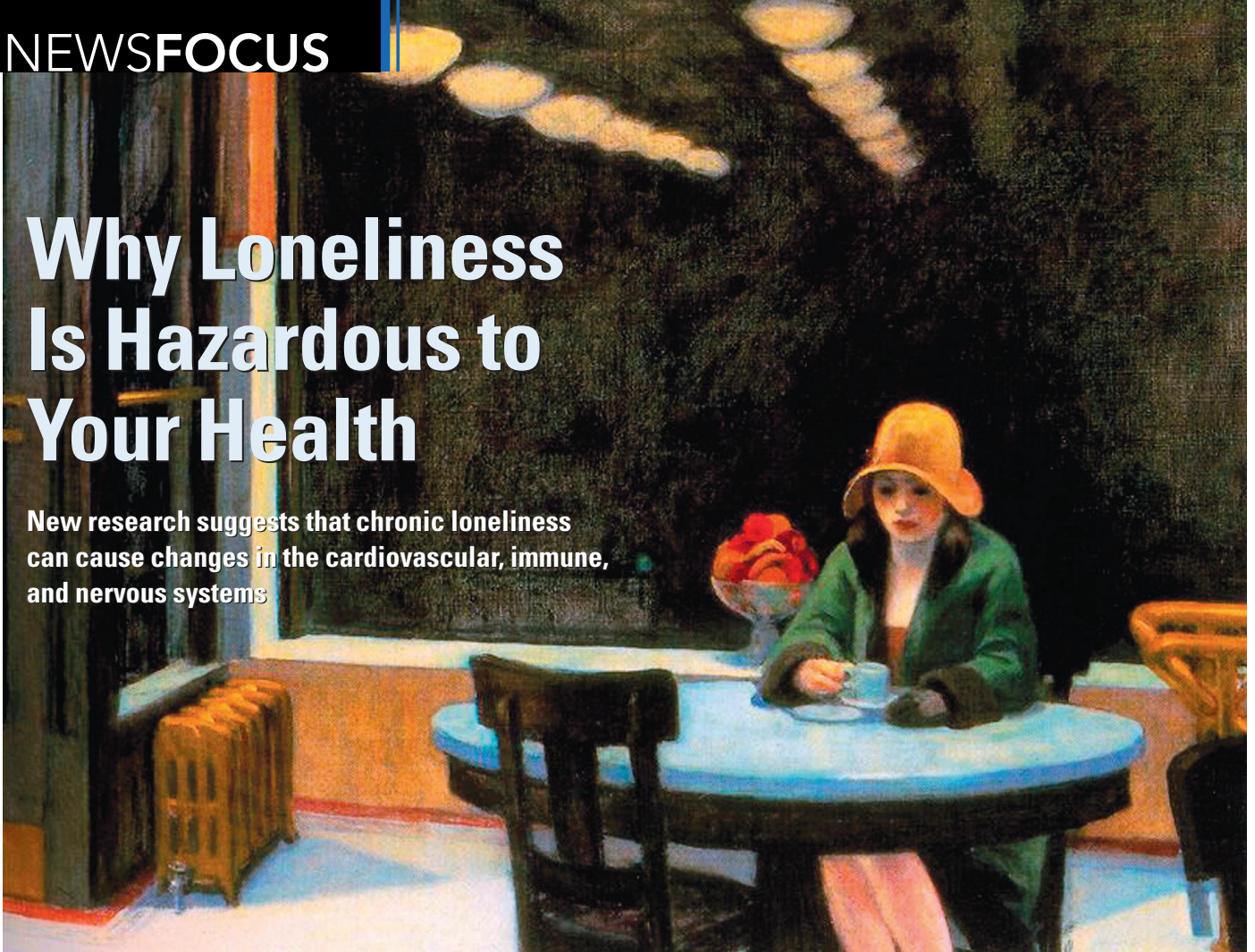


Why Loneliness Is Hazardous to Your Health

New research suggests that chronic loneliness can cause changes in the cardiovascular, immune, and nervous systems



EVERYONE KNOWS WHAT IT'S LIKE TO BE lonely. It often happens during life's transitions: when a student leaves home for college, when an unmarried businessman takes a job in a new city, or when an elderly woman outlives her husband and friends. Bouts of loneliness are a melancholy fact of human existence.

