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Psychosocial and Behavioral Predictors of Longevity

The Aging and Death of the "Termites"

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Impulsive, undercontrolled personalities and major family stresses are known predictors of impaired adjustment, but long-term health effects are unclear. In an archival prospective cohort design, we followed up on L. M. Terman's (Terman & Oden, 1947) sample of gifted children by collecting and coding death certificates for the half of the sample that is now dead. Statistical survival analyses were used to predict longevity and cause of death as a function of parental divorce during childhood, unstable marriage patterns in adulthood, childhood personality, adult adjustment, and possible mediating health behaviors. Psychosocial factors emerged as important risks for premature mortality.

In 1921, Lewis Terman began one of the most comprehensive and best-known studies in psychology. To investigate his genetic theories of intelligence, Terman recruited 1,528 bright California boys and girls, intensively studied their psychosocial and intellectual development, and followed them into adulthood. These clever participants nicknamed themselves the "Termites." About half of the Termites are now dead, and we have gathered most of their death certificates and coded their dates and causes of death. These life span data provide a unique opportunity to address intriguing questions about the role of psychosocial variables in physical health and longevity through a life span prospective design.

Although there is little doubt that psychosocial factors such as stress and coping play some role in the development or progression of many chronic diseases and in premature death, there is quite a bit of uncertainty about the nature of the causal pathways. Are aspects of personality and social stress related to longevity in general and to heart disease or cancer in particular across the life span? If so, what is the nature of the links? To address these matters, we studied Terman's archives and our new follow-up data to focus on psychosocial disturbance and mortality. We considered three types of variables. First, we examined two major sources of social stress: the divorce of one's parents (during childhood) and the instability of one's own marriage. Second, we looked at patterns of personality evident in childhood and general psychological stability in adulthood. Finally, we considered the possible role of certain unhealthy habits in mediating the influence of stress and personality on longevity. This article integrates the key findings uncovered thus far, in a search for synthesis. A common thread does indeed emerge—a psychosocial risk pattern for premature mortality. Our more technical articles should be consulted for details that cannot be included here.

The "Termites"

The Terman Life-Cycle Study (formerly called the Genetic Studies of Genius or Gifted Children Study) began in 1921–1922, when most of the children were preadolescents (Terman & Oden, 1947). Terman's aim was to secure a reasonably random sample of bright California children, and so most public schools in the San Francisco and Los Angeles areas were searched for bright kids, nominated by their teachers and tested by Terman to have an IQ of at least 135. There were 856 boys and 672 girls in the study; they have been followed at 5- to 10-year intervals ever since. In addition to Terman, many other researchers, including Melita Oden and Robert

Robert M. Kaplan served as action editor for this article.

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This research was supported by National Institute on Aging Grant AG08825. Part of the data was made available by the Terman Life-Cycle Study of Children, begun by Lewis Terman. Assistance was provided by Eleanor Walker and comments by Miriam Schustack and Dan Ozer. We bear responsibility for the death certificate collection and coding, data corrections and refinements, analyses, and interpretations presented in this article. Because of ongoing data refinements and slightly differing subsamples, there are sometimes minor changes in sample and effect sizes as new papers emerge from this project. This article integrates certain key findings from the larger ongoing project.

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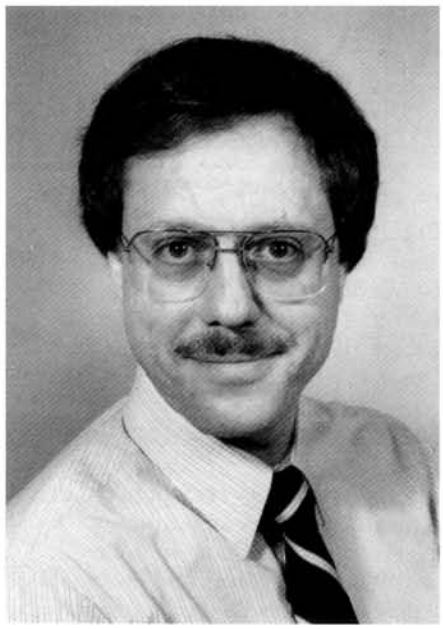


Howard S. Friedman
Photo by Jeanne Neville.

Sears (himself a Termite), contributed heavily to the archives, and we are certainly in their debt. Our own contribution has been to gather and code death certificates, to gather and refine certain data about smoking, and to develop the many new indexes necessary for studying longevity and cause of death effects.

In this remarkable study, only small percentages (fewer than 10%) of participants are unaccounted for. (Size varies somewhat with the subsample of each analysis.) We generally restricted our analyses to those who were of school age in 1922 (M = 11 years old), who lived at least until 1930, and for whom there were no substantial missing data. Our childhood personality measures were derived from information obtained by Terman in 1922, and our adult health behaviors, adult marriage information, and adult adjustment measures derived from midlife follow-ups (usually 1950, but ranging from 1940–1960). This typically resulted in a sample size of between 1,100 and 1,300. Analyses by Terman's researchers as well as our own comparisons indicated that those lost from study did not differ systematically.

