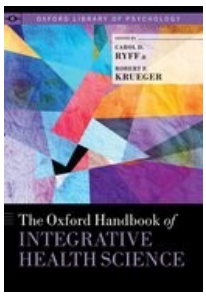

The Oxford Handbook of Integrative Health Science

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CHAPTER

1 Approaching Human Health as an Integrative Challenge: Introduction and Overview

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Abstract

This chapter provides an overview of the *Oxford Handbook of Integrative Health Science.* A first section examines the rationale for multidisciplinary research on human health via evolution of biopsychosocial integration in a major national longitudinal study, known as MIDUS (Midlife in the United States). It began with in-depth survey assessments of sociodemographic and psychosocial factors and a daily diary component and was then expanded to include assessments of cognition, biomarkers, and neuroscience as well as a city-specific minority sample. Multiple waves of longitudinal data and recruitment of a "refresher" sample followed. The remainder of this introduction highlights scientific advances (elaborated in subsequent chapters) that followed from collecting in-depth information *on the same set of participants.* Each chapter offers a narrative of multiple scientific findings in targeted areas. We end with a glimpse at the road ahead in advancing integrative health science.

Keywords: MIDUS, human health, biopsychosocial integration

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Introduction

Studies of human health are often pursued in a fragmented or piecemeal fashion that reflects the questions, priorities, and research strategies within specific disciplines or within distinct disease domains. For example, in the United States, research is often organized and segregated by the priorities of disease-specific divisions of the National Institutes of Health (NIH). Similarly, population-based disciplines (e.g., demography, economics, epidemiology, sociology) frequently employ large national samples to explicate how sociodemographic factors (e.g., age, gender, race, socioeconomic status [SES]) contour rates of morbidity and mortality. In contrast, behavioral and psychosocial disciplines (including many subfields of psychology, such as emotion and cognition) tend to study small select samples, frequently in experimental contexts. Biomedical and neuroscience fields, in turn, draw on diverse domains (e.g., immunology, genetics) to explicate underlying mechanistic processes in pathways to mental or physical disease outcomes.

The intent of this *Handbook on Integrative Health Science* is to embrace the idea that it is worth working across these wide territories, via targeted research questions, to illustrate how they can be fruitfully woven together. The motivational principle behind the endeavor is that understanding why some individuals remain healthy and well as they move across the decades of adult life, while others succumb to different varieties of disease, dysfunction, or disability requires a commitment to comprehensiveness that attends to the interplay of multiple interacting influences.

A further justification behind the reach toward integration involves a fundamental reckoning, namely, the awareness that although each of the disciplines and domains mentioned has reliably documented influences
p. 4 on health (broadly defined), all are, in and of themselves, *inherently ↳ limited.* Such limitations stem directly from the fact that they do not explicitly encompass influences known to matter for health outside their purview. Epidemiological and sociodemographic approaches are thus incomplete when they do not incorporate behavioral and psychosocial factors. Conversely, behavioral and psychosocial approaches are limited when they do not attend to influences from macro-level, structural factors, such as position within socioeconomic hierarchies, major economic events, or cultural contexts. Both large- and small-sample disciplines often seek to explicate biological and neurological mechanisms, but do so via notably different methods (e.g., laboratory-based experimentation vs. longitudinal/epidemiological studies). Finding ways to exploit the complementarities in these differing approaches while also addressing the limitations that exist within discipline-specific science further motivates this handbook.

In this introductory chapter, we describe the evolution of a vision of integrative health science, drawing extensively on experiences from the MIDUS (Midlife in the United States) national longitudinal study of health. A key message is that biopsychosocial integration is challenging to orchestrate. It requires incremental steps in which scientists from different disciplines learn each other's languages and objectives and then puzzle their way through targeted agendas that bring their respective strengths together. Our goal is to characterize how this increasingly deep and wide disciplinary integration unfolded in a national study of health, while noting the challenges that had to be navigated along the way. Following this distillation of the history of our integrative endeavor and how it has been brought to life in an actual study, the scientific products that have resulted, which constitute the chapters in this volume, are then briefly introduced.

The Evolution of Science for Biopsychosocial Integration: MIDUS

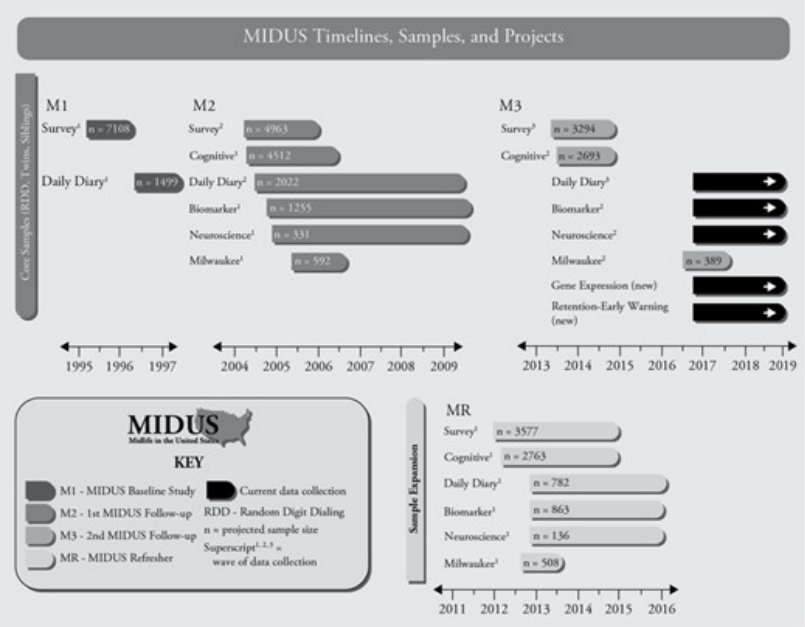
The mission of MIDUS is to study health, broadly defined, as an integrated biopsychosocial process that is unfolding across the decades of adult life. How the study evolved over time to pursue this overarching objective is sketched next with emphasis on the multidisciplinary scope of the endeavor.

Figure 1.1 provides an overview of how MIDUS began and how it has grown since its inception nearly 20 years ago. The progression clarifies why MIDUS is uniquely positioned to advance understanding of how sociodemographic, psychosocial, and neurobiological factors work together to illuminate integrative pathways to health and illness as people age. The MIDUS 1 baseline study was initiated in 1995/1996 by the MacArthur Midlife Research Network. Data were collected from a national survey of over 7,000 US adults, including twins and siblings, aged 25 to 74. A central objective was to bring, for the first time, an extensive battery of psychosocial measures to a population-based study. Such factors had defined mainstream psychological research on adult development and aging for decades, but previous work had been restricted to small, select samples having limited generalizability to the US population. A subsample of the original MIDUS respondents also participated in the first national diary-based study of daily stress.

At the outset, there were notable challenges in balancing disciplinary-specific priorities in allocation of resources. Specifically, population-based investigators (demographers, epidemiologists, sociologists) wanted to invest resources in recruiting a maximally representative sample, while those from experimental or small-sample disciplines (cognitive, personality, social psychologists) wanted to invest resources in obtaining in-depth assessments of key constructs from their domains of interest. What was ultimately achieved was a compromise between these competing priorities. The net effect of this resolution was that population researchers got access to important new domains of psychological, social, and behavioral assessments, while varieties of psychologists were, for the first time, able to collect data on their preferred constructs from a nationally representative sample of US adults.

Building on extensive scientific engagement with the initial survey (see Brim, Ryff, & Kessler, 2004), the National Institute on Aging (NIA) funded a program-project grant (P01) a decade later to conduct MIDUS 2 (center of Figure 1.1) (see Radler & Ryff, 2010, for a description of the MIDUS 2 sample). Thus, a second wave of survey data, including daily diary assessments, was collected. In addition, the content of the study was significantly expanded to include (a) a comprehensive cognitive battery administered by phone; (b) a comprehensive assessment of biomarkers (involving 2-day visits to biomedical clinics) on a subsample of respondents; and (c) laboratory-based measures of affective neuroscience, also obtained on a subsample of MIDUS respondents. These expansions signaled a pivotal shift in the MIDUS mission: Sociodemographic
p. 5 and psychosocial factors and their interplay would, going forward, be linked with diverse physiological ↳ systems and brain-based assessments of emotion regulation. These refinements were responsive to the growing emphasis on including biological factors in population-based surveys (Weinstein, Vaupel, & Wachter, 2008). Alternatively, the inclusion of brain-based assessments was responsive to the call for greater emphasis on neurobiological pathways linking socioeconomic position to health (Gianaros & Manuck, 2010).