But when loneliness becomes a chronic condition, the impact can be far more serious, says John Cacioppo, a social psychologist at the University of Chicago in Illinois. Cacioppo studies the biological effects of loneliness, and in a steady stream of recent papers, he and collaborators have identified several potentially unhealthy changes in the cardiovascular, immune, and nervous systems of chronically lonely people. Their findings could help explain why epidemiological studies have often found that socially isolated people have shorter life spans and increased risk of a host of health problems, including infections, heart disease, and depression. Their work also adds a new wrinkle, suggesting that it's the subjective experience of loneliness that's harmful, not the actual number of social contacts a person has. "Loneliness isn't at all what people thought it was, and it's

a lot more important than people thought it was," Cacioppo says.

Colleagues credit him with building an impressive network of collaborations with researchers in other disciplines to pioneer a new science of loneliness. "He's placed it on the scientific map," says one collaborator, Dorret Boomsma, a behavioral geneticist at Vrije Universiteit Amsterdam in the Netherlands. "He's doing very creative work," says Martha Farah, a cognitive neuroscientist at the University of Pennsylvania. "He's created a new way of thinking about the biology of interpersonal relationships."

A new beginning

Cacioppo hasn't always studied loneliness. In the 1980s and '90s, he made a name for himself with meticulous laboratory studies on various aspects of emotion and cognition, and he's a founder of the field of social neuroscience, which seeks to understand the brain's role in social behavior. (Last month, colleagues elected him president of the newly formed Society for Social Neuroscience.)

Cacioppo says a 1988 *Science* paper suggesting that social isolation increases mortal-

ity (29 July 1988, p. 540) prompted him to change the focus of his research. Since then, scores of studies have found that people who lack social support are more prone to a variety of ailments. An analysis of 148 of these studies, published in the July 2010 issue of *PLoS Medicine*, suggests that social isolation increases the risk of death about as much as smoking cigarettes and more than either physical inactivity or obesity.

Compelling as these epidemiological studies are, Cacioppo says, they leave unanswered many questions about the mechanisms involved and about what aspects of social isolation are responsible. In the early 1990s, he set out to tackle these questions. He began by handing out questionnaires to thousands of students at Ohio State University in Columbus, where he was based at the time, and following up with physiological and psychological testing in the lab. For the past 10 years, he has been testing hundreds of Chicago-area residents, working closely with psychologist Louise Hawkley and other University of Chicago colleagues.

This work has convinced Cacioppo that

Online

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Podcast interview with author Greg Miller.

loneliness is a health risk on its own, apart from conditions such as depression or stress that are common fellow travelers. More specifically, it seems to be the subjective experience of loneliness that's important for people's well-being rather than any objective measure of social connectivity (the number of close contacts someone has, for example). It's an important distinction that most previous studies had ignored, says Daniel Russell, a psychologist at Iowa State University in Ames. "Some people are socially isolated and they're not lonely," Russell says. "By contrast, some people are lonely even if they have a lot of social contacts."

As a graduate student in the 1970s at the University of California, Los Angeles (UCLA), Russell helped develop the scale Cacioppo now uses in most of his research. The UCLA Loneliness Scale is based on a questionnaire that tries to size up how people

"Those were landmark investigations" that got other researchers interested in potential biological effects of loneliness, says Chris Segrin, a behavioral scientist at the University of Arizona in Tucson.

Lonely people also have elevated molecular markers of stress. Cacioppo's group has found that cortisol and epinephrine are elevated in saliva and urine, respectively. That might help explain why lonely people report feeling more stressed in situations most people experience as only moderately stressful, such as public speaking, Cacioppo says.

Together, these findings point to activation of the sympathetic nervous system, which coordinates the body's fight-or-flight responses. It's as if loneliness prepares the body for some looming threat. Cacioppo thinks that makes evolutionary sense. He argues that being alone, for our distant ancestors, meant abandoning the protection

other colleagues to investigate gene activity across the genome in the white blood cells of 14 participants in a longitudinal study of loneliness among Chicago-area residents. The volunteers selected scored in either the top or the bottom 15% of the study cohort on the UCLA Loneliness Scale.

