

Survey Response in the Long Run: The Wisconsin Longitudinal Study

ROBERT M. HAUSER
University of Wisconsin–Madison

This article reviews the history and design of the Wisconsin Longitudinal Study (WLS), which has successfully followed a sample of more than 10,000 members of Wisconsin's class of 1957 from high school graduation to the retirement years. It describes methods that have been used to locate the graduates in the 1964, 1975, 1992–1993, and 2003–2005 follow-up surveys and differentials in survey participation. Although typical response differentials by gender and education appear in the WLS, these are explained by differentials in response by adolescent academic ability, academic performance, and social participation.

Keywords: longitudinal study; life course; survey methods; survey response; response bias

In 2002, the Russell Sage Foundation published a wonderful volume, *Looking at Lives: American Longitudinal Studies of the Twentieth Century* (Phelps, Furstenberg, and Colby 2002). The chapters mix autobiography with project histories written by principals—or the survivors of principals—in a dozen important longitudinal studies of the life course. Among others, the studies include Sheldon and Eleanor Glueck's pathbreaking study of juvenile delinquents, Frank Furstenberg's multigenerational study of teen-

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age mothers in Baltimore, and Glen Elder's classic study of youth who grew up during the Great Depression, along with some of the large-scale socioeconomic surveys of the past few years.

Looking at Lives contains an extensive index without a single reference to nonresponse. To be sure, some of the essays do discuss coverage. Some studies suffered great cumulative losses, whereas others retained a remarkably large share of participants throughout several decades. The remarkable point is that nonresponse was not a central focus of the work. We now take it for granted that it is possible to retain study participants across long segments of their lives and, in some cases, their entire life span. This is new. Forty years ago, when I attended graduate school at the University of Michigan—and despite the reputed wonders of longitudinal analysis—panel studies of substantial duration were few and far between, and, it was presumed, high nonresponse rates would guarantee that. Now, we know better, yet global changes in social structure, technology, and daily routine—along with inevitable exigencies of the life course—conspire to make survey nonresponse a persistent challenge.

CHALLENGES OF NONRESPONSE

Why is nonresponse a problem? In principle, if nonresponse occurred strictly at random, it would merely reduce the number of participants in a study and, thereby, reduce statistical power. If investigators chose enough participants initially, there would be a large enough number of survivors to support analyses planned for the end of the period of study. I have never seen a study with such a design. Some longitudinal studies begin with no clear end in sight, with no anticipation of how long they might last, and even without a clear understanding of how their design and content might evolve (Hauser and Willis forthcoming). Also, from personal experience, I think it is difficult to convince potential funding agencies that they need to support a much larger study than is actually needed, right now, to guarantee a desired number of observations in the distant future. Finally, depending on resources, methods, and changes of circumstance, long-term sample loss is not easy to predict, so it is not clear how to anticipate and plan for future nonresponse.

The far more serious problem, of course, is that survey nonresponse is rarely a random process. In one circumstance, attrition is the subject—as in studies of human mortality or of survey nonresponse itself—and differential attrition is precisely what makes the study worth doing. One national longitudinal study, the Panel Study of Income Dynamics (PSID), is self-refreshing because it follows offspring, including persons who leave sample house-

holds, and it has also made a major effort to recapture individuals who left the survey. Such efforts may, but do not necessarily, solve the problem of selective coverage. The PSID has remained representative of the household population, and some, but not all, biases may be corrected by poststratification and weighting (Fitzgerald, Gottschalk, and Moffitt 1998a, 1998b). Most of the time, systematic nonresponse is a threat to validity. It may affect univariate distributions of key variables, or, worse yet, it may distort observed relationships among variables with or without affecting marginal distributions.

THE WISCONSIN LONGITUDINAL STUDY: HISTORY AND FINDINGS

I turn now to an extended description and discussion of the Wisconsin Longitudinal Study (WLS). I have worked on the WLS since June 1969 and have directed it since 1980. For a comprehensive review of the WLS, see Sewell et al. (2003). Despite an obvious conflict of interest, I have no hesitation in writing that it is one of the real treasures of American social science, but that, across the next several decades, its past may be overshadowed by its future contributions. The future of the WLS depends greatly on success in retaining the sample through the current round of surveys, which have entered the field in July 2003. Both the past and the future of the study provide a useful framework for discussion of the challenges of survey non-response.

The WLS began with a 1957 survey of the educational plans of all high school seniors in the public, private, and parochial schools of Wisconsin. Not only was there a rising demand for college and university education in the late 1950s, but also economic and technological competition with the Soviet Union was a major public issue. Many states, including Wisconsin, were then consolidating and upgrading their postsecondary educational institutions. At that time, most of the units of the present University of Wisconsin system were state and county teachers' colleges. A professor in the School of Education at the University of Wisconsin, J. Kenneth Little, conducted the statewide survey with the cooperation of the Wisconsin state superintendent of schools, and it was used to plan the expansion and consolidation of public higher education in the state (Little 1958, 1959, 1965).

In 1962, William H. Sewell, one of the academic leaders who brought the behavioral and social sciences into NIH, learned that the 1957 survey schedules and punch cards were sitting unused in the university administration building. Sewell had long been interested in the formation and consequences of youthful aspirations, but he had lacked access to an appropriate population

for study. At that time, social scientists had little real evidence about the extent of social and economic mobility among generations in the United States. Only in 1962 was the first large national study of social mobility in the United States conducted (Blau and Duncan 1967). Researchers could do little more than speculate about the processes of selection and socialization that accounted for social stability or social movement.

On inspecting the survey instruments, Sewell discovered that each form contained the name of the graduate and the name and address of the graduate's parents, as well as a code for the high school attended. That gave him a nicely identified list sample. He selected a random one-third sample of the graduates, consisting of 10,317 cases, for further study. Sewell also selected all students in the top tenth of academic ability, but this component of the study was abandoned after the 1964 follow-up because of insufficient funding. He then added information on the measured mental ability of each student from files of the Wisconsin State Testing Service, a unit of the university that had, since 1929, conducted a cooperative testing program covering all high school students in the state (Henmon and Holt 1931; Froehlich 1941). Sewell developed a number of indexes based on information from the survey—including the socioeconomic status of the student's family, the student's attitudes toward higher education, the student's educational and occupational plans, and the perceived influence of significant others on educational plans. Using secondary sources, he constructed relevant measures of school, neighborhood, and community contexts. These included the socioeconomic composition of each senior class, the percentage of its members who planned on going to college, the size of the school, the size and degree of urbanization of the community of residence, and the distance of the student's place of residence from the nearest public or private college or university. Thus began a research program that is entering its fifth decade and that now focuses on the lifelong antecedents of health and aging.