Figure 1.1



MIDUS timelines, samples, and projects.

Another key refinement at MIDUS 2 was to recruit a sample of African American respondents from Milwaukee, Wisconsin, to increase the presence of minority respondents in the study. We chose a city-specific rather than national expansion of the African American sample to facilitate participation of minority respondents in the biomarker and neuroscience assessments being collected in Madison, Wisconsin. These additions have been pivotal in contributing to advances on race and health, as illustrated by several chapters in this volume, all of which are briefly described in this introduction.

A unique and critical achievement at MIDUS 2 was the collection of in-depth biopsychosocial data *on the same respondents.* This required unprecedented coordination across investigators and staff working at multiple sites (see Chapter 2, Behind the Scenes). Importantly, MIDUS 2 achieved high levels of participation across the various projects (survey, cognitive assessments, diary assessments, biomarkers, neuroscience), although cost and feasibility prohibited the collection of all project data on all respondents. Demographic characteristics of these subsamples compared favorably to the MIDUS parent sample (Love, Seeman, Weinstein, & Ryff, 2010). The biomarker and neuroscience subsamples were unique relative to clinic-based biomarker studies or laboratory-based neuroscience studies. Indeed, a key novelty of the MIDUS 2 design was to bring members from a national sample of US adults to these in-depth projects. Few neuroscience samples have been recruited from national samples, which meant bringing notable
p. 6 sociodemographic heterogeneity (e.g., age, gender, ↳ race, SES) to fields of research that typically rely on select and less representative samples.

It is also important to note the high participation rates of twins, siblings, and Milwaukee participants across MIDUS projects. Monozygotic (MZ) twins were heavily recruited to the biomarker and neuroscience projects, specifically as a strategy to control for genetic influences in investigating how sociodemographic and psychosocial factors are linked with biological risk factors and brain-based assessments of emotional reactivity and recovery. The unique strengths afforded by the presence of twins in the MIDUS enterprise is a point elaborated in Chapter 3 (on the role of twin studies and genomic research) as well as several other chapters that follow.

Illustrated on the right side of Figure 1.1 (MIDUS Timelines, Samples, and Projects) are other enhancements of MIDUS that have unfolded over time. The sample was greatly expanded via recruitment of the MIDUS

Refresher sample (lower right side of figure), which paralleled the size and age distribution of the original random-digit-dialing (RDD) baseline sample while also doubling the size of the African American sample from Milwaukee. Data collected on Refresher respondents paralleled the content of MIDUS 2, thus including survey, cognitive, diary, biomarker, and neuroscience projects.

The expanded sample responded to needs that had become evident in working with the initial biopsychosocial analyses. That is, in linking psychosocial factors with biomarkers and neuroscience, it became apparent that age, gender, race, and SES factors frequently mattered for the biopsychosocial linkages being investigated. Investigations of social inequalities in health showed that psychosocial factors often moderated links between SES variables and biological risk factors, but in addition, these patterns were often further moderated by age, gender, or majority/minority status. Such analyses of multiway linkages *demanded larger sample sizes*. The MIDUS Refresher sample thus greatly improved the integrative biopsychosocial potential of MIDUS by enlarging the pool of respondents on which integrative analyses could be conducted. In so doing, MIDUS became one of few longitudinal studies capable of exploring deep intersectionality (interplay of age, SES, gender, and race) and its implications for health.

A further advance afforded by the MIDUS Refresher sample was the opportunity to investigate the impact of a major historical event (i.e., namely, the Great Recession) on the health and well-being of US adults. MIDUS thus became uniquely positioned for comparative research involving same-age adults from two different historical periods, punctuated by sustained economic trauma occurring among large segments of society. A key question related to these period effects is whether more recent cohorts of adults show heightened profiles of economic hardship, work and family stress, and compromised physical and mental health compared to same-age adults studied prior to the Great Recession. Initial findings that supported these predictions are included in the final Chapter 35 (The Great Recession, Inequality, and Health) Long-term tracking of the core and Refresher samples over time will illuminate a further important question, namely, whether more recent cohorts of adults will show earlier profiles of disease and disability relative to prior cohorts with such differences tied to hardships endured during the Great Recession.

MIDUS is an ever-unfolding study. A third wave of survey data and a second wave of cognitive data were recently completed on the core longitudinal sample. Participation rates have been high: 77% (adjusted for mortality) of the overall sample has returned for this new round of data collection, paralleling the longitudinal retention rate obtained at MIDUS 2. Further, 69% of the cognitive sample returned for a second wave of participation. Of critical importance were retention rates among respondents who previously participated in the diary (82%), biomarker (90%), and neuroscience (91%) projects. To our surprise, the highest retention rates are evident among those who have participated in the most demanding of the MIDUS projects. Contrary to long-standing claims that participation rates may be compromised by asking a lot from respondents, we found that those most committed to MIDUS are the ones who have participated in multiple projects. Their sustained engagement likely reflects the care with which they have been treated during data collection as well as extensive efforts to communicate with them (newsletters, birthday cards) along the way. For the scientific community, MIDUS has changed the vision of what is possible in pursuing biopsychosocial integration in a national sample of US adults.

Completing the tale depicted in the figure, we are now in the field to collect a third wave of data from the diary project as well as second waves of data from the biomarker and neuroscience projects. Obtaining
p. 7
cross-time dynamics across these multiple domains will afford notable opportunities ↳ to investigate integrative factors in predicting who maintains good health, broadly defined, over time and who shows decline. In addition, two new projects have been added. The gene expression project aims to integrate gene expression profiling and assessment of transcriptome profiles into MIDUS. These functional genomic outcomes will be predicted by cumulative profiles of SES, social relational adversity, and psychological well-being, thereby advancing prior cross-sectional studies of links between sociodemographic and psychosocial

factors and gene expression. This project will also draw on the MIDUS twins to sharpen inferences regarding genetic and environmental influences.

A further new project focuses on the interplay of retention and early warning markers of decline. Using proven strategies in survey research, a subsample of respondents lost to the study at MIDUS 2 and MIDUS 3 will be contacted to collect a condensed battery of survey, cognitive, and health data (including biomarkers). These data will be used to test the hypothesis that those lost to the study over time show greater decline in health compared to continuing participants, and further that these differences reflect early profiles of stress exposure and psychosocial vulnerability. A key innovation is to compare extant approaches to adjusting for attrition in longitudinal research with alternative imputation strategies based on newly collected data from reinstating those who previously dropped out of the study (attriters).

Before detailing what follows in the remaining chapters of this volume, we conclude with a look at the rich content of the MIDUS study (see Figure 1.2). This visual does not capture the notable detail behind many terms depicted; for example, numerous single words (personality, cognitive functioning, well-being) are operationalized with multiple indicators. Thus, the overall picture is but a preliminary sketch of the depth involved in the biopsychosocial integration that we seek to study and understand. Nonetheless, we conclude our opening section with an overview of the content of MIDUS to convey the many varieties of integrative science that can be built around a study collecting wide-ranging information on large national samples, including twins and siblings, all of whom are tracked repeatedly through time.

What Have We Learned? A Preview of What Follows

The chapters that follow in this handbook are organized into six separate sections. In the first section, we extend our introductory chapter with two additional stage-setting chapters, one dealing with what is involved in orchestrating integrative health science and the other with the need for genetically informative research designs and strategies in pursuing biopsychosocial integration. The second section then focuses on early life experience and life course pathways to adult health by weaving together different domains of inquiry (e.g., early life adversity [ELA], cumulative stress, subjective aging) across time. The third section delves into the contexts, particularly experiences in work and family domains, including daily experiences and social capital, and how these matter for adult health. The fourth section offers several examples of research built around the interplay of psychosocial factors (e.g., social relational histories, psychological resources and vulnerabilities) and biology in understanding health outcomes. The fifth section digs deeply into key psychological domains (cognition, personality, emotion, well-being) and how they matter for adult health, including for biomarkers and affective neuroscience. The sixth section addresses integrative biopsychosocial research in MIDUS focused on social inequalities (assessed in terms of socioeconomic disparities, racial disparities, perceived discrimination, hardships of the Great Recession) and health, often examined in terms of biological risk factors. Brief summaries of the chapters within each of these sections are provided. A final summary section reflects about future directions across these wide-ranging topics.