In our sample, women significantly outlived men. As of 1991, 50% of the men but only 35% of the women were known to have died. Statistical survival analyses produce a ratio called a relative hazard, which is the relative probability that a person will die at any given time. The hazard rate for women was more than one third lower than that for men, confirming what is of course generally true in the population. Because women in this sample live about six years longer than men, all our analyses examined or controlled for gender differences.

The Termites were a bright, well-educated group, integrated into American society (but none grew up to win a Nobel prize or to be identified as an obvious genius). They had regular contact with Stanford University. Certain confounds common to other psychosocial health studies are therefore not likely in this sample. The Termites could understand medical advice and prescription, had adequate nutrition, and had access to medical care. Explanations of poor health involving poverty, ignorance, or discrimination are generally not applicable to this sample, and so the sample is valuable for focusing on certain personality and social stress variables.[1] The Termites were successful in public school, at least to the extent that they made it through teachers' nominations and Terman's tough screening for intellectual talent; this is important to keep in mind because it helps rule out certain competing explanations for longevity. The sample is certainly not, however, representative of the U.S. population as a whole (e.g., it contains less than 1% Asian, African, or Native Americans); results are not necessarily generalizable to subpopulations that are different on health-relevant dimensions.

During the past several years, we have hunted down and gathered up hundreds of death certificates for the dead Termites, often from resistant state bureaucracies (Friedman, Tucker, & Martin, 1994). Following established epidemiologic procedures, we coded underlying cause of death according to the *International Classification of Diseases* (9th rev., U.S. Department of Health and Human Services, 1980), with the assistance of a certified nosologist supervised by our team's physician–epidemiologist. As in the general population, the leading cause of death was cardiovascular disease, followed by cancer.

Divorce

Divorce of Parents

It has been well established that the divorce of one's parents during childhood can have ill effects on one's future mental health. Although some questions remain about the causal processes, there is good longitudinal evidence that children of divorce, especially boys, are at greater risk for observable behavior and adjustment problems (Amato & Keith, 1991; J. Block, Block, & Gjerde, 1988; J. H. Block, Block, & Gjerde, 1986; Hetherington, 1991; Jellinek & Slovik, 1981; Shaw, Emery, & Tuer, 1993; Zill, Morrison, & Coiro, 1993). Most of the conceptual analyses concern a lack of social dependability or ego control (i.e., impulsivity and nonconformity), although neuroticism or low emotional stability have also often been implicated.

There has never before been a lifelong prospective study of family stress predictors of mortality and cause of death. Even physical health effects of family stress have been the object of little research attention, although some physiological differences among children have been documented (e.g., Gerra et al., 1993; Weidner, Hutt, Connor,

[1] Neither father's education, mother's education, nor father's occupational status predicted longevity of the Termites. Although the bottoms of the distributions of childhood socioeconomic variables were truncated by Terman's selection of bright White schoolchildren, there is considerable socioeconomic variation. The childhood sample is not characterizable as elite on any dimension except intelligence.

& Mendell, 1992). Family stress (particularly parental divorce) has been found to predict unhealthy behaviors such as smoking and drug use in adolescence as well as poor psychological adjustment (Amato & Keith, 1991; Chassin, Presson, Sherman, Corty, & Olshavsky, 1984; Conrad, Flay, & Hill, 1992; Hawkins, Catalano, & Miller, 1992), but the further consequential links to physical health have rarely been studied from long-term longitudinal data. Can these detrimental effects of parental divorce reach across the life span and affect longevity? Do they differentially affect cause of death?

We looked at the children (N = 1,285) whose parents either did or did not divorce before the child reached age 21, who were of school age in 1922, and who lived at least until 1930 (Schwartz et al., in press).[2] We used hazard regression analyses (survival analyses) to predict longevity, controlling for gender.

Children of divorced parents faced a one third greater mortality risk than people whose parents remained married at least until they reached age 21 ($p < .01$). Among men whose parents divorced while they were children, the predicted median age of death was 76 years old; for men whose parents remained married, the predicted age of death was 80 years old. For women, the corresponding predicted ages of death were 82 and 86 years (Schwartz et al., in press).

This striking finding raises many important questions about causal mechanisms. Only 13% of the people in the Terman sample had faced the divorce of their parents during childhood, a situation different from that faced by children today. The estimates of the size of the effects on mortality may not be directly comparable for today's children. Still, in light of the overwhelming evidence from other studies indicating damaging psychological effects of parental divorce, this finding does provoke serious concern. Death of a parent had very little effect, consistent with other research indicating that parental strife and divorce is a greater influence on subsequent psychopathology than is parental death (Tennant, 1988). In the Terman sample, our analyses suggested that parental divorce was the key early social predictor of premature mortality, throughout the life span.

