

SOCIAL ISOLATION AND HEALTH, WITH AN EMPHASIS ON UNDERLYING MECHANISMS

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ABSTRACT Social isolation is a potent but little understood risk factor for morbidity and mortality, and its negative consequences are most profound among the elderly, the poor, and minorities, some of the fastest growing segments of the U.S. population. A steadily increasing number of people are living alone and are therefore more likely to experience social isolation. We discuss four mechanisms—attractiveness, health behavior, stress, and repair and maintenance—by which perceived social isolation might affect health. Our studies show that neither attractiveness nor health behaviors differ as a function of social isolation, but stress and repair and maintenance do seem to be factors. While socially isolated young adults did not report more frequent everyday stressors, they rated everyday events as more intensely stressful. They were also more likely to report passively coping with stressors, and to show greater vascular resistance, a mechanism of blood pressure control previously associated with passive coping and a risk factor for hypertension. Finally, they exhibited less efficacious repair and maintenance of physiological functioning, including slower wound healing and poorer sleep efficiency. These mechanisms have implications for designing appropriate interventions. We advocate a national health care plan that promotes preventive medicine, recognizes the significance of stress-related disorders, and supports the maintenance of social connections across the life span.

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THE 21ST CENTURY HAS BEEN HERALDED for revolutions in technology, yet a quieter but no less dramatic change is occurring in terms of the socio-demographic structure of the United States. The population of the United States is now over 273 million—an approximately 7 percent increase from 10 years ago. In addition, the population is graying. During the 20th century, the rate of growth in the number of persons 65 and over was approximately four times that of persons under the age of 65. Currently, more than one out of every six individuals is age 65 years or older, and the fastest growing segment of the population is over 85. The U.S. Census Bureau estimates that, by the year 2050, there will be more elderly (age 65 and over) than young (14 and under). The costs of medical care continue to rise more rapidly than inflation or the gross national product, with a disproportionate amount going to the treatment of aging-related disorders. According to estimates by Luskin and Newell (1997), by the early 1990s, 36 percent of all hospital stays and 48 percent of total days of doctor care were for individuals age 65 or over, even though this age group constituted only about 11 percent of the U.S. population.

The major causes of death in older adults are chronic diseases: myocardial infarction, stroke, cancer, and diabetes. The risk factors for these diseases—smoking, obesity, high blood pressure, and sedentary lifestyles—are well known, but one of the strongest and least understood is social isolation (House, Landis, and Umberson 1988). Changes in marital and childbearing patterns and in the age structure of U.S. society are projected to produce a steady increase in the number of older people who lack spouses or children. The average household size declined from 3.1 in 1970 to approximately 2.6 in 2000, for instance, and households with only one or two people increased from 46 to 59 percent during the same time period (Fields and Casper 2001). By 2010, the number of people living alone is projected by the U.S. Census Bureau to reach almost 31,000,000—a 40 percent increase since 1980. The negative health consequences of social isolation are particularly strong among some of the fastest growing segments of the population: the elderly, the poor, and minorities such as African Americans (House, Landis, and Umberson 1988).

These facts have stimulated efforts to improve health outcomes by decreasing social isolation. In a large multi-site intervention study, for instance, patients received either standard care following myocardial infarction or they received social support and treatment for depression in addition to standard care. At six months, patients in the latter intervention reported lower levels of depression and higher levels of social support than patients in the standard medical care group, yet, after three years, mortality in the two groups was comparable (24.4 versus 24.2 percent) (ENRICH 2001; NIH 2001). In a meta-analysis of prior research on social support and autonomic, neuroendocrine, and immune functioning, the effects of social support were more apparent on basal measures than on the measures of stress reactivity (Uchino, Cacioppo, and Kiecolt-Glaser 1996). This finding suggests that, in most individuals, the sequence of events

responsible for the association between social connectedness and health, if causal, may unfold over years rather than weeks or months. Post-intervention measurement periods of weeks or months allow little time for the filtration of societal, community, interpersonal, and mental events to manifest in any measurable pathophysiological or health outcome.