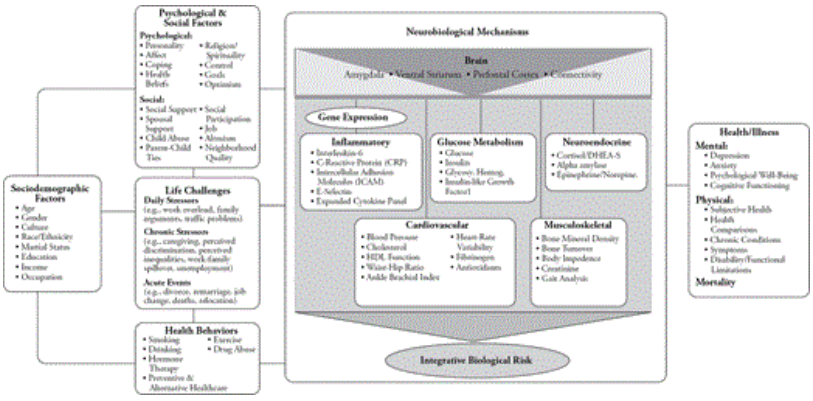
The second chapter in this opening section provides an in-depth look at how integrative biopsychosocial science is done, that is, how such comprehensive data across wide-ranging domains are collected on the same group of participants who are followed repeatedly over time. In **Behind the Scenes in Integrative Health Science**, Radler and Love clarify the array of challenges that must be negotiated in assembling such biopsychosocial data. These complexities need to be explicated if interested researchers are to understand what lies in the background of multidisciplinary research. Collecting in-depth data across multiple projects at different sites must be carefully orchestrated to ensure maximal participation as well as high-quality data products that are understandable and well documented. To unpack the tasks involved, this chapter reveals guiding principles behind multiproject data collection, such as that all projects need to have

p. 8 sufficient ↳

p. 9 ↳

cases to recruit from and that a reasonable amount of time must elapse between participants' completion of one project before they are invited to participate in another. Such requirements demand a carefully managed flow of available cases from the administrative core to project sites, which is managed with an administrative database whose purpose and content are briefly described. Challenges involved in creating user-friendly data and documentation across projects are also detailed. A final section discusses the need for research metadata that uses cutting-edge technological standards, which generate documentation that is web friendly and interoperable (can be exchanged and used across different computer and software systems). A central message from this chapter is that integrative health science as pursued in MIDUS resulted in new approaches to the collection, management, and public sharing of biopsychosocial data.

Figure 1.2



Overview of the content of the MIDUS study.

The third chapter in the opening section by Kruger and South is **The Roles of Twin Studies and Modern Genomic Technologies in Integrative Health Science.** They proposed that genetically informative research designs and strategies are essential for the biopsychosocial integration that is the core of this volume. Drawing on methodological ideas from behavioral genetics research, they illustrate how the national sample of twins that has been a part of MIDUS since the beginning has broad applicability in health research, stemming from the core idea that certain segments of the population may differ in the relative influence of genetic and environmental factors on phenotypic outcomes. One example pertains to the genetic contribution to alcohol problems, which may vary according to the personality trait conscientiousness, viewed as a kind of psychological environmental influence. Their findings show that the proportion of genetic variance (heritability) in alcohol problems was higher at higher levels of conscientiousness. That is, genetic risk for alcohol problems is expressed with greater clarity at high levels

of conscientiousness. Other examples from their group have shown that the links between SES and health are not directly environmentally mediated. Although research supports an association between lower educational attainment and higher allostatic load (AL), they find no evidence of a direct causal, environmentally mediated connection between the two. Instead, the effects were mediated through family-level differences, which include both genetic and shared-environmental factors. Regarding future work, they elaborate on the new MIDUS project on gene expression and the role of cumulative psychosocial adversity or advantage in understanding patterns of gene expression underlying physical health outcomes.

Part II. Early Experience, Life Course Pathways, and Adult Health

Growing research has shown that early life experience (ELA) can have implications for a range of health outcomes in later life. In **Early Life Adversity and Adult Health,** Levine, Miller, Lachman, Seeman, and Chen review prior findings on various forms of early adversity (growing up in a low SES environment, experiencing abuse) and their links to poor adult health, including cardiovascular disease, cancer, and Type 2 diabetes. They also summarize prior research on mechanisms, which include unhealthy behaviors (smoking, decreased physical activity, using food to cope with stress) and psychological vulnerabilities (depressive symptoms, anxiety). Their unique angle is to focus on positive psychosocial factors that might buffer against the adverse health impacts of early life difficulties. For example, having a warm family environment and nurturing mother in childhood is shown to protect against adult risk of metabolic syndrome among those who grew up in low SES environments. Another example pertains to a style of coping (shift-and-persist) in situations over which one has no control. Findings from a community-based study of children as well as adults from MIDUS showed health benefits of this strategy for body mass index and biomarkers (inflammation, AL). They conclude with emphasis on the unique abundance of positive psychosocial factors in MIDUS that may be protective of health in the face of adversity, including across different social and cultural groups.

The next chapter in this section, **Gender, Early Life Adversity, and Adult Health** by Lee, Ryff, and Coe, extends the focus on the long-term reach of early adversity with an explicit emphasis on differences between females and males. The prior literature on exposures to ELAs and adult health problems has tended to use gender as a control variable, as opposed to considering how gender might moderate connections between ELAs and adult health problems. They offer multiple theoretical frameworks, such as the life course pathway model, to illuminate possibly distinct structural, psychological, and behavioral pathways. Recent related findings from the Wisconsin Longitudinal Study, the Health and Retirement Study, and MIDUS are summarized. One key study from MIDUS ↳ examines differences between men and women in exposure to severe child abuse, which is then linked to dysregulation of physiological stress systems. A second examines differential vulnerability, suggesting that women from a low SES background are less likely than men from similar backgrounds to participate in regular exercise in adulthood. The third study explicates gender-specific pathways linking childhood SES to adult heart disease, giving primary emphasis to gender differences in the timing of reproduction—an early transition to parenthood translated to multiple adverse consequences (educational and economic attainment, well-being, smoking, obesity) that were more extensive for women than men. Future directions include adopting more comprehensive formulations of ELAs (e.g., family instability, childhood health) as well as examining factors that may promote resilience (e.g., optimism, purpose in life, environmental mastery) in the face of ELAs.

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Slopen, Meyer, and Williams are authors of **Cumulative Stress and Health,** which gives central attention to the adverse effects on physical and mental health following from the *accumulation* of life stressors. They highlight multiple studies from MIDUS that have jointly considered multiple social stressors in relation to health behaviors, biomarkers, and multiple health outcomes (smoking, body mass index, cancer). For example, they document cross-sectional associations between a broad range of psychosocial stressors (e.g., psychological and work stress, work–family conflict, perceived inequality, relationship stress,

neighborhood stress, discrimination, financial stress, etc.) and higher odds of smoking among African Americans in Milwaukee after adjusting for numerous covariates. A further study extended these findings longitudinally and showed nearly double the odds of failure to quit smoking over time among those with high cumulative stress profiles. They then highlight novel research probing interactions between daily and chronic stressors, including via the MIDUS twins, to examine genetic contributions to the effects of stressors on health. They end with a call to deepen understanding of associations between cumulative stress and health via pathway models and moderators as well as variation in individual sensitivity to context.

The final chapter in this section examines a largely neglected aspect of aging across the life course, namely, people's subjective experience of their own aging. How old individuals feel as they journey across the decades of adulthood and later life is emerging as a unique marker of developmental time, independent of chronological age. In **Determinants and Implications of Subjective Age Across Adulthood and Old Age,** Stephan, Sutin, and Terracciano review the growing interest among life course researchers in subjective age, which serves as a window into diverse age-related changes and experiences, from biological to social, that predict important life outcomes. They first review evidence from MIDUS and other longitudinal studies on factors that predict subjective aging, including age discrimination, negative change in social and family networks, lower well-being, less control, and poorer physical health. In addition, longitudinal evidence shows that younger subjective age is subsequently associated with better self-rated health, fewer chronic diseases, less decline in physical functioning, and reduced risk of hospitalization. Links between subjective age and well-being, cognition, and personality are also reviewed, along with experimental studies that induce people to feel younger and then examine effects on grip strength and inflammation. The authors call for future work that will extend subjective age to diverse health behaviors (sleep, diet, smoking, drinking) and multiple physiological systems as well as to sharpen understanding of the causal directionality involved in such patterns.