We used the information we gathered and coded from the death certificates to examine whether divorce of one's parents related differentially to cause of death. We found that parental divorce was not associated with whether one is more likely to die of cancer or heart disease or other disease. Also, the overall higher mortality risk cannot be explained away by a higher injury rate, although the possibility of an especially increased risk of injury death cannot be ruled out, because of the small sample.

Instability of One's Own Marriage

There is substantial epidemiological evidence that marriage is correlated with longer life (e.g., House, Robbins, & Metzner, 1982; Hu & Goldman, 1990; Kotler & Wingard, 1989). This is often viewed as a protective effect of the social support of marriage. "Get married" appears on pop lists of health recommendations. However, embedded in this relation are several distinct issues too rarely discussed. Should we assume that it is the marriage itself that is protective? Marriage brings the risk of marital dissolution. Death of spouse, divorce, and marital separation are the top three most stressful events on the classic Social Readjustment Rating Scale (Holmes & Rahe, 1967), and there seems little doubt that marital dissolution is the most significant common social stressor in American society (with the possible exception of abject poverty). Furthermore, is it possible that an unstable marital history is the result of other psychological and behavioral problems rather than itself being a primary cause of premature mortality?

As of 1950 (when they were about 40 years old), the vast majority of the Termites were alive, mature, and had married if they were ever going to marry. We classified them as currently and steadily married (N = 829), married but not in their first marriage (inconsistently married; N = 142), never married (N = 102), or currently separated, widowed, or divorced (N = 70). Very few Termites had been widowed by this point. Controlling for gender and self-reported health, we found (in survival analyses) that the inconsistently married people were at higher risk for premature mortality than the steadily married people and that the currently separated, widowed, or divorced people were at even higher risk. Inconsistently married men had a relative hazard of mortality of almost 1.4 (40% greater risk), and separated or divorced men had a relative hazard of 2.2. For women, the relative hazards were 1.4 and 1.8, respectively. Those who had never married had less of an increased risk and resembled the steadily married when their other social ties were taken into account (men's relative hazard = 1.05 and women's relative hazard = 1.00 when controlling for social ties; Tucker, 1993; Tucker, Friedman, & Wingard, 1994). This last finding concerning the long life of the never marrieds may be particular to the bright, career-oriented nature of the sample. Note that we have purposely considered marital history at a relatively stable, healthy, and mature time of life; the effects might be different in the very young or in much older people.

The steadily married people and the inconsistently married people were all married in 1950, yet they had significantly different life expectancies. This dramatic finding suggests that it may not be marriage's effect as a buffer against stress that is always important. Rather, there seems to be a detrimental effect of previous divorce that is not eliminated when the individuals remarry. Furthermore, additional analyses revealed that part of the association between marital status and mortality risk seems to be due to a selection into steady marriages—Termites who were impulsive children grew up both more likely to be inconsistently married and more likely to die younger ($p < .05$; Tucker, 1993).

[2] In about 15% of cases that we classed as parental divorce, the parents were actually separated because divorce was not feasible. Analyses without them show a very slight increase in the effect.

Parental Divorce and One's Own Divorce

Is the increased mortality risk of children of divorce due in part to these people's own subsequent divorce? People whose parents divorced were indeed more likely to face divorce themselves ($p < .05$). Furthermore, individuals who were divorced or remarried reported that their childhoods were significantly more stressful than did those who stayed married ($p < .05$). In other words, Terman study participants who experienced a marital breakup were more likely to have seen the divorce of their own parents, and they were more likely to report having experienced a stressful home environment as children, such as marked friction among family members.

Given that parental divorce is associated with one's own future divorce, and given that one's divorce is predictive of increased mortality risk, it is indeed the case that one's unstable adult relations "explain" some of the detrimental effects of parental divorce. However, after controlling for one's (adult) divorce, parental divorce during childhood remained a significant predictor of premature mortality ($p < .05$), suggesting that it has additional adverse consequences in adulthood.

In summary, in this sample, marriage itself was not fully health protective. On the other hand, a stable marriage history was indeed predictive of increased longevity. Advice to get married to promote health seems unjustified. Advice to stay in a satisfactory marriage seems somewhat better, as there are hints of negative health consequences of divorce. Most surprising in light of previous research is the appearance of a psychosocial selection factor: Some people make poor marriage partners and are also prone to die prematurely (Tucker, 1993; Tucker, Friedman, & Wingard, 1994). All in all, family instabilities—parental and one's own divorce—are clearly predictive of premature mortality.