The 1950s were a lively period in American sociology and social psychology. They were also a period of growing affluence during which adolescence was redefined by the emergence of youth culture. Thus, Sewell and Little were by no means alone in focusing on adolescent circumstances and aspirations as the stepping stones to adult lives. Other influential studies of American youth included James Coleman's *The Adolescent Society* (1961) and Albert J. Reiss Jr.'s studies of Nashville youth (Hauser 1968, 1972; Reiss and Rhodes 1961). Sociologists of that time were also captivated by Ralph Turner's provocative thesis contrasting "sponsored" mobility in British school systems with "contest" mobility in the United States (Turner 1960, 1964).

The Wisconsin study had been preceded by careful and insightful but small and selective longitudinal studies that had long been in progress, such as the studies of exceptionally able youth initiated by Lewis Terman (Terman 1925; Terman and Oden 1959a, 1959b; Oden 1968) and the two small studies of youth in California communities made famous by Glen Elder (1974, 2002) and John Clausen (1991, 1993). One excellent model for successful longitudinal study—on a somewhat smaller scale than the WLS—was the first of the British birth cohort studies, which had begun with about 3,500 infants in 1946 (Douglas and Blomfield 1958; Douglas 1964; Douglas, Ross, and Simpson 1968; Wadsworth 1991).

THE 1964 SURVEY

Sewell's scheme for following up the Wisconsin graduates in 1964 was deceptively simple. Reasoning that parents would be easier to find than youth in their mid-twenties, and that parents like to talk about their children, he surveyed parents rather than graduates. The survey instrument was a folded, four-sided postcard that could be filled out in a few minutes: parents' address, respondent letter, questionnaire, and return address. The survey ascertained a brief educational history, current occupation, military service, and marital status. In addition to the original name and address records, Sewell was able to gain access to Wisconsin state income tax records. These were stored by year within household, thus providing address updates for parents who remained within the state, in addition to information available through telephone and street address directories. The tax records also yielded self-reports of parental occupation and income during the years when graduates were most likely to have attended postsecondary schools.

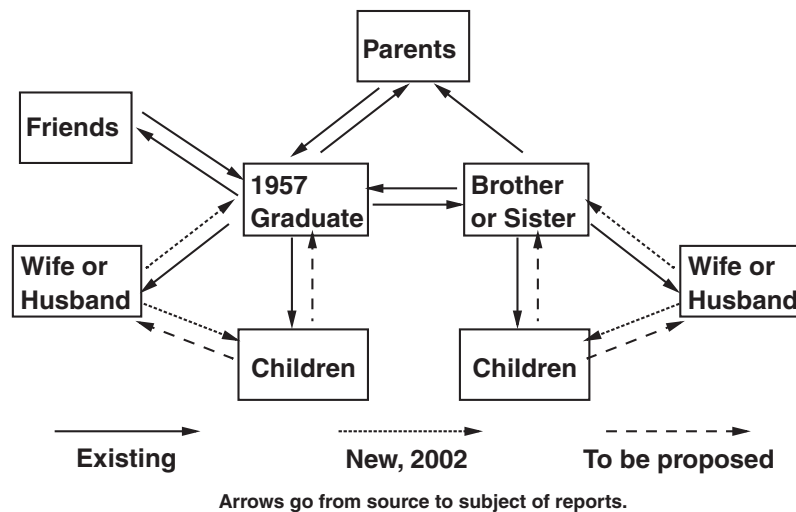
After four waves of mailings to the publicly located addresses, four waves of mailings to addresses from the tax records, and a round of telephone calls, responses were obtained for 87.7% of the surviving men in the sample and 86.5% of surviving women in the sample for an overall coverage rate of 87.1%. (Dates of death have been obtained from various sources throughout the years, including parents, siblings, classmates, newspaper obituaries, the Social Security Death Index, and the National Death Index. A full accounting of sample attrition in the WLS is available at http://dpls.dacc.wisc.edu/wls/flow_charts/cor459d6.pdf. Also, see Figure 3, discussed below.) At the time, for a study of that size and of seven years' duration, Sewell's high response rate was a significant and highly visible accomplishment. There were few signs that nonresponse was systematic (Pavalko and Lutterman 1973; Sewell and Hauser 1975:26–41), and had it been so, the high response rate would

have rendered it inconsequential for most purposes. For example, Sewell and Hauser found very modest effects of wave of response on the estimated parameters of simple models of status attainment. The failure to retain the participants in the much larger sample of Project Talent, which had begun in 1960 (Lohnes et al. 1966; University of Pittsburgh, Project Talent Office, and Flanagan 1964; University of Pittsburgh et al. 1966), provided a counterpoint to the success of the Wisconsin study.

The WLS was soon followed by large, national longitudinal studies of youth, including three highly successful school-based national longitudinal studies of youth—the National Longitudinal Study of the High School Class of 1972, High School and Beyond (the class of 1982), and the National Educational Longitudinal Study of 1988 (the class of 1992). None of these larger studies, however, has continued for more than fifteen years. The studies of 1972 and of 1982 were not abandoned because of sample loss but because the sponsoring agency, the Department of Education, was no longer interested in the samples after typical ages of school completion and were unable or unwilling to pass along the data to other agencies. Two of the four samples in the National Longitudinal Studies of Labor Market Experience, which began in the late 1960s, were fourteen- to twenty-four-year-old women and men. The male sample was abandoned in 1981 because of high sample loss, but response was better in the sample of young women (and those of older women and men). Only with the aging of the cohorts in the 1979 National Longitudinal Study of Youth—who were thirty-nine to forty-six years old in 2004—is there likely to be a national longitudinal study covering women and men that compares favorably with the WLS both in size and coverage of the life course.