Part III. Work and Family Roles, Daily Life, and Adult Health

MIDUS brings notable texture and content to assessment of adults' experiences in work and family domains. A first chapter in this area, **Promoting Healthy Practices in the Workplace: Making Workers' Health a Priority Before It Becomes a Problem**, by Longley, Smith, and Grzywacz, underscores the fundamental role paid work plays in most adult lives, which, next to sleeping, consumes the single largest portion of people's time. They describe multiple features of the MIDUS design that offer unique opportunities to contribute to this literature and also review prominent theoretical models. Illustrative MIDUS findings are that those exposed to higher physical hazards at work showed poorer episodic memory and executive functioning, that long working hours were associated with greater risk of diabetes among low SES individuals, and that decision-making at work was linked with physical activity in ways that differ for men and women. Blacks report more psychological demands and less control in their jobs than whites as
p. 11 well as greater likelihood of being denied ↳ a job or promotion. Managers and professionals showed higher levels of optimism and life satisfaction compared to other occupational groups, while shift workers had poorer sleep quality, which was further linked to elevated inflammatory markers. Longitudinal findings showed that greater psychological demands at work predicted increases in body mass index across time. Future directions include exploiting the MIDUS longitudinal data to sharpen understanding of causal directionality in work and health links, to examine impacts of the Great Recession on work and health, and to deepen the incorporation of biomarker data into these analyses. Strengthening linkages to the O*NET online database that captures hundreds of work and job characteristics for classified jobs will also greatly expand capacities to link diverse elements of work life to adult health.

The next chapter, **Work and Family: Pathways to Health**, by Smith, Longley, and Grzywacz, elucidates how combined responsibilities of family life and full-time employment matter for health. Most prior research has suggested that combining work and family is stressful in ways that ultimately take a toll on health, but

there is growing emphasis on ways to better balance demands between these core domains. MIDUS has been instrumental in exploring how day-to-day responsibilities in work and family are linked to adult health in positive and negative ways. The strain pathway is the backbone of the work, family, and health literature. Findings from MIDUS have linked conflict between these two domains, which go in both directions (from family to work, from work to family) to poorer self-rated health, greater odds of multiple morbidities, and greater risk for obesity. Additional findings have linked these conflicts to daily stress as well as daily cortisol assessments (blunted waking cortisol, flatter diurnal cortisol). Nonstandard work schedules have also been shown to predict psychological distress, while work pressure and marital conflict were associated with greater odds of problem drinking. Alternatively, the enhancement pathway focused on enrichment and positive spillover between domains of work and family, with such patterns linked to lower odds of comorbid conditions and psychological distress (negative affect, depression, anxiety). Longitudinal evidence has linked increases in work-to-family enrichment with greater improvements in self-rated health and chronic conditions, particularly under conditions of moderate physical activity. Future directions emphasize the need to incorporate more biological outcomes as well as to enrich ways of thinking about family enhancement, while also examining genetic influences via the MIDUS sibling and twin data.

Marriage has been extensively studied as a possible influence on adult health. In **Intimate Partner Relationships and Health**, Carr and Mouzon synthesize contemporary theories and empirical findings on how such partnerships affect physical and mental health over the life course. Distinctive hypotheses follow from social causation (e.g., marriage as resource or a stress buffer) versus social selection (healthier individuals are more likely to have happy marriages) perspectives. Four key findings, drawing heavily on MIDUS, are put forth. First, although relationship status is powerfully linked to health in cross-sectional studies, weaker associations are evident in longitudinal studies that account for social selection. Second, the protective effects of romantic partnerships vary based on structural (e.g., marriage, cohabitation) and emotional characteristics (relationships quality) of the union. Third, sociodemographic factors (gender, race, age) matter in studying the nexus between marriage and health. Fourth, integrative science approaches that encompass behavioral and biomedical measures have advanced understanding of pathways linking social relationships to health. For example, marital transitions have been linked to high-frequency heart rate variability, which is considered an early indicator of a compromised cardiovascular system, while marital quality has been linked to inflammatory factors, bone mineral density, sleep efficiency, and healthier diurnal cortisol slopes. Using neuroimaging data, chronic marital stress has also been linked to reactivity to and recovery from emotional provocation. Future research needs to continue elaborating subgroup differences (by gender, race/ethnicity, SES, age/cohort) that shape associations between intimate relationships and health as well as examine social change, such as declining rates of marriage among low SES young adults.

Parent–child relationships are a focus in MIDUS built around the novel emphasis on the health effects of nonnormative parenting. These issues are examined by Song, Mailick, Greenberg, and Hong in **The Lifelong Health Effects of Parenting a Child With Developmental or Mental Health Problems**. The importance of such inquiry stems from the fact that 19% of the US population had a disability in 2010, and that because of deinstitutionalization, there has been dramatic growth in the number of such parents. Most of the previous
p. 12 literature has been based on volunteer samples. ↳ Thus, there is limited information about these issues in representative samples. MIDUS addresses this need while also providing comparative analyses with sociodemographically matched parents who do not have children with such conditions. Findings document higher levels of psychological distress, lower levels of well-being, and increased physical symptoms among nonnormative parents compared to matched peers, with younger parents showing greater vulnerability. Parents of children with disabilities also had higher levels of daily stress and more dysregulated profiles of diurnal cortisol compared to age peers, particularly on days when parents spent more time with their children. Links between nonnormative parenting and AL were found to be moderated by positive affect (PA), which provided a protective buffer. Greater physical health symptoms were found among African American

parents of children with disabilities compared to matched peers. Providing lifelong care to a child with disabilities increases risk for accelerated cognitive aging among mothers, especially when parenting stress is high. Parents of children with disabilities have also shown greater adverse impact following the Great Recession compared to normative parents. MIDUS has also provided a normative comparison group for studies of parents of children with autism spectrum disorders (ASDs) and fragile X syndrome. Risk of divorce was found to be higher among parents of children with ASDs compared to matched peers. Future directions include tracking longitudinal change in healthy nonnormative parents as well as finding a better understanding of differences between mothers versus fathers. The effects of stigma on the well-being of parental caregivers of persons with disabilities is another promising direction. Opportunities to examine unobserved genetic vulnerability via use of the MIDUS sibling and twin samples also lie ahead.

Daily experiences have been richly probed in MIDUS. Sin and Almeida's chapter on **Daily Positive Experiences and Health: Biobehavioral Pathways and Resilience to Daily Stress** provides a conceptual framework for investigating how positive daily experience may matter for physical and mental health through various behavioral and biological pathways. The bulk of prior research on daily experience has focused on negative experience (e.g., interpersonal tensions, work demands, family responsibilities). Positive events, or "uplifts," and the emotions derived from them are interesting for their stress-buffering effects. They consider how such positive experiences are patterned by sociodemographic factors (age, race, SES) and then examine numerous findings linking positive daily experience to biological outcomes (inflammatory responses, blood pressure, cortisol output) and health behaviors (sleep), including prospective associations. Innovative features of MIDUS, particularly its multiday assessment of daily experience combined with its multiproject design and multidisciplinary assessments are then emphasized. Those with higher educational attainment report more events that are positive than those with less educational attainment, who were also more emotionally reactive to daily stressors. Interestingly, people who reported more positive events encountered more stressors, suggesting higher engagement in social roles more generally. Controlling for age and gender, greater frequency of positive events (especially interpersonal events) was linked with lower inflammatory levels. Daily positive events also attenuated between-person associations of daily stressors and a blunted cortisol awakening response. Future directions include investigating whether daily stress and financial strain tied to the Great Recession might change the impact of positive events on well-being and stress processes. Overall, incorporating positive experiences in the study of daily stress will facilitate more comprehensive understanding of how ups and downs in daily life contribute to long-term health.

The next chapter in this section, **Family as a Naturally Occurring Stressor: Race, Psychosocial Factors, and Daily Health** by Cichy and Lee, summarizes prior research on racial disparities in health and well-being and then examines the benefits that follow from bringing daily diary methods to such inquiry. The background is that after controlling for SES, African Americans are at increased risk of most causes of death, and they show accelerated physiological aging relative to whites. Stress exposures and stress reactivity likely matter in explicating these outcomes. Daily diary methods thus illuminate within-person processes in these experiences, such as how daily experiences of racial discrimination compromise daily health and well-being. Given that family networks are often viewed as protective and health-enhancing resources that may buffer African Americans from the harmful effects of other stressors, they focus specifically on interpersonal family tensions and family network events that elicit stress. Racial differences were not
p. 13 evident in exposure to family stressors, but African Americans showed increased health symptoms on ↳ days when family arguments occurred compared to days with no family argument. African Americans also showed increased negative affect on days when they provided family support compared to days they did not. Engaging in poor health behaviors (smoking, drinking) also contributed further vulnerability to the effects of daily family stress on the lives of African Americans. The idea of being more vulnerable to the costs of caring is an important direction for future research that investigates effects on physiological dysregulation

and tracks longitudinal dynamics in these processes. Avenues for investigating African American resilience vis-à-vis race-related adversities are also discussed.