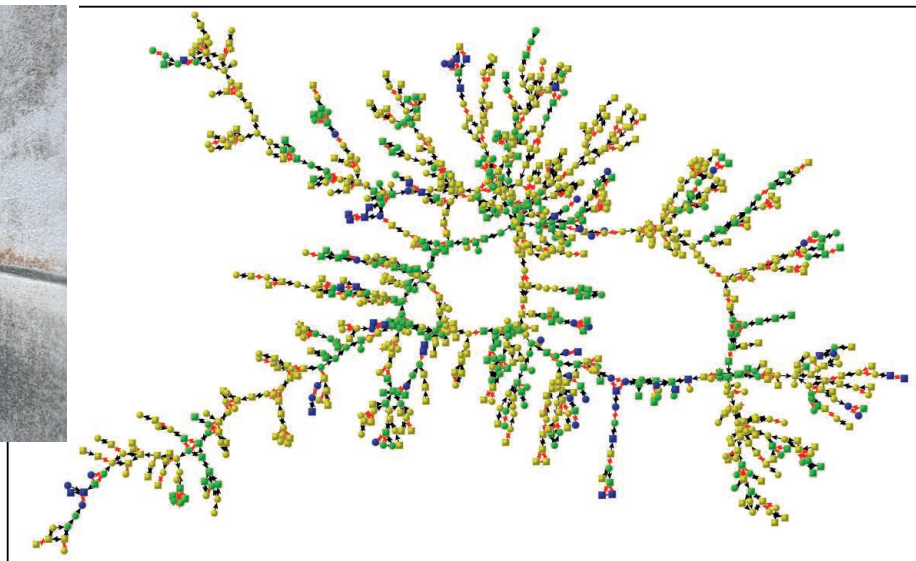
Two differences between the groups stood out: Lonely people exhibited increased activity for several genes encoding signaling molecules that promote inflammation and decreased activity for genes that normally put the brakes on inflammation. They also showed diminished activity in genes that help mount a defense against viral invaders.

Cole says that jibes with epidemiologic findings that socially isolated people are more susceptible to viruses, from the common cold to HIV, and to cardiovascular disease, which has been linked to excess inflammation. Cole says the team will soon



"Loneliness ... [is] a lot more important than people thought it was."

—JOHN CACIOPPO,
UNIVERSITY OF CHICAGO



Clusters of loneliness. Loneliness tends to spread among people on the fringes of social networks, according to a 2009 study. Blue dots represent people who reported feeling lonely three or more days a week, green corresponds to two lonely days, and yellow corresponds to less than two lonely days.

perceive their social situation, with questions about how often they feel a lack of companionship, feel they have no one to talk to, or feel out of tune with those around them.

Sympathetic feelings

When people score high on the UCLA Loneliness Scale, Cacioppo and colleagues have found, they also tend to exhibit several physiological changes that effectively put the body in a state of alert. In one early study, they found that lonely people exhibit higher vascular resistance, a tightening of the arteries that raises blood pressure. That forces the heart to work harder and can contribute to wear and tear on vessels.

of the group and jeopardizing one's genetic contribution to the next generation. He posits that the physiological changes and anxiety that accompany loneliness are a warning that an individual's social ties have gotten too weak: "It's an aversive signal that motivates us to change our behavior in a way that's good for our genetic survival." In his view, loneliness is a double-edged sword—adaptive in the short term but dangerous when it becomes chronic.

Cacioppo and colleagues have also found evidence that loneliness has a direct impact on the immune system. In a 2007 study in *Genome Biology*, Cacioppo teamed up with UCLA genomics researcher Steve Cole and

publish a replication of the findings in a group of about 120 participants in the Chicago study. He notes that just feeling a little left out isn't likely to throw the immune system out of whack. "It really takes a person who has taken and consolidated a lonely view of the world to show these changes in gene expression," he says.

Loneliness not only increases wear and tear by keeping the body in alert mode but also may prevent people from recharging their batteries with rest and relaxation. In the March 2010 issue of *Health Psychology*, Cacioppo and colleagues reported that although lonely people sleep a normal number of hours, they report more fatigue

the next day, suggesting that their quality of sleep isn't as good. Segrin says his group has recently replicated this finding and extended it to show that lonely people derive less satisfaction from leisure activities. Their findings are in press at *Health Communications*.

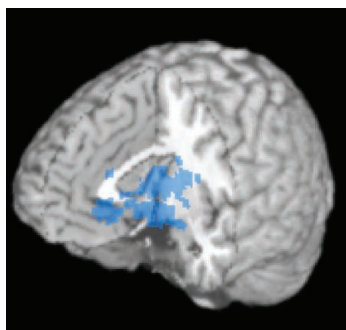
The lonely brain

Studies by Cacioppo and others before him have found that lonely people tend to rate their own social interactions more negatively and form worse impressions of people they meet.

Researchers are beginning to show how these biases may be encoded in the brain. In a 2008 study in the *Journal of Cognitive Neuroscience*, Cacioppo and colleagues used functional magnetic resonance imaging to measure metabolic activity in the brains of 23 undergraduate women at the University of Chicago. Those who were lonelier, as rated by the UCLA Loneliness Scale, exhibited less activation in the ventral striatum, a component of the brain's reward circuitry, when they viewed pictures of smiling faces.