The meta-analysis by Uchino and colleagues (1996) revealed that perceived social connectedness or support was more strongly associated with lower levels of autonomic activity (e.g., lower resting blood pressure), better immunosurveillance (e.g., greater natural killer cell lysis), and lower basal levels of stress hormones (e.g., lower levels of urinary catecholamines) than was objective social connectedness or support. Moreover, cross-sectional research on perceived social isolation (loneliness) and health outcomes have confirmed an association. For instance, Herlitz and associates (1998) reported that among 1,290 patients who underwent coronary artery bypass surgery, ratings of the statement "I feel lonely" predicted survival at 30 days and five years after surgery, even after controlling for preoperative factors known to increase mortality (see also Seeman 2000), and evidence for a possible link between loneliness and cancer was provided by Fox and colleagues (1994), who found that loneliness measured prior to a mammogram screening was higher among women who later were diagnosed as having breast cancer relative to women who were proclaimed disease-free.

UNDERLYING MECHANISMS

Policy recommendations and interventions to improve social connectedness and health may benefit from a better understanding of the mechanisms responsible for the association. Social isolation and connectedness have been defined in various ways in the literature. We focus here on *perceived* social isolation, measured using the UCLA loneliness scale (Russell, Peplau, and Cutrona 1980).¹ In this paper, we review four major accounts for this relationship: (1) attractiveness; (2) health behavior; (3) stress; and (4) repair and maintenance. Evidence bearing on these hypotheses comes from a series of studies we have conducted to explore how the social world gets under the skin (Cacioppo et al. 2000, 2002a, 2002b; Hawkey et al., in press). One study involved pretesting over 2,600 undergraduates at a large Midwestern university, followed by more detailed psychological, behavioral, and physiological assessments of 135 of these students, selected from the top, middle, and bottom quintiles in terms of their total score on the UCLA loneliness scale. A second study consisted of a smaller sample of older adults (median age 65 years) from an apartment building in south Chicago.

¹Perceived social isolation forms the dominant factor underlying the UCLA loneliness scale, a measurement instrument that, despite its name, does not include the term "loneliness" (Adams et al. 1988; Russell, Peplau, and Cutrona 1980).

Attractiveness

According to the attractiveness account, socially active, popular, and connected individuals are also healthier and more physically appealing and intelligent than are individuals who perceive themselves to be relatively socially isolated. This explanation is derived from evolutionary psychology, where Buss and Schmitt (1993) have argued that physical features (e.g., symmetry, stature, waist-hip ratio) that are judged to be physically attractive are also features associated with health and fertility. To assess this hypothesis, physical attractiveness, height, weight, body mass index, education, age, SAT scores, number of credit hours in college, grade point average, and number of roommates were contrasted in the undergraduate students whose total score fell in the lowest, middle, or highest quintile on the UCLA loneliness scale (Cacioppo et al. 2000). Contrary to this hypothesis, no significant difference was found on any of these measures.

Individuals from the lowest quintile on the UCLA loneliness scale were found to score lower on neuroticism and higher on surgency (extraversion), conscientiousness, and social agreeableness than individuals from the highest quintile, who in turn did not differ on any of these dimensions from individuals from the middle quintile (Cacioppo et al. 2000). Studies of monozygotic and dizygotic twins suggest there is a heritable component to feelings of social isolation (McGuire and Clifford 2000). To the extent that individual differences are contributing to the association between social isolation and health, these data and previous reports suggest that they are likely to be operating through more complex pathways (Uchino, Cacioppo, and Kiecolt-Glaser 1996). We turn next to three such mechanisms.

Health Behavior

According to the health behavior account, individuals who are socially engaged and connected, in contrast to those who perceive themselves to be socially isolated, are exposed to stronger normative pressures from and control by friends and loved ones to perform healthy behaviors and to access health care when needed.² Having multiple social ties also provides multiple sources of information, thereby increasing the likelihood of having access to an appropriate information source to foster relevant health behaviors or to minimize stressful or risky situations (Cohen 2002). If individuals low in perceived social isolation were characterized by better health behaviors at least in part due to the influence of friends and loved ones who exerted pressure on them to adopt a healthy lifestyle, then differences in health behaviors could help account for the association between social connectedness and health.