The final chapter in this section brings a social capital perspective to links between social ties and health. It is widely documented that social support and social connections tend to be good for health, but Fujiwara and Ryff choose to focus on the giving rather than receiving of caring behaviors. In **Social Capital, Altruistic Behavior, and Mental Health**, they distinguish between cognitive aspects of social capital, such as perceptions of trust and beliefs about whether neighbors can be called on, and social structural aspects of capital, such as participating in locally based associations. Altruistic behaviors are then defined as behaviors to benefit another. These ideas are applied to the family context, specifically the expression of altruistic behaviors of parents and grandparents toward children. Six studies from MIDUS that examine associations between social capital, altruistic behaviors, and health, especially mental health, are then summarized. Degree of felt obligation toward others in providing time or money or voting for laws to help the less privileged were linked with lower odds of experiencing major depression. The findings were then extended with longitudinal data from MIDUS, thereby sharpening issues of causal directionality. Patterns varied, however, by the type of altruistic behavior involved: Unpaid assistance to others worked as a protective factor against onset of depression, but financial and emotional support increased risk for depression. Further inquiry differentiated between cognitive and social structural domains of social capital, showing associations between trust and depression, but not between mutual aid and depression. MIDUS twins were then utilized to examine pairs discordant on levels of social capital. After considering genetic and early family environment, social trust was positively associated with perceived health. Final studies focused on altruistic behavior toward children, with a varied set of findings on health of parents and grandparents depending on gender. Their call for future research targets mechanisms through which altruism might affect health, including biological pathways. Examining how acts of altruism might vary depending on historical events (e.g., Great Recession in United States, great earthquake in Japan) is a further future research objective.

Part IV. Interplay of Psychosocial Factors, Biology, and Health Outcomes

Chapters in this section elaborate in more detail linkages between psychosocial resources, broadly defined, and an array of physiological indicators and other disease outcomes. In **Psychosocial Resources and Physiological Dysregulation**, Wiley, Gruenewald, and Seeman focus on AL, a composite index of multisystem dysregulation. Drawing on data from MIDUS and numerous other large epidemiological studies, they examine evidence linking psychosocial factors (self-esteem, optimism, purpose in life, size and quality of social relationships) to AL and select individual biomarkers. For psychological and social resources, multiple main and moderated effects are summarized. For example, sense of control has been linked with lower AL, although optimism has not shown links to AL but has been associated with inflammatory markers, controlling for numerous confounds. Social support (across multiple studies) and AL linkages have been mixed, depending on cross-sectional or longitudinal data. Given such heterogeneity, the authors suggest that difference may reflect sample characteristics (age, gender, race/ethnicity, country/culture). They also suggest that composite indices of psychosocial resources might bring greater clarity to obtained findings. Refinements are needed in conceptual models of psychosocial resources and AL, particularly in specifying under what conditions, when, and for whom such resources are related to AL. Future inquiries must also attend to the nature and timing of stress, psychosocial resources, and AL, thereby calling for greater use of longitudinal data.

Aging is given explicit emphasis in the chapter by Friedman, Lebreton, Fuzzell, and Wehrspann, **Biopsychosocial Patterning of Multimorbidity and Its Consequences**. The majority of adults over age 65 have two or more chronic conditions (multimorbidity), which puts them at increased risk for further outcomes, such as disability, cognitive decline, and early mortality. They review the independent and

p. 14 interactive contributions of demographic, socioeconomic, psychosocial, behavioral, ↳ and biological factors to multimorbidity and changes in it over time. Multimorbidity tends to be more common and increase more rapidly over time in less educated adults as well as older, female, minority respondents. Although the bulk of prior work has focused on factors that increase risk of disability with aging, psychosocial resources may mitigate these outcomes and also illuminate the biological pathways (e.g., inflammation) through which they occur. Given that multimorbidity is the norm, a unique feature is the focus on the characteristics of those who avoid multiple chronic conditions with aging. New longitudinal analyses examine the psychological impact of multimorbidity, showing that it is linked with decreased levels of well-being. Future work needs to examine more closely the specific conditions under which multimorbidity occurs and intervening biological processes. Dynamic processes in this complex model (chronic conditions, psychosocial resources, disability, cognitive function) need further inquiry. Importantly, psychosocial factors, as determinants of multimorbidity and as consequences, are areas ripe for interventions.

In **Psychosocial Life Histories and Biological Pathways to Bone Health**, Karlamangla, Binkley, and Crandall review the importance of bone strength in preventing hip and spine fractures in later life. They emphasize that the accrual of bone mass begins in childhood, although growing evidence shows that it is influenced by psychosocial and biological factors across adult life. MIDUS was the first large national study to investigate links between life span psychosocial histories (socioeconomic conditions, social relationship histories, psychological profiles) and multiple indicators of bone health (bone mineral density, bone turnover, composite indices of bone strength). Cumulative psychosocial histories, they argue, may be more important than current conditions in understanding bone strength. Although bone mineral density is the strongest predictor of fracture risk, bone turnover also affects bone strength. New MIDUS evidence compellingly illustrates integrative health science in its linkage of cumulative psychosocial histories, health behaviors, medications, dysregulated physiology, multiple markers of bone strength, and risk of fracture. Illustrative findings show that cumulative socioeconomic conditions matter for bone strength, while current adversity is linked to bone metabolic balance. Prior to MIDUS, no studies had examined links between number and quality of social relationships and bone strength, but they show that being a child in a single-parent family is linked to lower bone strength relative to load, even after controlling for childhood and adult SES and health behaviors. Adult marital histories and marital quality also are related to bone health. For the first time, MIDUS data show that psychological well-being (positive affect, positive relations, self-acceptance, purpose in life) is positively associated with greater lumbar spine bone mineral density and greater femoral neck bone strength after adjusting for numerous covariates. Physiological systems implicated in these linkages, such as glucose dysregulation and AL, are also examined. Promising avenues for future research include incorporating assessments of life stress, sharpening evidence of causality in linking psychosocial histories to bone strength, quantifying the role of health behaviors in these relationships, and identifying resilience factors that buffer the impact of life stresses on bone health and, ultimately, fracture risk. The future availability of repeated measures of bone health, currently in the field, will be of particular value going forward.

The next chapter examines integrative pathways to Type 2 diabetes, which constitutes a public health epidemic of striking proportions. In **Biopsychosocial Pathways to Prediabetes and Diabetes**, Tsenkova, Carr, Coe, Karlamangla, and Ryff review prior work to show that biomedical and public health models typically focus on excess weight and physical activity as key targets for reducing diabetes risk. They further underscore that significant heterogeneity in progressing from preclinical stages to overt diabetes is largely unexplained: Most obese persons do not develop diabetes, suggesting moderating roles of other factors. With novel advances from MIDUS, they show the interplay between established risk factors, psychosocial influences, and diabetes risk. For example, associations between obesity and diabetes risk are exacerbated by numerous psychological factors (depression, anger, perceived discrimination, neuroticism). Particularly noteworthy are the numerous indicators of glucoregulation (fasting glucose, fasting insulin, glycosylated

hemoglobin) available in MIDUS. Family history of diabetes is a key risk factor, but it is moderated by psychological factors. Positive affect, for example, mitigates the influence of parental history of diabetes on diabetes risk. Other traditional risk factors, namely SES and race, are also contoured by other factors, such as physical activity, depressive symptoms, and anxiety. Going forward, longitudinal data on glucoregulation

will afford important opportunities for tracking dynamics and causal relationships between the ↳ interplay of sociodemographic factors, psychosocial functioning, and behavior on pathways to diabetes. Prevention efforts demand understanding the integrative nature of these multiple influences.

Issues of obesity are continued in the next chapter, **Weight Identity Among Older Adults in the United States: Genetic and Environmental Influences** by Wedow, Briley, Short, and Boardman. A substantial fraction of adults classified as overweight or obese do not self-identify as overweight or obese. Using the MIDUS twins, they examine how such self-perceptions of weight are linked with genetic and environmental influences, recognizing that heritability always reflects variation in both genetic architecture and nurture (environmental inputs). Overall patterns from their analyses show that perceived weight status is more heavily influenced by environmental factors than objective weight. Importantly, the heritability of weight identity operates above and beyond simple changes in physical weight. Their larger message is that genetic factors may impact subjective health assessments in ways that are contingent on other social identities or social contexts. Interestingly, the genetic contributions to weight identity are significantly higher for women than men, likely reflecting the disproportionate emphasis in social contexts on women's bodies compared to men's. They call for future research that elaborates aging and historical changes in weight identity as well as incorporating molecular genetic approaches. More broadly, the relevance of their work for other identities, defined by race, social class, religion, and so on, is noted, given that the tendency to identify with a particular group may have some genetic origins, although environmental factors are also likely key to the formation and maintenance of such identities.