Figure 1 suggests a way of looking at the WLS study design in terms of the set of role relationships about which the study provides information. Although the WLS data center on the 1957 graduates, we think of them as focal points in sets of relationships with aging parents, spouses, adult children, and siblings, as shown in Figure 1, as well as relationships with the localities and social institutions through which they have passed—high schools, colleges, and employers. WLS files include full survey and administrative data records for graduates, linked with those of friends and siblings. Parents were the initial post-high school informants about graduates, but a great deal of our information about parents has come from administrative records or from graduates and siblings. Data have not previously been obtained from spouses or children—except sometimes to help locate sample members—but we are interviewing spouses (and widows) in the current (2003–2005) wave of the study, and we hope to add children in the future.

FIGURE 1
Some Social Links in the Wisconsin Longitudinal Study



The parallel data for siblings are a special strength of the WLS. Siblings provide unique data—self-reports of variables that cannot be obtained from proxies, cross-validated information about graduates and their families, and complementary accounts of interhousehold (and intergenerational) exchanges. Analytically, the sibling data permit the construction of multi-level models of family and individual effects on life course outcomes (Hauser and Sewell 1986; Hauser, Sheridan, and Warren 1999).

Among Americans aged sixty to sixty-four in March 2000, 66.7% are non-Hispanic white women and men who completed at least twelve years of schooling and thus resemble the WLS cohort. The WLS is unusually valuable in its representation of women as well as men. Also, because the WLS is the first of the large, longitudinal studies of American adolescents, it provides the first large-scale opportunity to study the life course from late adolescence to the retirement years in the context of a full record of ability, aspiration, and achievement. The WLS graduates and their siblings have lived through major social changes: rising affluence, suburban growth, the decline of old ethnic cleavages, the cold war, and changing gender roles. Moreover, the WLS cohort, born mainly in 1939, precedes by a few years the baby boom generation that has taxed social institutions and resources at each stage of

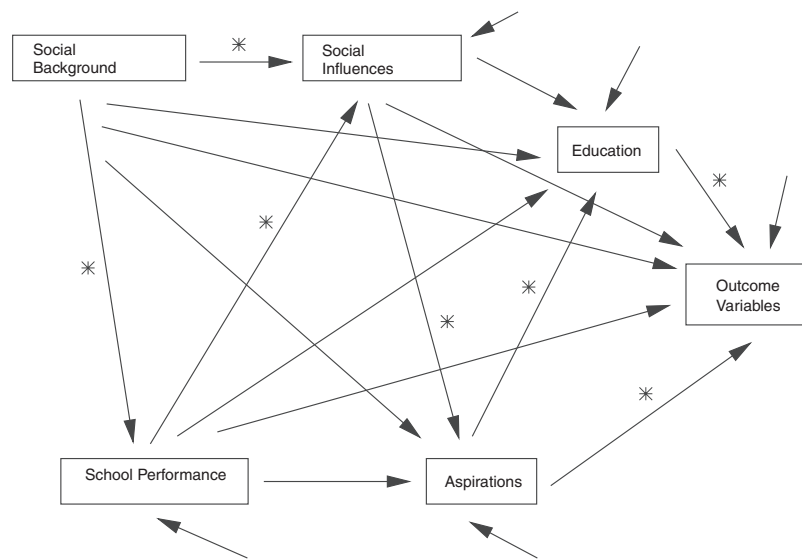
life, and thus the study can provide early indications of trends and problems that will become important as the larger group passes through its early sixties. The WLS overlaps the youngest cohorts that entered the Health and Retirement Survey (HRS) in 1992, and this provides continuing opportunities to check the scope of our findings. Unlike the WLS, HRS is nationally representative, but it does not cover the lives of participants from adolescence to old age.

The WLS data also have obvious limitations. Some strata of American society are not represented. Everyone in the graduate sample completed high school. It is estimated that about 75% of Wisconsin youth graduated from high schools in the late 1950s; about 7% of siblings in the WLS did not graduate. There are only a handful of African American, Hispanic, or Asian persons in the WLS, and there is no way to generalize from the WLS to the unique conditions of these population groups. Given the minuscule share of minorities in Wisconsin when the WLS began, there is no way to remedy this omission. We have, however, identified nonsample African Americans in the class of 1957 using high school yearbook photos, and we have started an intensive effort to recruit them into the study. About 19% of the WLS sample is of farm origin; this is consistent with national estimates for cohorts of the late 1930s. In 1964, 1975, and 1992, 70% of the sample lived in Wisconsin, but 30% lived elsewhere in the United States or abroad. Fifty-seven percent of WLS graduates resided in Wisconsin at every contact. WLS graduates are homogeneous in age, but the ages of selected siblings vary widely, mainly within the range of ten years older to ten years younger than the graduates.

THE WISCONSIN MODEL

In the early years, WLS research focused mainly on the ways in which adolescent achievements and aspirations were formed and then influenced postsecondary schooling and occupational careers. This work led to the so-called Wisconsin Model of Status Attainment (see Figure 2), which became a template for subsequent research on the life course—and for critical attention to the social psychological theory of status attainment (Sewell et al. 2003). As of June 2001, there had been more than 1,600 citations in the Social Science Citation Index to just eight key project publications (Sewell and Shah 1967; Sewell, Haller, and Portes 1969; Sewell, Haller, and Ohlendorf 1970; Sewell and Hauser 1972, 1975; Sewell, Hauser, and Wolf 1980; Hauser, Tsai, and Sewell 1983; Hauser and Sewell 1986). WLS data had also been used, even before the 1992–1994 round of data collection, in studies of geographic constraints on college access; recruitment into teaching, nursing, and

FIGURE 2
The Wisconsin Model



other occupations; choice of marital partner; differential family formation and fertility; gender differences in market participation and success; religious and ethnic differences in achievement processes; birth-order effects on ability and achievement; effects of high schools and colleges on aspirations and achievements; and interfirm and interindustry differences in compensation.

The essential ideas of the social psychological model are as follows: Social background affects school performance. These two sets of variables affect social influences—the expectations and modeling behaviors of significant others. Social influences largely determine educational and occupational aspirations, thus carrying much of the influence of social background and school performance. Aspirations, in turn, have large effects on post-secondary schooling and occupational careers, and they carry many of the effects of social influences, school performance, and social background.