Personality and Adjustment

Childhood Personality

There is a long history of research and theory arguing that certain patterns of psychological responding are damaging to physical health—that is, that certain personalities are disease-prone or self-healing (see overviews by Friedman, 1990, 1991, 1992; Pennebaker, 1990). The theorists and researchers have generally argued that resilient personalities—high in stability, sociability, and optimism—are prone to health, whereas aggressive, excitable, impulsive, and neurotic people are prone to disease and mortality.

In 1922, Terman collected trait ratings about the participants from their parents and teachers. The scales he used were remarkably modern in their appearance and provide a better assessment than the primitive personality tests that were available at the time. It is reasonable to expect that parents and teachers have a good idea of whether an 11-year-old child is sociable, popular, conscientious, self-confident, and so on. We constructed six personality dimensions and used them to predict longevity and cause of death through 1986, using survival analyses (see Friedman et al., in press; Friedman et al., 1993). We used both Cox proportional hazards and Gompertz regressions; they yielded the same results.

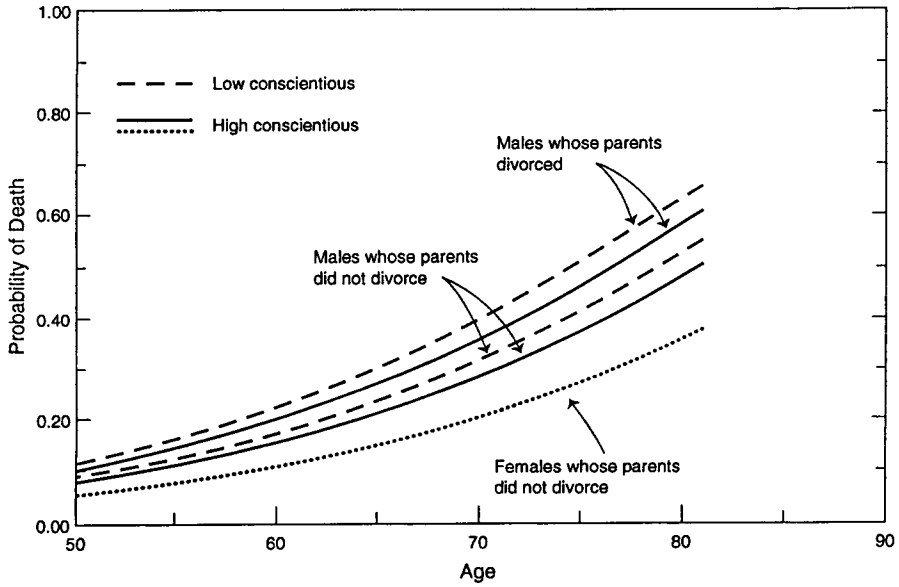
Did childhood personality predict premature mortality decades later? The most striking finding in these and follow-up analyses was that childhood social dependability or conscientiousness predicted longevity. Children, especially boys, who were rated as prudent, conscientious, truthful, and free from vanity (four separate ratings, which we averaged, $\alpha = .76$) lived significantly longer. They were about 30% less likely to die in any given year.[3]

The finding that certain aspects of personality predicted survival across the life span raises many fascinating questions concerning causal mechanisms. Why are conscientious, dependable children who live to adulthood more likely to reach old age than their less conscientious peers? Our survival analyses ($N = 1,215$) suggested that the protective effect of conscientiousness was not primarily due to a reduction in the risk of injury: Although there is some tendency for the unconscientious to be more likely to die a violent death, conscientiousness is also protective against early death from cardiovascular disease and cancer. A focus on unhealthy behaviors showed them to be somewhat relevant as explanatory mechanisms (see below), but a significant effect of conscientiousness remained after controlling for drinking ($p < .01$) and for smoking and other aspects of personality ($p < .05$; Friedman et al., in press).

We have found no evidence so far that the personality trait of sociability or other elements of extraversion were strongly related to health and longevity in this sample. This is somewhat surprising, given that biological and social theories of psychosocial factors and health generally predict such effects. Rather, the locus of health-relevant effects seems to be centered in such traits as impulsivity, egocentrism, toughmindedness, and undependability. For example, childhood ratings on such variables as popularity and preference for playing with other people did not predict longevity. To further explore the lifelong effects of sociability, we followed up on Terman's (1954) study of scientists. Terman had found that the Termites who grew up to be scientists (broadly construed) were much less sociable early in life than the nonscientists. (Terman studied only male scientists.) In fact, Terman considered the differences in sociability to be quite remarkable. Using the Stanford archives, we recreated Terman's groups (*N*s = 288 and 326) and compared their longevity through

[3] We used small sets of theoretically chosen predictors (indexes). For example, we created six scales of childhood personality, two measures of family stress, one index of adulthood heavy alcohol use, and two indexes of adult adjustment. Model testing proceeded on the basis of previous theory and research, in a search for patterns; reported *p* values were not adjusted. Type I errors are possible, but we feel it is more important to avoid Type II errors (i.e., missing a key set of predictors) in a study of this type; that is, we used past research to guide our models and then looked for patterns of findings relevant to longevity. Effect size estimates should not be directly generalized to other populations without further confirmatory research.