The final chapter in this section continues the focus on body weight. In **Psychosocial Consequences of Body Weight and Obesity**, Carr and Tsenkova observe that more than 60% of US adults are overweight or obese. Although the health consequences of obesity are widely documented, less is known about possibly harmful effects for psychosocial and interpersonal well-being. After reviewing rates and correlates of obesity, they examine the consequences of body weight for three MIDUS outcomes. The first pertains to institutional and interpersonal discrimination, which is found to be significantly more likely among overweight and obese persons compared to normal weight counterparts. Further, comparison of MIDUS 1 and MIDUS 2 shows that the prevalence of weight-based discrimination is increasing across time. These experiences are occurring in work and health-related contexts as well as everyday interactions (daily slights, insults, harassing/disrespectful treatment). A second key outcome pertains to social and intimate relationships, where severely obese persons report significantly higher levels of strain and lower levels of support in their family relationships compared to other weight groups. Those with higher body mass index levels, especially women, also report less frequent and less satisfying sexual experiences. A third outcome is psychological well-being. After controlling for a variety of factors, high body weight in itself is not found to be a source of compromised well-being. Rather, it is the stressors and stigmatization associated with weight that account for poorer self-perceptions and more negative daily moods among obese Americans. They call for further work on the impact of weight stigma for other social relational measures (strain, social support) as well as sleep disorders (sleep apnea) and functional limitations. Long-term tracking of the broad health consequences of obesity will continue as a major focus of MIDUS going forward.

Part V. Psychological Factors and Health: Cognition, Personality, Emotion, Well-Being

Comprehensive cognitive assessments were added to MIDUS at the second wave of data collection. In **Cognition at Midlife: Antecedents and Consequences**, Agrigoroaei, Robinson, Hughes, Rickenbach, and Lachman review the rich advances that have grown up around the BTACT (Brief Test of Adult Cognition by Telephone), which they briefly describe. They then consider the role of psychosocial and behavioral factors as protective influences on cognition. For example, perceived control, social engagement, and physical activity have been linked with better cognitive performance, thereby pointing to potentially modifiable factors that can reduce or delay cognitive decline. Personality traits, stress exposures and physical health status have also been linked to cognitive performance. They also consider the consequences of cognitive aging. For example, higher executive functioning has been linked with higher heart rate reactivity, whereas lower executive functioning has been linked with increased physical limitations. Differences in cognitive performance have also been linked with biomarkers (inflammation, AL) as well as adjustment to stress, subjective age, and everyday ↳ memory problems. Longitudinal data on cognitive assessments, now available, will advance understanding of directionality of these many relationships. Although cohort differences in cognitive aging have long been studied, the MIDUS Refresher sample offers unique opportunities to compare cognitive aging across adult living through different slices of time.

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Personality traits have emerged as robust predictors of health over the life course. In **Associations Between Personality and Health Behaviors Across the Life Span**, Turiano, Hill, Graham, and Mroczek review extensive findings that have linked personality to behaviors such as drinking, smoking, and drug use. Advances from MIDUS show that those who increased in neuroticism and openness over a 10-year period had a greater risk of using alcohol during the past month. Greater likelihood of smoking was evident among those higher in neuroticism and openness and lower on conscientiousness. Controlling for prior levels of substance abuse, higher levels of neuroticism and lower levels of openness predicted increased odds of using illegal drugs and misusing prescription drugs. Health behaviors have been found to mediate the association between conscientiousness and 14-year mortality risk, while conscientiousness moderated the link between neuroticism and biological risk (interleukin 6). Going forward, the addition of a third wave of personality assessments, now available, will facilitate growth curve modeling techniques to better understand whether personality predicts reliable behavior change over time.

Personality questions are extended in the next chapter by Jokela, **Personality as a Determinant of Health Behaviors and Chronic Diseases: Review of Meta-Analytic Evidence**. Meta-analysis allows researchers to overcome the limitations of small samples or idiosyncrasies of individual studies by harnessing their combined strengths. Conscientiousness has emerged in these analyses as a positive predictor of health behaviors, with several pathways considered (SES, marital status, adaptive styles of coping with stress). Alternatively, neuroticism consistently is associated with poorer health behaviors, perhaps due to other emotional vulnerabilities. Extraversion, in contrast, has been linked with both healthy (physical activity) and unhealthy (smoking, drinking) behaviors. However, only conscientiousness is systematically associated with chronic diseases (dementia, cardiovascular disease, obesity, cancer) and mortality across multiple studies. Future work is called for to better understand the pathways in these associations as well as their developmental patterning throughout the life course. Evaluating causal versus noncausal explanations of associations between personality and health is another important future direction.

The next chapter shifts the focus to psychological factors that may enhance health and longevity. In **The Road to Positive Health: Behavioral and Biological Pathways Linking Positive Psychological Functioning With Health Outcomes**, Boehm reviews the growing science linking constructs such as optimism, purpose in life, life satisfaction, and positive emotions to health. For example, optimistic individuals have reduced risk of cardiovascular disease, and purposefully engaged individuals live longer than their less optimistic or

purposeful peers. However, underlying pathways are unclear. MIDUS is particularly well suited to investigate these questions given its comprehensive assessments of stress and behavioral and biological processes. Both restorative and deteriorative processes are considered. Illustrative findings link positive psychological factors to reduced risk of metabolic syndrome in adult life, after controlling for numerous factors, including who had heart problems at the beginning of the study. Stress buffering among those of low SES is evident via linkage of higher life satisfaction to healthier patterns of diurnal cortisol. Underscoring the novelty of restorative biological processes, those with higher profiles of optimism had higher concentrations of antioxidants (carotenoids and vitamin E) that work to prevent free radicals in the body from damaging cells and fostering disease. Optimism has also been linked to the "good" cholesterol, high-density lipoprotein (HDL) cholesterol, with such associations maintained after adjusting for numerous sociodemographic factors, chronic health conditions, and medications. Behavioral pathways (eating, drinking, smoking, sleep quality) are implicated in these results. Future work needs to test possible mediational models as well as exploit the richness of MIDUS measures of contrasting aspects of well-being (e.g., hedonic vs. eudaimonic).

Varieties of positive affect (PA) are the focus of the next chapter by Ong, Sin, and Ram, **Distinguishing Between Enduring and Fragile Positive Affect: Implications for Health and Well-Being in Midlife**. Although considerable research has linked high PA to adaptive outcomes, it is increasingly clear that PA also has a costly side. They emphasize the importance of attending to both PA level and PA dynamics in reconciling
p. 17 whether ↳ it is conducive or detrimental to health. Fragile PA reflects feeling states that are fluctuating, variable, and subject to external influence, while enduring PA reflects global feelings that are relatively stable across time. They draw on survey, daily diary, and biological data from MIDUS to examine links between affective variability (as well as affective reactivity) and health. They also consider multiple future directions in integrative health research, such as why at very high levels PA may be detrimental for health. PA dynamics are central to investigating this question. They also point to rich future directions in MIDUS for illuminating why positive emotions appear to occur with greater frequency with age. They conclude with consideration of multiple methodological challenges that are important for sharpening understanding of the fragile versus enduring nature of PA and how such distinctions matter for mental and physical health.