The key theoretical idea of the model is the importance of social psychological processes in mediating the connections between positions in the social structure across generations. This idea now seems simple because it is widely accepted among social scientists. The model also specifies a modified

causal chain leading from social origins to adult outcomes, and for that reason, it is simple in a more important way: Not every earlier variable affects every later variable. Of fifteen possible paths from antecedent variables in Figure 2, only the seven paths marked with * carry large effects.

The distinctive scientific contributions of the Wisconsin project lie not merely in proposing the model, but also in testing it by means of careful measurement—and remeasurement—of key variables across the entire adult lives of the vast majority of participants in the study. For example, social background variables include four years of data on the incomes of parents of the graduates that were obtained from Wisconsin tax files, and nearly 8,500 of 9,750 surviving graduates participated in the most recent—1992–1993—round of the study. The structural features of the model become simpler, stronger, and more powerful when measurement error is controlled and when data for sisters and brothers of the graduates are introduced to control for common but unmeasured family background effects.

Figure 3 provides a succinct overview of sources of survey data and types of administrative record data available in or proposed for the WLS. After the 1957 survey of graduates, the next two waves of survey data were collected from the graduates or their parents in 1964 and 1975. Those data provide a full record of social background, high school curriculum, youthful aspirations and social influences, schooling, military service, family formation, labor market experiences, and social participation. Early survey data were supplemented by earnings of parents from state tax records, mental ability test scores and rank in high school class, and characteristics of high schools and colleges, employers, industries, and communities of residence. Recently, state archival data on high school district resources from 1954 to 1957 were added. WLS records for graduates are also linked to those of three best same-sex high school friends; about half the graduates have a named peer in the sample. Data on the occupational careers of male graduates are supplemented by Social Security earnings histories from 1957 to 1971.

THE 1975 AND 1977 SURVEYS

In the early 1970s, Sewell and I decided that it was time for another follow-up of the graduates. In their mid-thirties, men were firmly established in their careers, and most women no longer had young children needing home care. We were able to secure funding from the National Institute of Mental Health. Eighteen years after the senior year of high school, we contacted graduates directly for the first time to conduct one-hour telephone interviews. We debated whether to drop nonparticipants in the 1964 study but

FIGURE 3
Survey and Administrative Record Data in the Wisconsin Longitudinal Study

Sources of Survey Data (<i>N</i>)
1957 senior survey of graduates (<i>N</i> = 10,317)
1964 postcard survey of parents (<i>N</i> = 8,923)
1975 telephone survey of graduates (<i>N</i> = 9,138)
1977 telephone survey of siblings (<i>N</i> = 2,133)
1992–1993 telephone/mail survey of graduates (<i>N</i> = 8,493/ <i>N</i> = 6,875)
1994 telephone/mail survey of siblings (<i>N</i> = 5,365/ <i>N</i> = 4,062)
<i>In progress</i> : 2003 telephone/mail surveys of graduates, siblings, spouses, and widows
Available Public or Administrative Record Data
Henmon-Nelson Mental Ability (9th and 11th grades)
Rank in high school class
Parents' adjusted gross income, 1957–1960
Male graduate's earnings, 1957–1971
College characteristics
Employer characteristics, 1975
National Death Index-Plus
Approved Public or Administrative Record Data
Birth records
Elementary school resources
Wisconsin state tumor registry
Wisconsin health insurance plans
Local health resources (Area Resource File and Interstudy data)
Medicare enrollment and claim data
Wisconsin Worker's Compensation records
Geocoded addresses across the life course

decided that we could easily recover the limited data ascertained in 1964 from anyone we could locate. Moreover, the prospective respondents were not the parents of graduates but the graduates themselves; thus, there were no prior refusals. We decided to contact all of the graduates, regardless of their response status in 1964. Ultimately, only one graduate claimed to recall having participated in the senior year survey.

Our first major problem was to find the graduates. We had names and addresses of parents, roughly a decade old, and we had the names of students, including the married names of women graduates as of 1964. We also knew which graduates had served in the military service, their occupations in 1964, and the names of high school and colleges or universities that graduates had attended. The names of high schools provided a rich set of links to potential informants, especially graduates who were active in organizing class reunions. The procedures used in the 1975 tracing operation have been described by Clarridge, Sheehy, and Hauser (1977:186), who summarized the success of the tracing and interviewing operations as follows.

Our 1975 tracing operation located 97.4% of the members of the original sample; this figure includes 99% of the persons (9,007) for whom responses were obtained in the 1964 survey and 86.2% of the persons (1,310) for whom no responses were obtained in the 1964 survey. Ultimately, 88.6% of the members of the original sample were interviewed by telephone. This compares favorably to the 87.3% response rate in 1964. Our success was in large part attributable to our extensive use of the telephone, during both the search and the interviewing, as well as to certain features of the search procedure.

Clarridge, Sheehy, and Hauser (1977:186) noted that tracing failure is often due to the “failure to exhaust all sources of information when searching for potential respondents” and the fact that “the search is often left to those who have no vested interest in the research or in the quality of the data.” Initially, a highly stratified sample of 216 cases was chosen, “stratified according to respondent characteristics thought likely to affect the complexity and success of the tracing operation” (Clarridge, Sheehy, and Hauser 1977:188). These were sex, educational attainment in 1964, rural or urban residence in 1957, and state of residence in 1964. All of these individuals were eventually located. The pilot tracing study provided strong evidence that successful tracing was possible across a long period, up to eighteen years after high school graduation, and it yielded strong clues about effective tracing methods and about the organization of the tracing process.

Tracing success was not merely a consequence of location of the participants in Wisconsin. At every wave of the study, approximately 70% of the sample has lived in Wisconsin and 30% has lived elsewhere. Forty-three percent of participants have lived outside of Wisconsin during one or more periods of data collection.

One organizing principle of the tracing process was to smooth the flow of easy- and hard-to-find cases. We stratified the sample by mental ability, socioeconomic status, and gender, and we split the sample into random tenths within each stratum. Then, we entered the replicates into the tracing process one at a time. This procedure also protected us against the possibility that we might run out of funds before the entire sample had been located. This was such a useful procedure that we have continued to follow it, not only in tracing but also in every survey operation since 1975. A secondary benefit is that the use of random replicates provides timely feedback about success or problems in the field operation, permitting corrective action before time and money run short. In 1975 and 1992–1993—and in the current field operation—by the time we completed the first replicates, we knew that the entire project would succeed.