Figure 1
Survival Functions for a 20-year-old, by Conscientiousness and Parental Divorce



Note. High and low conscientiousness represent the 75th versus the 25th percentiles. Fitted curves were based on Gompertz hazard function estimates. Copyright 1994, Joseph E. Schwartz and Howard S. Friedman.

1991. However, our survival analyses found that the scientists did not die at a younger age. In fact, the scientists tended to live longer (relative hazard = 1.26, $p < .09$; Friedman et al., 1994).

What about neuroticism? Although the traits of neuroticism—emotional instability, depression, and hostility—are thought to be correlated with poor health, we have found mixed results in this sample. On the childhood measures, there is some hint that neuroticism may be unhealthy. For example, for men, permanency of mood (as rated in childhood) tended to be associated with increased longevity. Effects of maladjustment appeared in adulthood (see the following section). In general, it has proved challenging to create valid measures of neuroticism because it is desirable to take various elements of the Termites' reaction patterns into account. This is a focus of our ongoing efforts.

Finally, we have been examining childhood cheerfulness—rated optimism and a sense of humor. Contrary to our expectations, we have found that childhood cheerfulness is inversely related to longevity. Survival analyses showed that the cheerful kids grew up to be adults who died younger (about 22% increased risk, $p < .01$; Friedman et al., 1993). Puzzled, we followed up on those Termites rated as cheerful in childhood. We found that they grew up to be more likely to smoke, drink, and take risks (all $ps < .05$, comparing upper and lower quartiles), although these habits do not fully explain their increased risk of premature mortality (Martin et al., 1994). It might be the case that cheerfulness is helpful when facing a stress such as surgery, but harmful if it leads one to be careless or carefree throughout one's life (Tennen & Affleck, 1987; Weinstein, 1984). In other words, the health relevance of such traits as optimism may need to be more carefully conceptualized (cf. Wortman, Sheedy, Gluhoski, & Kessler, 1992).

Personality, Parents' Divorce, and Longevity

Children of divorced parents were somewhat less likely to have been seen as conscientious children, $r(1283) = -.14$, but controlling for parental divorce did not change the relations between childhood personality and longevity. Other correlations of parental divorce with personality characteristics were even smaller. In our sample, personality and parental divorce are independent predictors of longevity (Schwartz et al., in press).

Survival functions for a 20-year-old Termite are shown in Figure 1. It shows the probability of death as a function of age. The top four curves are for males in the sample. The topmost curve is for men who were rated as unconscientious in childhood and whose parents divorced during childhood; their probability of dying by age 70 was 40%. In contrast, for conscientious males whose parents did not divorce, the probability of dying by age 70 was less than 30%.

The bottom curve shows the longest-living women—those rated as conscientious and whose parents did not divorce. The difference between this curve and the bottom curve for men represents the gender effect—the longer lives of women. Note that the difference between these

two curves at age 70 is smaller than the difference between the highest and lowest male curves. This means that the combined effect of the two psychosocial variables is greater than the well-known major effect of gender on longevity. Although we have purposely selected these two strong psychosocial predictors for this figure, there is (as noted above) excellent theoretical and empirical reason to believe that these childhood factors are highly relevant to subsequent unhealthy psychological functioning and behavior. The fact that childhood psychosocial information about personality and family stress does as well as gender in predicting longevity is dramatic evidence of the importance of psychosocial factors for understanding premature mortality.

Adult Psychosocial Adjustment

The relation between psychological adjustment and premature mortality has not been much studied in long-term prospective population research. Although special groups such as the clinically depressed or criminals are more likely to face early death (e.g., from suicide or homicide), the more general question has received surprisingly little study. It could be argued that psychosocial maladjustment is implicit in the Type A disease-prone pattern, but only the psychosomatic theorists have focused intensively on psychotherapy as a means of promoting general physical health (Dunbar, 1943; see also Berry & Pennebaker, 1993).

In 1950, the Termites were asked about tendencies toward nervousness, anxiety, or nervous breakdown; there had also been personal conferences with participants and with family members. On the basis of this and previous related information in the files dating back a decade, Terman's team then categorized each on a 3-point scale of mental difficulty: *satisfactory adjustment*, *some maladjustment*, or *serious maladjustment*. (Almost one third experienced at least some mental difficulty by this stage.) Survival analyses show that for men, mental difficulty as of 1950 significantly predicted mortality risk through 1991, in the expected direction (relative hazard = 1.30, $p < .01$, for men and 1.12, *ns*, for women). Similar results were found on a measure we constructed of poor psychological adjustment as self-reported in 1950 on six 11-point scales that included items like *moodiness* (significant risk for men, $p < .05$, but not for women).