An important addition at the second wave of data collection was a project that brought affective neuroscience into MIDUS. In **The Temporal Dynamics of Emotional Responding: Implications for Well-Being and Health From the MIDUS Neuroscience Project**, Schaefer, van Reekum, Lapate, Heller, Grupe, and Davidson summarize advances that have followed from this endeavor. Emphasis is on the temporal dynamics of responses to brief emotional stimuli presented in the laboratory, as assessed with functional magnetic resonance imaging (fMRI) and facial electromyographic (EMG) recordings. Such assessments are rarely included in population-based longitudinal studies of aging. Emotion-based assessments of reactivity and recovery have been linked with multiple factors, including personality traits, well-being, stress exposures, biomarkers, and aging. For example, extending findings noted previously, those with higher levels of conscientiousness show quicker recovery profiles from negative emotional provocation, after controlling for a variety of factors, compared to those lower in this trait. Further, the effect was moderated by age, such that it was more prominent among younger and middle-aged than older aged adults. In addition, those reporting higher purpose in life showed better emotional recovery from negative emotional provocation, even after controlling for initial reactivity levels. Bringing in the social relational realm, those who reported chronic marital strain across two time periods exhibited briefer responses to positive stimuli after controlling for participants' depressive symptoms at MIDUS 1. Briefer responses to positive stimuli also significantly mediated the link between marital strain and depressive symptoms at MIDUS 2. Moving to neuroimaging results, adults with higher overall levels of eudaimonic well-being showed sustained engagement of reward circuitry (ventral striatum, dorsal lateral prefrontal cortex) in response to positive pictures, and this sustained activity was further associated with healthier patterns of diurnal cortisol. The neuroscience project was enriched by the expanded sample size from the MIDUS Refresher, which will allow

for assessment of subgroup differences defined by gender, race, and SES. Longitudinal data on reactivity and recovery profiles, currently being collected, will afford unique opportunities to examine the causal implications of temporal dynamics of emotional responding to multiple aspects of health.

The two final chapters in this section bring cultural context into thinking about links between emotion and health. In **Culture, Emotion, and Health**, Yoo and Miyamoto summarize the growing evidence that cultural context has a big influence on the health implications of emotions. Situated within cultural psychology, this literature distinguishes between independent and interdependent self-construals tied to Western and Eastern cultural contexts. Drawing on comparative findings from MIDUS and MIDJA (Midlife in Japan), they note the cultural preference for positive, and against negative, emotions in most Western cultures. Eastern cultures, in contrast, see both as important and emphasize ideas of balance between the two. Empirical findings have shown, as predicted, that associations between negative emotions and poorer health (chronic conditions, physical functioning) were significantly greater among American than Japanese adults. Negative emotions were also linked with elevated inflammatory profiles (interleukin 6) in the US but not among Japanese respondents, after adjusting for numerous covariates. They then move to positive emotions and cardiovascular risk, measured in terms of lipid profiles. Although positive emotions were significantly linked with better lipid profiles (higher HDL cholesterol, lower levels of the ratio of total cholesterol to HDL cholesterol) in US respondents, such associations were absent among Japanese respondents. Addressing pathways, the interplay of social relational ties, positive emotions, and health were also explored, guided by the idea that positive emotions may entail a social cost in interdependent cultures. Findings, in fact, showed that positive emotions were negatively associated with health biomarkers of neuroendocrine function and
p. 18 metabolic function (DHEA-S ↳ [dehydroepiandrosterone sulfate], HDL-C) among Japanese adults who had low levels of social connectedness. Behavioral pathways (eating a healthy diet) have also been investigated, with healthy eating linked to independent self-construals in the United States but interdependent self-construals in Japan. Given the frequent absence of findings in Japan, a key future direction is to consider social emotions, such as sympathy, which may be more relevant in Eastern cultures as well as to probe more deeply the social situations/contexts in which emotions are expressed. Recognizing rich experimental traditions in social psychology, causal directionality may also be advanced through experimental paradigms that can test ideas of cultural fit by manipulating emotional processes in the laboratory.

The final chapter by Park and Kitayama, **Anger Expression and Health: The Cultural Moderation Hypothesis**, continues the East–West comparison with a focus on anger. They hypothesize that anger, as vented frustration, is more salient in Western cultural contexts, particularly among those of lower status, whose lives expose them to more things to be frustrated about. Alternatively, in Eastern cultures such as Japan there is more of a cultural prescription against anger because it undermines social harmony. In such contexts, high-status individuals may be at greater liberty to express anger, as a display of dominance, without fear of negative consequences. As predicted, Americans with lower social status expressed more anger compared to their higher status counterparts, and this effect was mediated by greater feelings of frustration. For the Japanese, higher anger expression was found for individuals with high compared to low social status, with these effects mediated by experiences of dominance. Further analyses brought biomarkers into the formulation (a composite involving inflammatory responses and cardiovascular risk). Findings showed that anger expression was linked with increased biological health risk among Americans, but with reduced risk among Japanese adults, controlling for numerous other factors. Future research directions include the need to explicate anger–health linkages via mediating mechanisms (e.g., neuroendocrine stress reactivity and recovery patterns) as well as to assess longitudinal dynamics in these associations.

Part VI. Integrative Perspectives on Social Inequalities in Health

Social inequalities in health constitute a major thematic focus on findings that have been generated from MIDUS and other large population-based studies. In **Personality and Socioeconomic Status Over the Adult Working Years**, Chapman and Elliot examine if and how personality traits are involved in SES and health differentials. Social causation/fundamental cause perspectives, which are quintessentially sociological, suggest that social structural factors create and perpetuate SES stratification over time. Alternatively, social selection/individual self-determination perspectives argue that cognitive abilities and personality traits are important influences on upward mobility. Prior work has documented that traits (neuroticism and conscientiousness) do explain some portion of the association of SES with mortality, but it is typically not large. They use three waves of data from MIDUS to estimate cross-lagged panel models of relationships between personality traits and SES over time. Results showed that SES standing across the adult years is heavily shaped by both family of origin SES and educational status, with only small associations evident for traits (positive links of openness and conscientiousness, negative links of neuroticism and agreeableness). Thus, reciprocal influences between these two phenomena are relatively small across a substantial period of working adult life, although the inverse effect on agreeableness is of note. A further novel result was the impact of family of origin SES on personality, both directly and indirectly through education, which reaches far into the future. Some of these effects may be transmitted in adolescence and early adulthood; thus, they call for greater attention to the "long arm of social class upbringing." Also emphasized is the need for future work that considers interactions between personality and SES factors.

The interplay of psychological factors, educational attainment, and biological risk in midlife is covered in the next chapter, **Social Inequalities, Psychological Risk and Resilience, and Health**, by Boylan, Coe, and Ryff. They underscore the considerable heterogeneity that exists within SES strata, such that not all socioeconomically disadvantaged individuals exhibit poor health. Using an integrative biopsychosocial framework, they juxtapose the mitigation hypothesis, wherein positive psychological factors protect against (buffer) the health costs associated with low educational status, with the exacerbation hypothesis, wherein negative psychological factors heighten the health costs associated with low educational status. Supportive evidence for mitigation showed the protective influence of multiple aspects of well-being on
p. 19 levels of interleukin 6 among less educated compared to ↳ more educated adults. Alternatively, and in support of exacerbation, expressions of anger among low education respondents were associated with higher interleukin 6 and fibrinogen, after adjusting for numerous covariates. Further analyses with the African American biomarker sample showed that anger was associated with elevated inflammation among those with higher educational status, thus adding to growing interest in whether African Americans are receiving the same benefits of higher educational standing that have been evident for whites. Using the MIDUS/MIDJA samples, further analyses showed cultural differences in links between well-being and glucoregulation. They call for future work that combines assessments of positive and negative psychological factors in assessing their impact on health; incorporates more longitudinal data, particularly on biomarkers; and combines experimental and epidemiological approaches to studying links between SES, psychological factors, and health.

The next chapter, by Zilioli, Imami, and Slatcher, is **Socioeconomic Status and Health-Related Biology: Links Between Socioeconomic Disadvantage, Psychological Factors, and HPA Activity in MIDUS**. They introduce a conceptual model that connects SES and related physical and social environments to biopsychosocial processes taking place at the individual level. The model gives emphasis to endocrine intermediaries and is illustrated with data from MIDUS linking SES to diurnal activation of the hypothalamic–pituitary–adrenal (HPA) axis. One example put childhood adversity together with assessments of diurnal cortisol and self-esteem as mediators. Findings showed that childhood adversity was associated with lower levels of cortisol at awakening, with effects partially mediated by self-esteem, and further that greater childhood adversity was linked to flatter cortisol slope through lower self-esteem.

Another example examined the role of life satisfaction as a moderator of the influence of SES on cortisol activity. Findings showed that greater life satisfaction was associated with steeper cortisol slopes and further that individuals with low SES and high levels of life satisfaction had cortisol slopes similar to those of high SES individuals. Additional findings investigated perceived control as moderators of the links between SES, daily cortisol activity, and physical symptoms. Going forward, they call for inquiries focused on multiple biological pathways that may work in an orchestrated fashion to give rise to an SES–health gradient, for example, that longitudinal association between SES and inflammatory risk may work through activity of the HPA axis.