²This account is closely related to the main effects model, which specifies that social connectedness is beneficial regardless of life circumstances due, for instance, to the social controls and peer pressure that influence normative health behaviors (Cohen and Wills 1985).

Health behaviors have a large and undeniable effect on morbidity and mortality (IOM 2001). However, the epidemiological studies of social isolation and health that have examined health behaviors have not found them to account for most of the differences in health outcomes of those low and high in social connectedness (e.g., Seeman 2000). In our survey of over 2,600 young adults and our more intensive study of 135 of these individuals, we found that individuals who scored high on the UCLA loneliness scale engaged in comparable weekly exercise, tobacco use, and caffeine and soda consumption, and slightly *less* alcohol consumption than individuals who scored average or low on this loneliness scale. Likewise, our study of older adults in Chicago revealed comparable levels of daily tobacco use, weekly caffeine consumption, weekly alcohol consumption, medical compliance, use of seat belts, and healthiness of diet across the full range of the UCLA loneliness scale (Cacioppo et al. 2002a).

Stress

A third perspective, termed the stressful life account, specifies that individuals who are socially active and connected are also characterized by lower levels of stress in their lives than are individuals who are lonely and isolated. The stressful life account does not represent a single homogenous mechanism but instead embraces a set of distinct mechanisms that have in common the catabolic actions of the body for purposes of surveillance, mobilization, and defense (fight or flight).

In one version of this account, perceived social isolation is the long-term consequence of insecure attachment during infancy and anxious or ambivalent attachment processes as an adult. Secure adult attachments promote trust, stability, security, and harmony, whereas insecure adult attachments have the opposite interpersonal and emotional effects, which in turn produce more frequent activation of the sympathetic nervous system and of the sympathetic adrenomedullary (SAM) and hypothalamic pituitary adrenocortical (HPA) neuroendocrine systems. Infant attachment is difficult to assess retrospectively, but poor or insecure attachment as an infant is thought to produce insecure adult attachment styles (Cassidy 2000). Our investigation of young adults confirmed the hypothesis that adults who felt socially isolated were also more likely to have insecure (anxious or ambivalent) adult attachment styles (Cacioppo et al. 2000). This hypothesis has limitations, however, including the malleability of adult attachment styles (e.g., as a function of relationship) and the finding that adult attachment style was unrelated to autonomic and neuroendocrine measures of stress or stress reactivity.

In a second version of the stressful life account, early or adult attachment processes are not what is crucial; instead, perceived social isolation (loneliness) is itself a stressor that produces negative affect (e.g., anxiety, depression), negative reactivity (e.g., irritability, hostility, mistrust), and lowered feelings of self-worth, which in turn promote chronic elevations in sympathetic nervous system, SAM, and HPA activation. Consistent with this reasoning, the motivational potency of

the *absence* of personal ties and social acceptance is reminiscent of more basic drives such as hunger and thirst (e.g., see Baumeister and Leary 1995). Solitary confinement is one of humankind's most severe punishments, and ostracism, the exclusion by general consent from common privileges or social acceptance, is universal in its aversive and deleterious effects (Felthous 1997; Williams 1997). Positively, tactile contact is a stronger determinant of mother-infant attachment than feeding (Harlow 1958). More recently, functional brain imaging studies have found that cooperation is associated with the activation of the ventromedial orbitofrontal cortex, nucleus accumbens, caudate nucleus, and rostral anterior cingulate cortex (Rilling et al. 2002)—some of the same regions that are activated by reward (O'Doherty et al. 2001). Evidence from our studies further indicate that adults who feel socially isolated are also characterized by higher levels of anxiety, negative mood, dejection, hostility, fear of negative evaluation, and perceived stress, and by lower levels of optimism, happiness, and life satisfaction (Cacioppo et al. 2000, 2002a). These feelings were not attributable to simple differences in the number of stressful life events, as neither the number of major life events nor the number or negative effect of traumatic life events differed as a function of perceived social isolation. More importantly, individuals who felt socially isolated also showed signs of elevated vascular activation and fragmented sleep, findings to which we will return below.