Another principle of the tracing operation was to use the telephone. At least in the 1970s, telephone contacts were more fruitful than mail contacts,

and the university provided long-distance telephone service that was exceptionally inexpensive for that time. Our first point of contact was a parent, and more than 82% of participants were located through their parents. Not only were parents good informants, but we also tried to avoid preliminary contact with the graduates. The next 10% of graduates were located directly through address searches or calls to same-named individuals. The last 8–10% were located through a variety of means, including alumni groups, businesses, neighbors, the post office, military service, and other informants (Clarridge, Sheehy, and Hauser 1977:193–96). We kept detailed records of each tracing attempt for each case, and, when all else failed, we started a case all over again. One of the things we learned about tracing is that it is an unreliable process with many decision points and many possible sources of error (e.g., simple transcription or spelling errors, or a more or less informed respondent at the same telephone number). A fresh start often led to successful location of the graduate.

A final lesson from the 1975 tracing operation was that we should obtain fresh anchor points that could be used to locate respondents in the future and, especially, after parents moved to retirement areas or died. For that reason, the 1975 interviews ascertained the current addresses of graduates and their parents; the name and address of the graduate's current or last employer; names and addresses of the colleges the respondent attended; the first name, age, and gender of each child; the first name, age, and gender of each sibling; and the full name and address of a randomly selected sibling of the graduate. These clues have proved valuable. Unfortunately, we were not able to assess the costs of different modes of tracing: The same individuals were engaged in several methods of tracing, and they were simultaneously engaged in other project activities.

Of course, successful tracing of all but 288 among 10,317 graduates was only part of the story of the 1975 follow-up. Ultimately, among graduates who had not died by 1975, 92.7% were interviewed. (This is higher than the rate reported by Clarridge, Sheehy, and Hauser [1977] because I have adjusted the base for mortality, including some deaths that were identified after 1977.) The nonrespondents included just 387 refusals; among the remaining noninterview cases were handicapped persons ($N = 15$) and those with no telephone access ($N = 187$). We also did not attempt to interview persons who were living outside the United States ($N = 128$) because, at that time, international calls were prohibitively expensive. What accounts for this high interview rate? We don't know. Our best guess is that it is a combination of four factors: persistent searching and callbacks, the moderately high social standing of the graduates, the legitimacy of the University of Wisconsin

among current and former state residents, and a historic pattern of higher survey response rates in Wisconsin than elsewhere in the nation.

In 1975, the WLS obtained a roster of living siblings and chose a focal sibling at random for each graduate (and all twins). Adolescent cognitive ability test scores were located for 6,619 of the focal siblings of graduates (75%). In 1977, parallel interview data were obtained for a highly stratified sample of 2,100 of the focal siblings. The response rate for siblings, 87.8%, was almost as high as that among graduates but was, of course, conditional on participation of the graduate in the 1975 survey. Nonresponse among siblings was, however, partly compensated by the fact that some key facts about the siblings (e.g., social background characteristics) either were the same as for the graduates or had been reported by the graduates (Hauser and Sewell 1986).

It would be misleading for me to suggest that the marginal response rates among graduates and siblings tell the whole story about nonresponse in the WLS. The joint response rates are obviously lower, roughly $0.901 \times 0.878 = 0.791$ for analyses using self-reported data from graduates and siblings—less item nonresponse. Although this is respectable, the loss is nontrivial, and the effects of sample loss on joint response rates have increased across time. In a complex study like the WLS, the extent as well as the effects of sample loss depend on how one uses the data.

THE 1992–1994 SURVEYS

In 1992–1994, the WLS conducted four major surveys with support from the National Institute on Aging: telephone and mail surveys of graduates and nearly identical telephone and mail surveys of an expanded random sample of focal siblings (Hauser et al. 1994). Repeated measurements included marital status, child rearing, education, labor force participation, jobs and occupations, social participation, and future aspirations and plans among graduates and siblings. The content of earlier follow-ups was expanded to include psychological well-being, mental and physical health, wealth, household economic transfers, and social comparison and exchange relationships with parents, siblings, and children.

In 1975, WLS concepts and measures had resembled those of the Current Population Survey (CPS) and the 1973 Occupational Changes in a Generation Survey (OCG) (Featherman and Hauser 1978). In 1992, continuity was balanced with comparability to other well-designed surveys, for example HRS (Juster and Suzman 1995), National Survey of Families and Households (NSFH; Sweet, Bumpass, and Call 1988), NIH surveys of work and psychological functioning (Kohn and Schooler 1983), and the NORC Gen-

eral Social Survey (GSS; Davis, Smith, and Marsden 2003). Some parts of the WLS instruments were developed in consultation with investigators in the MacArthur Foundation Research Network on Successful Midlife Development, Michael Marmot's Whitehall II study (Marmot et al. 1991), and Michael Wadsworth's longitudinal cohort study of births in Great Britain in 1946 (Wadsworth 1991).

In 1992, the one-hour telephone interview covered life history data, family rosters, and job histories, which have many skips or branches. The mail instrument also added measures of well-being, social contact, exchanges, and health, including an extensive account of menopausal experience. The sibling mail survey was modified to obtain additional measures of physical health and health-related behaviors, richer accounts of menopausal experiences, and more information about relationships between the focal sibling and other family members—including indicators of childhood abuse.

Subsequently, the WLS matched graduates and siblings to the National Death Index-Plus (NDI-Plus)—using Social Security numbers, names, and birth dates as identifiers—to obtain cause(s) of death and confirm date and place of death. Similar searches have been undertaken for parents of the graduates and siblings, but coverage is not as high as for the graduates, primarily because many of the mothers of participants were never issued Social Security numbers. Also, the National Death Index covers deaths since 1979 and thus fails to cover earlier deaths of parents and siblings.