In another study, Cacioppo and colleagues asked lonely and nonlonely people to perform the Stroop test, a workhorse task in experimental psychology in which people see words presented in colored text one by one on a computer screen, then indicate what color it was. When lonely people saw words that evoked negative social interactions, such as "isolate" or "reject," they took a split second longer to identify the color than they did for negative nonsocial words, such as "vomit." Nonlonely people showed no such delay. To Cacioppo, the findings, as yet unpublished, suggest that lonely people pay extra attention to negative social cues. "It suggests the brain is on the alert for social threats," he says.

A recent study by researchers at Duke University in Durham, North Carolina, meshes with these findings. Neuroscientist Ahmad Hariri and colleagues set out to replicate previous reports that people with anxious tendencies (but not a clinical diagnosis) exhibit more activity in the amygdala, a brain region crucial for threat detection, when they see images of angry or fearful faces. But Hariri's group found that this was true only for the subset of the volunteers who also reported below-average levels of



Unrewarding. Lonely people take less enjoyment from social interactions and exhibit less activity (blue) in the ventral striatum.

social support. (They did not measure loneliness per se.) To Hariri, the findings, published online 31 August in *Neuropsychologia*, suggest that people's perceptions of social support may calibrate how the amygdala assesses social threats, which in turn could influence their risk for anxiety disorders or other conditions.

Loneliness may also affect the prefrontal cortex, a region important for what cognitive scientists call executive control. In daily life, that often translates to restraint—as in not

eating cheeseburgers at every meal or putting the stopper back in the wine bottle after one or two glasses. Epidemiological studies have suggested that people with poor social networks are more likely to eat poorly, consume more alcohol, and exercise less. Several studies have found that lonely people perform poorly on lab tests that require executive control, and at least one study, published in the June 2006 issue of *Social*

Neuroscience, found reduced prefrontal cortex activity in socially isolated people.

Contagious ... but curable

Evidence that loneliness is partly heritable has emerged from a collaboration between Cacioppo and Boomsma, who oversees a database of Dutch twins and their family members. They've found that genetics accounts for up to half of the individual variation in loneliness. Their most recent study, published in the July 2010 issue of *Behavioral Genetics*, used an abbreviated version of the UCLA Loneliness Scale in a survey sent to 8683 twins and family members. In this group, genetics accounted for 37% of the variability in loneliness, somewhat lower than in some previous studies. Overall, the heritability of loneliness is comparable to that of depression, Boomsma says, but less than that of traits such as high blood pressure and cholesterol levels.

In his 2008 book, *Loneliness: Human Nature and the Need for Social Connection*, Cacioppo hypothesizes that there is a "genetic thermostat" for loneliness that's set differently in different people. That setting determines the degree of distress triggered by social isolation. "You're not inheriting loneliness; you're inheriting how painful it feels to be alone," Cacioppo says.

But environment matters, too, as studies

by Russell have shown. College freshmen rank among the loneliest populations he and his colleagues have studied, because they've left behind their family and high school friends and are trying to find their way in a new social ecosystem, Russell says.

According to some measures, society is changing in ways that may make people even lonelier. The U.S. Census Bureau estimates that nearly 29 million people live alone in the United States, a 30% increase from 1980. A widely cited 2006 study in *American Sociological Review* asked a representative sample of the U.S. population how many people they would feel comfortable discussing an important personal issue with. Between 1985 and 2004, the average number dropped from three to two, and the percentage of people who reported having no such confidants rose from 10% to 25%.

And like certain other health risks, loneliness may be contagious. Cacioppo recently teamed up with James Fowler of UC San Diego and Nicholas Christakis of Harvard University to investigate the spread of loneliness through social networks. Scrutinizing data on thousands of people participating in the Framingham Heart Study, Fowler and Christakis have reported that everything from smoking habits to happiness appears to spread from person to person within social networks (*Science*, 23 January 2009, p. 454). So, too, can loneliness, the trio reported in December 2009 in the *Journal of Personality and Social Psychology*.

The news isn't all bad, however. Even for hard cases, Cacioppo believes loneliness can be overcome. He and colleagues recently conducted a meta-analysis of 20 studies on interventions for loneliness. Simply providing social support doesn't seem to work, especially if people know they're being looked after. "If you know people are stopping by to check on you, it makes you feel like more of a loser," Cacioppo says. The most effective interventions were those that borrowed methods from cognitive behavioral therapy to shift people's attention and interpretation of social situations in a more positive direction, the team reported online 17 August 2010 in *Personality and Social Psychology Review*.

As for preventing loneliness, Cacioppo says it helps to know where your own thermostat is set and strive to stay in your comfort zone. In *Loneliness*, he writes: "The degree of social connection that can improve our health and our happiness ... is both as simple and as difficult as being open and available to others."

—GREG MILLER