Further analyses revealed that the consistently married Termites had the fewest mental difficulties; alternatively, this could be stated as a finding that those with the fewest mental difficulties were most likely to remain married. It is interesting that controlling for mental difficulty weakened but did not eliminate the relation between marital history and longevity. In other words, although mental distress seemed to play the expected role in poor health, a significant detrimental effect of divorce remained, even after taking psychological health in 1950 into account.

In analyses thus far on cause of death, there have been no dramatic differences as a function of psychological adjustment. A general survival analysis model testing for differences among cause of death (cardiovascular disease, cancer, injury, and other diseases) has shown no significant difference. That is, poorly adjusted men are more likely to die from all causes. There is some indication that poorly adjusted participants are especially more likely to die from injury (including suicide), as would be expected. However, because so few people died from injury in this sample, such differences cannot (and do not) account for the main effect of adjustment on longevity. There is also a hint that poorly adjusted men may have an extra risk of dying from cardiovascular disease.

Health Behaviors

Cigarette smoking and heavy use of alcohol (which often occur together) are well established as behavioral causes of significant morbidity and premature mortality. Thus, it is of significant interest to ascertain the extent to which such behaviors can be predicted from childhood and the extent to which they might account for differences in longevity. It is important, however, to keep in mind the time periods in which the various predictors were measured as well as the nature of the Terman sample. We deem it inadvisable to attempt precise effect size comparisons; rather, these data are best suited for uncovering stable, robust patterns.

Terman collected very good contemporaneous data on alcohol consumption. We used information collected in 1950 and 1960 to classify the Termites as heavy drinkers ($N = 226$ men and 87 women), as moderate drinkers (seldom or never intoxicated; $N = 339$ men and 302 women), or as rarely (or never) taking a drink ($N = 99$ men and 128 women). Alcohol use was quite stable across decades. Because moderate drinking may be protective of heart disease, we also looked for U-shaped effects on mortality, but none were found. Information about smoking was poorly documented in the files, so we collected as much smoking information as possible during 1991–1992. We contacted those Termites who could be found, and we attempted to contact relatives of the rest. We gathered smoking data on over 900 Termites, but some of them were missing data on other key variables. Unlike the other measures, there was some evidence of bias in this subsample. Those who died young seemed more likely to have had very unhealthy behaviors and also were less likely to have locatable families. Thus, the mediating effect of smoking may be underestimated.

As expected, smoking and drinking each predicted premature mortality. Did they mediate the relations reported above? Conscientious children grew up to drink and smoke less, but cheerful kids grew up to drink and smoke more (all *ps* < .05; Tucker et al., 1994; cf. J. Block, Block, & Keyes, 1988). However, conscientiousness remained a strong predictor of longevity in various survival analyses, controlling for smoking and drinking (decreased hazard of 20%–30%). Cheerfulness remained predictive when alcohol use was controlled, but the effects of cheerfulness changed when smoking was controlled; because the sample size dropped by one third, what this means is problematic. Termites (especially girls) who faced pa-

rental divorce grew up to smoke a little more ($p < .05$), but not drink more (possibly due to Prohibition during adolescence).

Analyses of obesity (body mass index in young to mid-adulthood) showed little systematic relationship to either psychosocial variables or mortality in this intelligent sample, perhaps because obesity was measured in 1940, when few participants were heavily overweight, or because obesity was unusual in bright people of this cohort. What about exercise, hobbies, and other such potentially important mediators? Although there is of course no simple exercise variable per se among the thousands of variables in the data set, information on activity levels and hobbies at various ages is scattered throughout and can eventually be pieced into the puzzle.

It might be the case that psychosocial factors affect a whole host of health behaviors in addition to drinking and smoking—exercise patterns, diet, use of prophylactics, adherence to medication regimens, avoidance of environmental toxins, and more—which, when put together, may explain most of the associations between psychology and longevity. Surprisingly, there has been little prospective study of psychosocial predictors of unhealthy lifestyle patterns across long time periods and how they subsequently and consequently affect health, longevity, and cause of death.