The WLS sample design has become increasingly complex throughout time, but a fair summary is that, in 1992, telephone interviews were completed with 8,493 WLS graduates out of 9,741 survivors (87.2%). As in 1975, tracing was highly successful, leaving only 316 graduates unlocated. Our tracing methods were, however, quite different. This time, we looked simultaneously for graduates and siblings, using either as an informant. Our first step was to call the graduate (or sibling) at the previously recorded telephone number and confirm his or her identity and, if appropriate, the name and location of the focal sibling (or graduate). If those contacts were unsuccessful, we called a parent. After that, we used address-telephone directories available on CD-ROM, which had just become available in the early 1990s. Those were extremely helpful in locating participants directly. In addition, they provided reverse address listings, that is, listings by address of city block faces, thus making it easy for us to call the current resident at a former address or to call neighboring addresses. Neighbors were especially helpful in providing location information about participants who had moved. Also, we continued to use fellow high school classmates as informants. In some cases, we were able to obtain high school reunion booklets, and in other cases we circulated lists of the names of individuals whom we had been unable to

locate. Finally, we also made limited use of a credit agency's online database, to which we were able to gain access at low cost by sharing access with another project.

The 1992–1993 mail survey of graduates was sent only to persons who had completed the telephone interview. The mail surveys were 20–24 pages long; the extended version was given to about half the sample and included additional questions to women about their menopausal experiences. After three waves of mailings and a reminder postcard, these were returned by 6,875 individuals, comprising 80.9% of the telephone sample and 70.6% of all surviving graduates. Again, the need for joint responses reduces coverage.

It is more difficult to describe nonresponse in the WLS sibling sample. We attempted telephone interviews, followed by the mailout, with all of the siblings who had participated in the 1977 study and with 80% of focal siblings who had not been selected for interview in 1977. The remaining 20% of surviving focal siblings received only the mail questionnaire, modified to include a few key demographic items that were ordinarily ascertained on the telephone. We truncated the data collection plan in the last two replicates of siblings who had not previously participated in the study because we had run out of money. This did not occur because of cost overruns in the field operation, but because a university building project shut down field operations for several months without compensating the project for fixed costs incurred during that period. In all, we completed telephone interviews with 76.7% of 6,261 cases of focal siblings who were entered into the field. The mail response rate among telephone completers was 72.9%, and a total of 4,062 mail surveys were completed, including those with the mail-only treatment. Again, these response rates would be respectable in a single, cross-section survey, but the joint coverage of graduates and siblings is problematic. Among 7,783 graduate respondents in 1992–1993 who had living siblings, there were 4,461 joint graduate-sibling responses to the telephone interview but only 3,361 joint responses to the mail survey.

DIFFERENTIAL SURVEY RESPONSE IN THE WLS

As previously noted, there was little differential response in the 1964 follow-up, and differentials were small in the 1975 survey, with one exception worth noting. The WLS data include scores from the Henmon-Nelson Test of Mental Ability, which was administered to about 70% of high school freshman and all juniors in the class of 1957. The first panel of Table 1 displays response rates to the 1975 telephone survey, classified by gender and by

TABLE I
Response Rates in the 1975 and 1992–1993 Graduate Mail and Telephone Surveys
by Decile of Henmon-Nelson (H-N) IQ Score: Wisconsin Longitudinal Study

<i>Gender</i>	<i>H-N Decile</i>	<i>Response Rate, 1975 (%)</i>	<i>N</i>	<i>Mail Response Rate, 1992 (%)</i>	<i>Telephone Response Rate, 1992 (%)</i>	<i>N</i>	<i>Conditional Mail Rate, 1992 (%)</i>	<i>N</i>
Male	1	85.3	502	50.8	75.9	498	66.9	378
	2	91.9	405	64.9	83.1	390	78.1	324
	3	93.1	481	66.6	83.8	482	79.5	404
	4	92.2	434	71.1	87.3	426	81.5	372
	5	90.4	471	66.8	83.5	461	80.0	385
	6	91.0	467	69.8	87.0	454	80.3	395
	7	93.4	454	70.8	88.0	449	80.5	395
	8	91.7	507	70.9	86.7	498	81.7	432
	9	93.7	505	75.4	89.3	495	84.4	442
	10	94.0	500	80.4	92.7	490	86.8	454
Total		91.6	4726	68.8	85.7	4643	80.2	3981
Female	1	90.9	495	55.1	79.9	488	69.0	390
	2	91.6	491	64.0	86.4	492	74.1	425
	3	93.6	545	69.3	85.9	531	80.7	456
	4	92.4	487	69.5	87.0	486	79.9	423
	5	94.5	542	73.8	89.0	545	82.9	485
	6	94.6	535	73.0	90.6	522	80.5	473
	7	93.1	475	76.8	91.1	474	84.3	432
	8	95.8	549	76.6	91.8	551	83.4	506
	9	95.6	526	78.5	91.4	522	86.0	477
	10	95.0	482	86.9	93.7	475	92.8	445
Total		93.8	5127	72.4	88.7	5086	81.6	4512

tenths of the distribution of average Henmon-Nelson scores. This and the following analyses pertain to living graduates. Nonresponse includes graduates who were complete or partial refusals, were unable to complete the interview, or were never successfully traced. Among men, there is a sharp drop in response in the bottom tenth of the test-score distribution, but there is otherwise little systematic variation in response status with test scores. Among women, the dip in response at the bottom is less sharp, but there is a very slight drop in response in the bottom 20% of the distribution. Above that level, there is little variation in response rates.

In 1992–1993, whether we consider telephone or mail response, there is a steep and regular gradient in response by test scores among both men and women. Among graduates who were alive then, only 50.8% of men and 55.1% of women in the bottom tenth of the test score distribution responded

to the mail instrument. In the top tenth of the test score distribution, 80.4% of men and 86.9% of women responded to the mail instrument. The test score differential in response occurred both in the telephone and in the mail surveys, but it was far stronger in the mail survey. The fourth column of Table 1 shows the telephone response rates in 1992–1993. There, as in 1975, the differential was greatest between the bottom tenth and the remainder of the distribution, but there was a modest gradient throughout the range of test scores. Among telephone responders, there was an even sharper division in mail response between the bottom of the distribution and the rest, but above the bottom two categories, the gradient appears steeper for women than for men.

Is the gradient in response merely an artifact of socioeconomic differences associated with adolescent test scores? Or does nonresponse to the 1992–1993 surveys reflect excessive cognitive demands of the instruments? What other factors may lead to differential nonresponse? To address these questions, I have carried out logistic regression analyses of response to the 1992–1993 graduate telephone interview and, conditional on response to the telephone interview, on completion of the mail interview.

