained at these levels prior to this measurement period. We cannot know, therefore, at what point the propensity for negative affect, health status, and life satisfaction developed in the lives of these participants, nor their temporal relationship to educational attainment. What can be stated with confidence is that education and negative affect appear to share variance in predicting successful aging as measured in this study.

The major advantages of this study included the use of a probability sample, the prospective design, and structural equation modeling. The use of a true probability sample is relatively rare in social science research; even large longitudinal studies frequently employ convenience or volunteer samples. Although the sampling methods used in this data set may have led to higher attrition, we would argue that the representativeness of the sample is still superior to many, because the sample was not preselected on the basis of any study variables. The prospective design in combination with SEM analysis provided superior psychometric measures by reducing random measurement error and allowing for the differentiation between trait and state successful aging. A major disadvantage of the study was the reliance on self-report measures that although not atypical for this body of research, did limit the generalization of these findings, particularly with respect to the health measure. Given previous findings that negative affectivity is not clearly related to more objective measures of health, these findings can apply only to health as self-reported by these older adults.

In summary, this study makes a number of conceptual contributions. On a general level, this study supports the assumptions of broad models that attribute successful aging to a combination of both lifelong resources and late-life experiences. George (1996) has

emphasized that one of the greatest weaknesses of social-psychological research with older adults has been the failure to include variables reflecting experiences that occurred earlier in life. Educational attainment, at least in this sample where the median education is below high school, is one such variable that maintains influence across the life span; negative affectivity is a personality variable that is also likely to be influential throughout life. The findings replicate the potency of education as a predictor of health and life satisfaction in previous studies. Beyond this replication, this study suggests that the function of education in successful aging may in part be explained by its relation to negative affect.

NOTES

1. Our thinking in using Waves 1 to 4 for the health and life satisfaction latent variables was that, although the analysis would still represent predominantly concurrent, cross-sectional shared variance with the negative affect latent variable, there would also be a longitudinal element. The analyses come out nearly identical if Waves 1 and 2 are used for negative affect and Waves 3 and 4 are used for the well-being variables, suggesting that what is being measured at any wave is constructs that have long-term stability, and consequently, any analysis is essentially cross-sectional.

2. Initially, the control variables age and gender were included in models. However, these variables did not add significantly to the tested models; that is, when their coefficients were constrained to 0, the models were identical in fit, and other coefficients did not change. The more parsimonious models are therefore reported. Age and gender correlations are included in Table 2.

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