In summary, the data concerning unhealthy behaviors are tantalizing but not definitive. Personal and social factors evident in childhood were predictive of smoking and excessive drinking in adulthood, and these unhealthy behaviors predicted premature mortality in this sample. Yet these behaviors did not come close to fully accounting for the effects of childhood predictors on longevity. It may be the case that more reliable and more extensive measurement of health behaviors could have a major impact in explaining the psychosocial predictors of longevity, without resorting to psychosomatic explanations involving stress. Given the documented associations of stress with both cardiovascular disease mechanisms and suppression of the immune system, however, it is likely that there are multiple pathways linking psychosocial factors to longevity. Our guess is that personality and stress variables have both direct (psychosomatic) and behaviorally mediated effects on health, but ascertaining their relative importance is a difficult empirical question.

Discussion

A number of intriguing new findings have emerged from efforts thus far in studying longevity and cause of death in the Terman cohort. These enduring patterns could emerge only from a lifelong comprehensive study such as the one that Terman and his colleagues worked so hard to establish.

First, and most basically, the results leave little doubt that aspects of individual psychology are significantly linked to longevity, across the life span. In particular, we found confirmation in the physical health arena of the importance of what psychologists have typically seen as ego strength—dependability, trust, and lack of impulsivity. This pattern of results unites and extends the various related sorts of findings by other researchers.

Second, we found evidence that both personality and social stress factors are independent predictors of longevity. Past findings of psychopathological sequelae of divorce and family conflict can now be extended to the arena of long-term health effects. In both childhood and adulthood, the trauma of divorce clearly predicted premature mortality—but so did personality. Yet the effect of each was substantially independent of the other. Further examination of Figure 1 reveals that unconscientious males whose parents divorced crossed the 50th percentile of survival at (i.e., lived on average to) 74 years. For conscientious males from stable families, the average survival was to 81 years. (The figures were analogous for females.) Although these numbers probably represent the maximum size of effect that is likely to be found in such a sample, their dramatic nature nevertheless should promote substantial future research focused on this area.

Third, we have not, as yet, found striking associations with specific disease causes of death. Our careful, physician-supervised collection and coding of underlying cause of death from death certificates makes us confident of the reliability of this variable. The fact that personality and social factors predicted all causes of death suggests either that a general homeostasis is critical to good health (Selye, 1976) or that a group of unhealthy behaviors mediates a wide variety of health problems. This is not to say that a specific psychosocial influence cannot further raise the risk of a particular disease. However, to the extent that specific disease-prone patterns do exist (such as a coronary-prone personality), they probably depend on the co-occurence of more than one factor; in other words, interaction effects are likely involved. This could explain why such phenomena have proved so hard to capture.

How large are these effects? Because genetic hardiness, exposure to microbes and toxins, and many random factors affect longevity, researchers should not normally expect an overwhelming effect of psychosocial influences. Yet, where life and death are concerned, an influence that leaves 55% of the people alive compared with only 45% alive in an uninfluenced comparison group is of great interest. The effects discussed would generally translate into a relative hazard of between 1.2 and 1.5, a correlation of between 0.1 and 0.2, or a decreased life expectancy of two to four years (comparing upper and lower quartiles; cf. Friedman & Booth-Kewley, 1987; Lipsey & Wilson, 1993; Rosenthal, 1991; Schwartz et al., in press). These effects are smaller than the influences of gender or smoking on longevity, but comparable to common biological risk factors such as systolic blood pressure and serum cholesterol and to common behavioral risks such as exercise and diet, as they affect all-cause mortality. Nevertheless, caution should be used in making inferences about the magnitude of the effects in other socioeconomic groups and in other historical times; the Terman data are best suited for uncovering robust psychosocial variables that predict longevity rather than for ruling out complex pathways or explicating a full causal model.

Women significantly outlive men in this sample. Consistent with previous research, most of the psychosocial effects were more pronounced for the men (e.g., greater effects for childhood conscientiousness, adult mental difficulties, and self-reported early family stress). Like other researchers (Wingard, 1984), we have not yet been able to account for the gender differences in longevity, nor for the greater psychological effects in males, but this is a focus of ongoing efforts.

As in the general population, the significant mortality in this sample occurs after age 55. The important questions that remain unanswered revolve around the mechanisms that lead from seemingly physically healthy but psychosocially impaired middle-aged adulthood to premature mortality. We have seen that smoking and excessive drinking likely play some causal role, but perhaps not a dominant role. Our analyses of cause of death have thus far not provided any dramatic insights into this question. We of course are studying this matter in the Terman sample, but insights will also be gleaned from cross-sectional and other shorter-term studies that now can be focused on these issues.

Especially interesting is the importance of stable individual patterns of responding. In light of the current findings, a model that focused on socioenvironmental stress would be clearly inadequate. It is not the case that most people are equally likely to die prematurely until some of them happen to encounter divorce, job loss, or other unexpected stress. Although such factors do play a significant role, it is also the case that personality—a stable individual pattern of responding—is highly relevant. Furthermore, this effect of personality was maintained when we controlled for childhood socioeconomic status and for childhood health (i.e., parents' reports of health and illnesses in infancy and childhood).