In the third version of the stressful life account, which has also been termed the stress-buffering model, having dependable social ties increases the probability that an individual exposed to a significant stressor has access to others who can provide relevant assistance, support, comfort, or relief (Cohen and Wills 1985). Those without such ties do not receive the same levels of tangible, emotional, appraisal, or self-esteem support in times of stress, and, consequently, are thought to show more frequent activation of the sympathetic nervous system and the SAM and HPA axes.

Considerable evidence indicates that social connectedness can be especially helpful during times of significant stress (Cohen 2002; Cohen and Wills 1985), but our studies, like the prior research, suggest that the detrimental effects of feeling socially isolated are not attributable solely to weaker buffers in times of stress. For instance, an experience sampling component of the study, which involved randomly beeping participants during a normal day to assess what they were doing and their perceptions and interpretations of their situation, revealed that individuals in the top, middle, and bottom quintiles on the UCLA loneliness scale were exposed to the same objective stressors and circumstances during a normal day, but those who felt socially isolated (i.e., those in the top quintile) perceived the hassles and stresses of everyday life to be more severe and the uplifts of everyday life to be less intense than those in the lowest quintile (Hawkley et al., in press). One possible explanation for this effect is stress buffering by social ties. Differences in the participants' ratings of the severity of hassles and stressors remained, however, irrespective of the presence of others in the situation. In fact,

social interactions, themselves a potential uplift and a source of pleasure for most individuals, were not experienced as positively by individuals who perceived themselves to be socially isolated.

Rather than stress-buffering, therefore, the differences we observed in hassles and stress may reflect differences in the manner in which people cope with stressors in their everyday life (Cacioppo et al. 2000). Daily hassles and stressors include events such as traffic congestion, difficult work assignments, deadlines, uncooperative equipment or technology, interpersonal conflicts, and perceived insults or injustices. Stress can contribute to disease by obscuring symptom profiles and increasing the delay in seeking care; decreasing medical compliance and health care utilization; increasing tobacco use and risky behaviors; and diminishing healthy behaviors such as eating well, exercising, and sleeping adequately (Institute of Medicine 2001). Moreover, although stressors can activate autonomic and neuroendocrine responses to mobilize metabolic resources in support of the requirements of fight or flight, the stressors of contemporary society typically do not require or even allow behavioral fight or flight. Consequently, the autonomic and neuroendocrine reactions shown in response to acute psychological stressors substantially exceed metabolic requirements (Cacioppo 1994; Turner 1989). Thus, although somatic activation in response to stressors is beneficial up to a point, excessive autonomic and neuroendocrine activation can diminish health across time.

Perhaps understandably, the view that stress is uniformly unhealthy has sometimes overshadowed possible individual differences in the appraisal of and coping with stress. Stress responses evolved because they can foster adaptive actions and adjustments. Overcoming stressful life circumstances may lead to an increase in one's sense of personal mastery or efficacy, help individuals minimize the negative outcomes of future stress, and increase resilience. The University of Chicago Student Prospectus entitled "The Life of the Mind," for instance, carries on its front cover the following statement:

WARNING: Study in this university is known to cause thinking, occasionally deep thinking. Typical side effects include mild temporary anxiety followed by profound long-term satisfaction.

This statement is a reminder that growth (muscular, cognitive, personal, social, and moral) is achieved by confronting and overcoming stressors, and then by consolidating what could be learned from the experience and recovering from these stressors. Thus, new challenges and demands can be a source of growth as well as a source of stress. Differences in appraisals of and coping with stressors may contribute to and result from successful adaptations to stressors.