The upper panel of Table 2 pertains to telephone response in 1992–1993 among living WLS graduates who had responded in 1975. The restriction to 1975 respondents is added because one of the explanatory variables, organizational membership, was ascertained in the 1975 survey. Organizational membership is defined as the number of organizations in which the graduate reported having at least some involvement. The other explanatory variables are gender (female = 1, male = 0), educational attainment (years of completed schooling), adolescent IQ (average of Henmon-Nelson test score from junior and/or freshman year), and rank in high school class (as reported by the high school and reexpressed in the IQ metric).

Model 1 in Table 2 displays estimates of the effects on telephone response of two variables that are typically used to account for survey response, gender, and educational attainment. Each of those variables has a large and statistically significant effect on response. The odds of responding are 34% higher among women than among men, and each additional year of schooling raises the odds of response by 13%. (In these models, $\text{Exp}[B]$ describes proportional change in the odds of response.) Note that, because 85% of the living graduates responded, large effects on the odds of response do not translate into large percentage point differences in response. In model 2, two adolescent test score variables are added to the equation, the IQ score and a dummy variable for the lowest tenth of IQ scores. In the case of telephone response, the latter variable does not have a significant effect in any model. When these variables are added, the effect of gender declines modestly to 29%, whereas the effect of educational attainment is cut in half. Thus, adoles-

TABLE 2
 Logistic Regression Analysis of Graduate Survey Response:
 Wisconsin Longitudinal Study, 1992–1993

<i>Variable</i>	<i>Model 1</i>		<i>Model 2</i>		<i>Model 3</i>		<i>Model 4</i>	
	<i>B</i>	<i>Exp(B)</i>	<i>B</i>	<i>Exp(B)</i>	<i>B</i>	<i>Exp(B)</i>	<i>B</i>	<i>Exp(B)</i>
1992–93 Telephone response among WLS graduates who responded in 1975 (<i>N</i> = 8,179)								
Gender	0.293 (0.080)	1.34	0.252 (0.081)	1.29	0.126 (0.086)	1.13	0.156 (0.086)	1.17
Educational attainment	0.119 (0.021)	1.13	0.055 (0.023)	1.06	0.030 (0.024)	1.03	0.011 (0.024)	1.01
Adolescent IQ			0.020 (0.004)	1.02	0.012 (0.004)	1.01	0.012 (0.004)	1.01
Lowest tenth in IQ			–0.033 (0.146)	0.97	–0.020 (0.147)	0.98	0.004 (0.147)	1.00
Rank in high school class					0.016 (0.004)	1.02	0.016 (0.004)	1.02
Organizational membership, 1975							0.108 (0.025)	1.11
Constant	0.347 (0.321)	1.41	–0.706 (0.422)	0.49	–0.988 (0.427)	0.37	–0.978 (0.427)	0.38
Mail survey response among 1992–1993 WLS telephone respondents (<i>N</i> = 7,475)								
	1.09	0.002	1.00	0.011	1.01			
Gender	0.131 (0.061)	1.14	0.090 (0.062)	1.09	0.002 (0.066)	1.00	0.011 (0.066)	1.01
Educational attainment	0.083 (0.015)	1.09	0.026 (0.017)	1.03	0.009 (0.017)	1.01	0.003 (0.018)	1.00
Adolescent IQ			0.015 (0.003)	1.02	0.010 (0.003)	1.01	0.010 (0.003)	1.01
Lowest tenth in IQ			–0.312 (0.116)	0.73	–0.304 (0.116)	0.74	–0.294 (0.116)	0.75
Rank in high school class					0.011 (0.003)	1.01	0.011 (0.003)	1.01
Organizational membership, 1975							0.034 (0.018)	1.03
Constant	0.214 (0.238)	1.24	–0.480 (0.314)	0.62	–0.670 (0.318)	0.51	–0.668 (0.318)	0.51

NOTE: Standard errors are in parentheses.

cent ability accounts for much of the association between educational attainment and telephone response in 1992. In model 3, rank in high school class enters the model, and its effect is slightly larger than that of IQ. The notable findings here are that the effects of gender and educational attainment are reduced by half from those in model 2, and neither effect remains statistically significant. Finally, in model 4, membership is added to the equation, and each membership increases the odds of participation by 11%. The effects of gender and educational attainment remain insignificant, and those of adolescent IQ and high school grades are unchanged. That is, the effects of test scores, high school grades, and civic participation account for the educational gradient in telephone response and for much of the gender differential.

The lower panel of Table 2 reports similar analyses of mail survey response among graduates who responded to the telephone interview in 1992. Again, in the simple regression, gender and educational attainment have statistically significant effects on mail survey response, parallel to but smaller than those on telephone response. The difference between model 1 and model 2 is, however, much more striking in this case. The effects of gender and of educational attainment are no longer statistically significant when the test score variables are controlled, but the point estimate for gender is still nontrivial—a 9% larger odds of response among women. A one-point increase in IQ raises the odds of response by about 2%. Moreover, the odds of response decline sharply (by 27%) among graduates in the lowest tenth of academic ability. Model 3 adds high school rank to the equation. Here, the effects of gender and educational attainment essentially disappear, and a one-point increase in IQ or in high school rank increases the odds of response by about 1%. Organizational membership is added to model 4. The effects in this model are little changed from those in model 3, but each additional organizational membership increases the odds of participation by 3%. Again, above and beyond the effects of the other variables, the odds of responding to the mail survey among persons in the bottom tenth of the test score distribution are about 25% lower than in the rest of the sample.

One important implication of these findings lies in the fact that most studies of survey response have no access to the more powerful explanatory variables that may help to elucidate the sources of nonresponse. To be sure, some studies obtain measures of social participation, but only a few include early measures of cognitive functioning or academic performance, and the key role of the cognitive variables has not been a focus of research on survey participation (Groves and Couper 1998; Groves, Singer, and Corning 2000; Groves 2002). Greater attention should be paid to the role of cognition in sur-

vey response in longitudinal studies of older populations, in which cognition is often assessed at baseline.