Could it be the case that biological factors are a primary cause of both personality and health, as Eysenck (1985, 1991) has argued? At this point, the evidence is not totally inconsistent with such an explanation. Surprisingly, however, it is what Eysenck termed *psychoticism,* not neuroticism or introversion, that seems most relevant. (People high on psychoticism are impulsive, cruel, hostile, foolhardy, impersonal, and troublesome.) That is, the unhealthy patterns that have emerged thus far in our study predominantly involved being impulsive, imprudent, and arrogant rather than anxious, shy, pessimistic, and unsociable. This may change somewhat as more complex approaches are taken to these data; there is of course good evidence from other studies that the latter traits are indeed also relevant. More complex models of causality are also plausible. In addition to underlying biology predisposing an individual to both certain styles of behaving and excessive sympathetic reactivity, individuals undoubtedly play some role in selecting their own healthy or unhealthy environments (Magnus, Diener, Fujita, & Payot, 1993; Scarr & McCartney, 1983; also see work on testosterone, Dabbs & Morris, 1990).

Previous notions of a disease-prone personality (Friedman & Booth-Kewley, 1987) and a self-healing personality (Friedman, 1991) seem viable in light of the current findings. Indeed, the long-term predictive value of psychosocial factors, across decades, confirms the utility of thinking in terms of stable individual differences. The past emphasis on emotional reaction patterns, however, must be supplemented by significantly increased attention to behavioral correlates and mediators. For those researchers with a psychodynamic bent, the healthy pattern might be termed *mature ego defenses* (Vaillant, 1993). For those more focused on behavior, key issues may involve dependability and addictions. In either case, the same sorts of variables emerge—the destructiveness of impulsiveness and substance abuses, and the healthiness of maturity and social stability.

The longitudinal design of the present study points out the importance of not focusing too heavily on short-term coping with stress to the exclusion of lifelong habits and patterns. Although other research gives reason to believe that aspects of personality such as sociability and optimism are related not only to feelings of psychological well-being but also to good health, such influences may be heavily context dependent. For example, it may be helpful to be optimistic when one is facing trauma and it may be helpful to have friends when one is bereaved, but these things may not necessarily be generally health protective by themselves across the life span. Impaired social support can sometimes occur as a result of (as well as be a cause of) psychological maladjustment.

This line of thinking points to the fascinating speculation that problems in psychosocial adjustment that revolve around an egocentric impulsivity are a key general risk factor for all-cause mortality. In terms of healthy aspects of the so-called "Big Five" dimensions of personality, this would probably involve elements of Agreeableness such as trust and straightforwardness, and elements of Conscientiousness such as achievement striving, competence, and deliberation (see McCrae & Costa, 1991; Ones, Viswesvaran, & Schmidt, 1993; Watson & Clark, 1992); closely related are stable interpersonal ties. It has been pointed out that such a pattern might be seen to define "character" (Costa, McCrae, & Dembroski, 1989). Although common wisdom might argue that a selfish, self-indulgent boor may prosper by stepping on others, this does not seem to be the case. Nor do we find a triumph of the lazy, pampered dropout. In terms of the rush toward death, the encouraging news may be that good guys finish last.

The size of the effects we have uncovered, their fit with previous theory, and their support by ancillary lines of research point to the possibility of major public health implications for these psychosocial variables. Although bright children growing up in California in the 1920s obviously faced some unique challenges and one should not carelessly generalize the results to other groups of people in other historical contexts, it is also the case that the findings fit quite well with what is already known about the correlates of better or worse mental health. Indeed, if such patterns of findings were found concerning toxic associations with insecticides, electromagnetic fields,

or diets (even in a nonrandom sample), it is likely that a public health emergency would be perceived.

Although improvements in longevity are often assumed to be a function of medical technology, a good case can be made that most of the increase has come from changes in public health—sewage handling, food supply, inoculation, lessened crowding, and so on (McKeown, 1979, makes a cogent case; of course, there are many particular exceptions where medical cures have been discovered). The psychosocial and behavioral variables we have been discussing fit well into such a public health framework—major, lifelong, psychosocial patterns seem highly relevant to longevity. On the other hand, the effects of successful social intervention are not necessarily so clear, as the causal pathways have not been proved. For example, the effects of early psychological and social interventions on subsequent longevity have not been studied, much less documented. Still, given the other known benefits of a society with socially dependable individuals and stable families, the findings of significant relations with longevity should lend a new sense of urgency to addressing these complex issues.

Terman died in 1956. He was almost 80. His wife had died earlier that same year, after more than 50 years of marriage. Terman had set out in 1921 to study the simple bases of intelligence and success, but he came to recognize that it was much more complicated than he had imagined. The same might now be said about our understanding of the psychosocial bases of longevity.

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