Therefore, we assessed the coping mechanisms deployed in response to stressors by individuals who were high, average, or low in perceived social isolation. Four significant differences were found: individuals low in perceived isolation

(i.e., high in social connectedness) were more likely to actively cope (e.g., problem solve), and to seek instrumental and emotional support from others, whereas individuals high in perceived social isolation were more likely to behaviorally disengage or withdraw from the stressor (Cacioppo et al. 2002a). Passively coping or withdrawing from stressful tasks, interactions, or circumstances is reasonable in certain instances—for example, when one has no control or low efficacy to learn or cope—but when applied broadly to quotidian stressors, it at best can retard learning and personal growth and, at worst, can lead to an accumulation of tasks and stressors that become increasingly burdensome and self-defeating to address. Individuals who perceive themselves to be socially connected, on the other hand, not only are more likely to actively cope with everyday stressors, but are more likely to seek the support and assistance of others to do so. Having social ties is more like physical fitness than a bank balance: rather than drawing down on the balance available, using social ties is associated with strengthened connections, perhaps in part through increased accessibility and in part through the development of reciprocal obligations and trust.

Interestingly, active coping on laboratory tasks has also been associated with blood pressure responses governed primarily by increases in cardiac output (a “cardiodynamic” response served largely by beta-adrenergic and vagal mechanisms), whereas passive coping on laboratory tasks has been associated with blood pressure responses characterized primarily by increases in total peripheral resistance (a “hemodynamic” response served largely by alpha-adrenergic and local vascular mechanisms) (Sherwood, Dolan, and Light 1990). Although our sample of young adults was normotensive, the underlying physiology matched this autonomic patterning: individuals who perceived themselves to be socially isolated were characterized by higher total peripheral resistance and lower cardiac output than individuals who perceived themselves to be socially connected. This difference was as apparent at rest (baseline) as during the performance of orthostatic or psychological stressors, and ambulatory recordings further revealed that this difference was evident not only in the laboratory but also during a typical day in their lives (Cacioppo et al. 2002a; Hawkley et al., in press).

Chronic elevations in total peripheral resistance not only means that the heart muscle must work harder to distribute the same amount of blood through the circulatory system, but the reduced diameter of the blood vessels may also increase turbulence in and potential damage to the vasculature. Further, both central (e.g., baroreceptor reflex) and peripheral (e.g., vascular elasticity) mechanisms may degrade over time, diminishing the ability to maintain normotensive pressure during rest and normal states. Consistently elevated levels of vascular resistance, coupled with age-related decreases in vascular compliance, may set the stage for the development of hypertension—a risk factor for a variety of adverse health outcomes. Indeed, our meta-analysis of the prior literature pointed to elevations in resting blood pressure in older adults as one of the most robust effects associated with low levels of social support (Uchino, Cacioppo, and Kiecolt-

Glaser 1996), and we hypothesized the same effect would be found among older adults who perceived themselves to be socially isolated. Our study of older adults in Chicago confirmed this hypothesis. Because the sample size was relatively small, we divided the participants into two groups, low or high perceived social isolation, based on their scores on the UCLA loneliness scale. Age was positively and significantly correlated with systolic blood pressure among individuals who were high in perceived social isolation, whereas individuals who were low in perceived social isolation (i.e., high in perceived social connectedness) showed no such age-related increases.

Repair and Maintenance

The final mechanism we have investigated, termed the repair and maintenance account, builds on points raised in the last section—namely, that social isolation may weaken ongoing anabolic processes that serve to repair and maintain physiological functioning, foster recovery from stress, and contribute to the expansion of physiological capital and capacities as a function of adaptive transactions with the environment (Cacioppo et al. 2002b; Hawkey and Cacioppo 2003). Marucha, Kiecolt-Glaser, and Favagehi (1998), for instance, studied the effects of stress on an explicit repair process—wound healing. Two punch biopsy wounds were placed on the hard palate of 11 dental students, with the first placed during summer vacation and the second placed on the contralateral side three days prior to their first major examination of the term. In all 11 participants, wounds took longer to heal during high-stress than low-stress periods. Six months after the completion of this study, we located eight of these individuals and administered the UCLA loneliness scale. Although preliminary, our results indicated that perceived social isolation was significantly correlated both with wound-healing time during the summer and with the additional time needed to wound heal during periods of stress—that is, perceived social isolation diminished the efficacy of repair mechanisms.