A major novelty in the MIDUS baseline study was the assessment of perceived discrimination. In **Perceived Discrimination and Health: Integrative Findings**, Cuevas and Williams summarize many advances that have been generated in this area, beginning with a description of the battery, which includes measures of both acute and chronic ongoing experiences of discrimination. Baseline findings showed that perceived discrimination was relatively common in the general population, mostly attributed to race/ethnicity, gender, appearance, and age. Links to psychological distress and depression were also evident. Later studies linked perceived discrimination to multiple health outcomes: waist circumference, weight and obesity, risk for cardiovascular disease, back pain, poor relationships, and use of complementary and alternative medicine. Biological processes have increasingly been considered. Greater lifetime discrimination has been shown to predict higher levels of E-selectin, a marker of endothelial dysfunction. Perceptions of everyday unfair treatment have also been linked with AL and indicators of chronic inflammation. For example, inflammatory biomarkers mediated the relationship between discrimination and relationship strain among African Americans. Future directions include the need to investigate protective or buffering factors in the face of perceived discrimination as well as to consider the health impacts of multiple, co-occurring stigmatized statuses.

Discussion of racial/ethnic disparities in health are continued in the next chapter, **Disparities in Health Between Black and White Americans: Current Knowledge and Directions for Future Research**. by Fuller-Rowell, Curtis, and Duke. They call for greater specificity in investigating the behavioral and biological mechanisms as well as underlying social determinants of racial differences in health. A guiding conceptual model is presented, as are extant findings on race differences in diverse health outcomes. They then probe adult contexts and experience mediators focused on three domains: experiences of discrimination, neighborhood environments, and SES. Illustrative findings have linked perceptions of discrimination to differences between African Americans and European Americans in diurnal cortisol rhythms and linked neighborhood disadvantage to black–white differences in blood pressure. Bringing health behaviors in, they
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also show that neighborhood disadvantage mediates differences in objectively ↳ measured sleep between African American and European American adults. Objectively measured sleep also mediates diverging cardiometabolic risk between black and white females over a 10-year period in middle adulthood. Childhood adversity is also examined as a mediator of race differences in health. They call for future work using cross-lagged models and sharpened assessments of discrimination that remove variance related to racial identity. A further important future direction is race differences in benefits of educational attainment.

In **The Educational Gradient in Physiological Dysregulation: A Cross-Country Investigation**, Glei, Goldman, and Weinstein review prior evidence suggesting an inverse relationship between education and biological risk, sometimes weaker at older ages, possibly due to selective attrition. Their focus is on whether such educational gradients differ by country and whether there are sex differences within such gradients depending on country context. Their analyses compare relationships between education and physiological dysregulation from five countries: United States (using MIDUS), England, Russia, Costa Rica, and Taiwan. Large educational differences in dysregulation were evident in Russia and in the United States (albeit among white men and black women) and English white women. They note that how high education is defined may matter for blacks and whites: When race-specific cutoffs were used, the gradient did not differ between

black and white women. Future questions include whether income and wealth have effects beyond those of education and whether there are psychological mediators of these links. Also important is the need to unpack what lies behind the strong race difference, wherein education has little association with dysregulation among white women but is notably strong among black women.

The final chapter by Kirsch and Ryff is **The Great Recession, Inequality, and Health: An Integrative Approach**. They begin by emphasizing that biopsychosocial integration requires attending to changing historical contexts. An important example pertains to events of the Great Recession (2007–2009), which is widely regarded as the most severe economic downturn since the 1930s. Extensive evidence, summarized by them, shows that the Great Recession has led to growing problems of inequality in America. Pathways that need to be considered include stress exposures and psychological resources. They compare data from the MIDUS baseline sample with the MIDUS Refresher sample, which are situated on either side of the Great Recession. Despite having higher educational and occupational attainment, the post-Recession (Refresher) sample is disadvantaged relative to the pre-Recession (baseline). Differences are evident with regard to economic indicators, multiple aspects of well-being and psychological distress, and physical health status, measured in terms of subjective health, chronic conditions, body mass index, and functional abilities. Further analyses connect actual Recession hardships to these outcomes among the post-Recession sample. Findings show the greater vulnerability among the educationally disadvantaged and the role of psychological resources as moderators of the link between Recession hardship and health outcomes. Some findings illustrate the "disabling" of the otherwise protective resources on health in contexts of notable economic adversity. They call for future work on the stigma of economic hardship as well as its impact on work/family stress, health behaviors, and biomarkers. Notable opportunities will also be afforded by longitudinal comparisons among the baseline and Refresher samples as each moves forward in time.

A Glimpse of the Road Ahead

The preview of the chapters that follow in this collection underscores the enormous richness of integrative health science made possible by combining contributions across multiple scientific disciplines, as depicted in Figure 1.3. They speak to what becomes possible when psychosocial content from multiple subfields of psychology and contextually oriented fields of human development are put together with contributions from population-based disciplines of demography, sociology, economics, and epidemiology. In turn, both psychosocial and sociodemographic factors need to be brought together with neurobiological factors, which represent numerous subfields, including genetics, neuroscience, and physiology, to explicate underlying mechanistic processes. This sweeping integration comes with challenges, many having to do with how to collect such comprehensive information on the same group of research participants, but creative researchers are finding ways to negotiate these hurdles. Along the way, it is important to emphasize that the scientists themselves are a collection of Venn diagrams. What makes them unique, as a group, is their commitment to pursuing their favored research questions at the interstices of numerous scientific disciplines.

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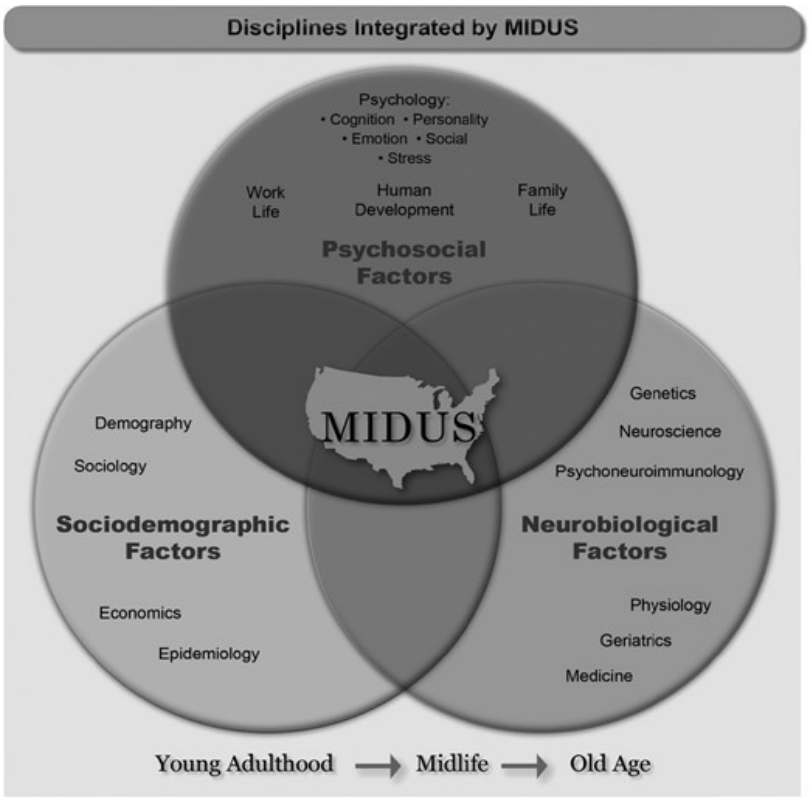
All of the chapters, as noted by the brief previews, offer visions for the work that lies ahead in ↳ advancing integrative health science. Despite widely differing substantive topics, there is consensus about the need to continue sharpening understanding of interacting biopsychosocial influences by tracking them through time. That is, continued longitudinal assessments are essential. A further overarching theme is the need to continue detailing pathways and intervening processes, including how they are evident in different subgroups, defined by sociodemographic factors (age, gender, SES, majority/minority status) as well as cultural context. As science in different domains evolves, new topics of assessment need to be added to ongoing or future biopsychosocial studies. For example, novel biomarkers that better explicate the intervening mechanisms between psychosocial factors and health outcomes are continually being

generated. Greater emphasis on contextual influences (neighborhoods and communities; workplace environments; healthcare settings) will also enrich the emerging science. Reaching more widely, new disciplines, such as those from the arts and humanities, are also worth pursuing, given growing evidence linking participation in the arts, broadly defined, to health and well-being. Thus, the overarching message of this collection is integrative biopsychosocial health science is well on its way and has a promising, though demanding, journey ahead.

Figure 1.3



Scientific disciplines integrated by MIDUS.

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