To examine whether perceived social isolation also modulates the potency of restorative processes, we examined a quintessential restorative behavior—sleep (Cacioppo et al. 2002b). Sleep deprivation has dramatic effects on metabolic, neural, and hormonal regulation—effects that mimic those of aging (Spiegel, Leproult, and Van Cauter 1999). The young adults in our study who had scored in the top, middle, or bottom quintile on the UCLA loneliness scale spent one night in the Clinical Research Center of the university hospital. In a double-blind procedure, a device called the Nightcap (REMview sleep monitor, Respirationics Inc.) was used to record sleep during their night in the hospital and during several subsequent nights in their residences. Results from both sites revealed that sleep efficiency was lower and wake time after sleep onset was higher for individuals from the top than the bottom quintile on the UCLA loneliness scale (Cacioppo et al. 2002b). Importantly, the Nightcap recordings revealed that total time asleep did not differ across the groups. The restorative act of sleep simply

appeared more efficient and effective—that is, salubrious—in individuals who perceived themselves to be socially connected.

Further evidence for this difference was found using the Pittsburgh Sleep Quality Inventory (PSQI), a self-report measure of sleep quality (Buysse et al. 1989). Results from the PSQI revealed that the young adults who perceived themselves to be socially isolated also reported poorer sleep quality, longer sleep latency, longer perceived sleep duration, and greater daytime dysfunction due to sleepiness than did individuals who were relatively socially connected—effects that were replicated in our study of older adults in Chicago, as well (Cacioppo et al. 2002a). Together, these results provide preliminary support for the notion that reparative and maintenance processes can serve to detoxify potentially harmful catabolic processes, thereby fostering growth and expansion of individual resources that would otherwise be exhausted. The increased effectiveness of restorative and maintenance processes in socially connected individuals suggests that these individuals may benefit from an enlarged repertoire of behavioral options, cognitive and emotional reactions, and physiological responses when confronted by everyday challenges. Expansion of individual resources has interpersonal implications that further increase the capacity for growth. For example, socially connected individuals are more likely to know where to look and whom to ask for assistance during stressful occasions, thereby increasing the likelihood of obtaining access to the stress-buffering effects of social support or of remaining focused on the challenge of the task at hand. In a sense, adults may not be that different from infants who are eager to play, explore, and learn from both successful and failed attempts when their caregiver is nearby, but are more anxious, inhibited, and sensitive to failure when their caregiver is not.

CONCLUSIONS

Most interventions designed to improve social contact have produced somewhat disappointing results in light of the strength of the risk factor for social isolation. The empirical association between social isolation and health, however, is mute regarding the specific behavioral, psychological, and physiological pathways that may be underlying this association. Specifying these mechanisms, in turn, provides a roadmap for those interested in interventions and public policy.

We focused here on perceived social isolation, as measured by the UCLA loneliness scale, rather than social isolation per se. Although there is an association between these constructs, the correlation is imperfect. We nevertheless focused on perceived social isolation because: (1) prior research has also found an association between this and health outcomes; (2) we reasoned that the pathways through which social isolation gets under the skin to produce broad-based morbidity and mortality goes through an individual's social psychology, brain, and physiology; and (3) delineating the mechanisms linking proximal levels of organization (social psychological, behavioral, pre-disease physiological pathways) is

more tractable than delineating these mechanisms using less fine-grain data from distal levels of organization (e.g., sociological, morbidity, and mortality).

Based on the foregoing, the conclusion to be drawn is not that interventions cannot work, but that mechanisms responsible for the association between social connectedness and health should be understood in order to design appropriate interventions. Candidate mediators at the social psychological level include not only subjective construals of the social context (e.g., perceived isolation or support), but also behavioral choices (e.g., exercising, smoking), affective states (e.g., hopelessness, perceived stress), and personality traits (e.g., extraversion, neuroticism). Downstream from these psychological processes are candidate physiological mediators that entail the engagement of one or more physiological system (e.g., sympathetic nervous system, HPA axis, immune system), the operation of basic regulatory functions (e.g., homeostatic maintenance), the activation of adaptive responses to acute and chronic stressors, the recruitment of catabolic processes that “cost” the organism, and the engagement of anabolic processes that maintain and repair the organism.

Although the level of specificity of the mechanisms discussed in this paper is limited, candidates for attention and further delineation are beginning to emerge. Several specific variations of the stressful life account, as well as the complementary repair and maintenance account, warrant additional research, whereas the attractiveness and health behavior accounts of the effects of social isolation on health received less support. Investigations and public policy, therefore, should not be focused exclusively on health behaviors or intractable individual differences, but should also consider how economic and public policies could foster productive coping and restorative physiological processes.

Perhaps unsurprisingly, given the broad-based nature of the morbidity and mortality associated with social isolation, the various stress and repair mechanisms we found to differentiate individuals from the top, middle, and bottom quintiles in terms of perceived social isolation were themselves statistically separable. The take-home message is clear, though: the social world does not get under the skin through any one means but through a variety of general means which, combined with physiological or behavioral vulnerabilities, manifest as a wide array of disorders across individuals.

Given the deleterious effects of perceived social isolation on health and well-being, one can ask why such feelings evolved in the first place. The reproductive value of such unpleasant feelings is readily apparent. The need to belong and the distress of social isolation in offspring fosters maturation and acculturation, as the offspring are more likely to remain with family and close kin during maturation. The same motives and affective states help sustain maternal nurturance during this period. In addition, our relatively recent ancestral heritage as hunter-gatherers, coupled with the likely prevalence of malnutrition, would have promoted forces of selection that opposed social isolation (Fogel 2003). The hunter-gatherer who felt no distress when socially isolated would have felt less need to share

food, but this would also have diminished the likelihood of his/her progeny surviving. That is, hunter-gatherers who had a genetic predisposition to need to belong and to suffer distress from social isolation may have been more likely to return to share their food with their family and allies than those without such a predisposition. Although the latter individuals may well have roamed the earth better nourished than those who were distressed by social isolation and shared their food, the abandoned offspring—and the genetic predisposition to thrive in social isolation—would have been less likely to survive. Perhaps it should not be so surprising, therefore, that feelings of social isolation in most individuals are punishing and have an influence on our brain and physiological functioning as well as on our long-term health.

The policy implications of this work are far reaching. Consider the social cost of the phenomenal economic growth of the past century. Moving up the socio-economic ladder has often meant geographical relocation. For decades the economic engine has been fueled by social mobility, as it was less expensive to move specialized labor (executive or technical expertise) to various geographical sites as needed than to develop the expertise from the extant labor force in each community. With the organization of labor unions and the rising costs of labor, it became economical to close entire plants and reopen them in communities where labor was cheaper. Such closings have often had destabilizing effects on small, closely knit communities. Over the past century, the economic notion of moving to opportunity has contributed to the reduction in the number of extended families that live in the same neighborhood.

The same economic engine that has benefited from social mobility should consider bearing some of the health care costs created by the resulting isolation. Precedence for this arises from, for example, the government's conclusion that the mining industry should bear the environmental costs of restoring the land it strip-mined. The most recent U.S. Census Bureau statistics continue to show an increase in the number of people living alone or who have relocated in the past several years. Contributing to the increase in the number of people living alone are alterations in the family structure and the aging of America. Social isolation, which is heightened by living alone and recent relocations, is a major risk factor for broad-based morbidity and mortality, even after statistically controlling for known biological risk factors, social status, and baseline measures of health. Moreover, the negative health consequences of social isolation are particularly strong among those most in need of societal support: those over 65 years of age, the poor, and minorities. Given the projections of health care costs and the looming budget deficits, there is a critical need not only for theory and research to determine the mechanisms by which social isolation gets under the skin to affect morbidity and mortality, but for a national health care plan that both supports palliative care and promotes preventive medicine, health behavior, and healthy lifestyles to address the rising incidence of chronic disease; that recognizes and deals with stress-related physical and psychological disorders as a means of

increasing physiological resilience; and that recognizes the importance of connecting lives and family—for instance, not by transferring the elderly to cost-effective care facilities but by capitalizing on their wisdom and their need to connect with, assist, and mentor others in thriving multigenerational communities.

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