Second, not only do test scores, academic performance, and civic participation affect survey response, but they also account in large part for the effects of gender and educational attainment. It appears that educational attainment is essentially a proxy for academic ability and achievement. This contrasts markedly with analyses that compare the effects of educational attainment on adult socioeconomic outcomes with those of academic achievement. In the Wisconsin data (and other studies), the effects of educational attainment usually account for the association of academic achievement with adult socioeconomic outcomes (Sewell and Hauser 1975; Warren, Sheridan, and Hauser 2002). Furthermore, the effect of gender is largely explained by its association with high school rank, that is, women may be more likely to respond to surveys than men by dint of the same characteristic—normatively compliant behavior—that leads them to obtain higher grades in school than men.

Third, a simple gradient in survey response by test scores would not address the question of whether the gradient can be attributed to a failure to understand the purposes of the survey or to the cognitive demands of participation. The combination, however, of the large effect of low ability on response to the long mail survey instrument and its negligible effect on telephone response strongly suggests that cognitive demands play a large part in the story. That is, persons with limited academic ability fail to respond to the mail survey at least in part because the extensive written material and instructions are challenging and tiring. Last, although overall response remained high in the 1990s, the differentials are large enough to suggest the desirability of weighting inversely to response probabilities.

THE 2003–2005 WLS SURVEYS

New surveys of WLS participants began in July 2003, when the graduates were sixty-four and sixty-five years old. As in the 1992–1994 round of the study, WLS graduates and the sample of their brothers and sisters are first interviewed by telephone for about seventy-five minutes. All surviving members of the samples who participated in either of the last two rounds of the survey are being contacted. Telephone interviews are followed by mail-out, mail-back surveys, which are longer than in 1992–1994—as many as fifty pages. The telephone interview schedules also build in supplementary sections for graduates or siblings (1) who have been widowed and (2) who

have had a physically or mentally disabled child or have experienced the death of a child.

Permission is being obtained from WLS participants to record the telephone interviews in support of a study of respondent cognition and interaction with interviewers. The recordings have already proved most useful in developing the telephone instrument, improving the training of interviewers, correcting errors in data, and providing data on cognitive functioning that cannot be recorded directly by interviewers (Hauser and Willis forthcoming). To prepare the way for studies of joint survivorship and (eventual) widowhood—and to cross-validate reports from graduates and their siblings—shorter (thirty-minute) interviews are being carried out with spouses and with approximately 900 widows or widowers of graduates and siblings. These interviews focus mainly on health and family relations. The new round of WLS data collection will also include matches with several sets of public record data, ranging from the resources of elementary school districts in the 1940s to additional sweeps of mortality records by cause of death in the National Death Index.

The 2003–2005 surveys are being carried out by an interdisciplinary team of researchers who plan to extend, enrich, and complement previous observations of the WLS cohort in ways that will illuminate current research questions in aging and that will anticipate scientific and policy issues that will arise in future years. The project, of course, continues to obtain life histories of education, employment and retirement, job conditions, family change, stressful life events, and economic transfers along with repeated measurements of health, wealth, and psychological well-being. It is also looking more deeply into the past of WLS participants by collecting data on the circumstances of their own birth and by adding to intriguing data on childhood abuse that were collected in the last round. The surveys obtain more extensive data on health-related behaviors—both those that are regarded as positive and those that carry substantial risks, like smoking and alcohol use. The surveys obtain extensive measures of social and civic engagement and of social isolation. They also permit intensive study of the effects of children's problems and successes on their parents—including the effects of child disability, mental illness, or early death. The surveys obtain new and more extensive measures of cognitive functioning. They obtain detailed data on insurance and pension coverage and on medical, legal, religious, and psychological preparation for the end of life. The new survey data will also be complemented by medical and neurophysiological examinations among a small subsample of participants.

There is every reason to expect that the WLS will continue to be an important resource of research on aging and the life course for decades to come. In

this regard, it is both a blessing and a curse that the sample is almost entirely composed of non-Hispanic whites who have completed high school. Based on recent U.S. life tables, there is good reason to expect that more than half of the women graduates in the WLS and more than a third of male graduates will live to at least 2022, when they will be eighty-three and eighty-four years old. Thus, the current round of the WLS is not an end, but a new beginning.

Of course—and especially given the response differentials that appeared in the 1992–1993 survey of graduates—nonresponse and differential nonresponse are major challenges in the new round of the WLS. Given the increasing age of WLS participants and the increased cognitive demands of a mail instrument that is twice as long as in 1992, we were concerned that our plans could fail. We were far more aggressive in publicizing the study in statewide media than in the past, and we developed a public Web site for WLS participants (<http://www.wisls.info>). For the first time, we also introduced a small response incentive—two crisp new \$5 bills attached to the first (of three) mailings of the self-administered questionnaire.

It is now one year since the graduate survey entered the field. It will be closed out by the end of calendar year 2004. Many of the graduate spouse interviews have also been completed, and the first sibling cases are about to be called. Response rates have been very high among living graduates who responded in 1992–1993 ($N = 7,990$), but our efforts to recover graduates who did not respond in 1992–1993 ($N = 701$) have been much less successful. For example, in the first replicate to enter the field, 85.9% of living graduates have completed the telephone interview, and telephone response is currently between 76 and 83% in the other nine replicates. Only 19% of the graduate nonrespondents of 1992–1993 have, however, responded to the telephone interview, and we have begun to experiment with an attractive response incentive—a CD of 1957's most popular songs—to improve their participation. The self-administered mail instrument is sent to graduates on completion of the telephone interview, and response rates to that component of the study are exceptionally high. In each of the first six replicates, mail response exceeds 88%, and it is already more than 83% in the later replicates. Response to the initial mailing has been so high that we have been able to reduce the number of second and third mailings below the budgeted level.

As the WLS becomes a full-fledged study of aging, it should serve a very broad agenda of research and policy interests. Public data and documentation from the WLS have long been available to qualified researchers (<http://dpls.dacc.wisc.edu/wls/index.html>). Sensitive data are accessible through the secure data enclave in the Center for Demography of Health and Aging at the University of Wisconsin–Madison (<http://www.ssc.wisc.edu/cdha/data.html>). The research agenda will range from the effects of childhood circum-

stances and work life on late adult health and well-being to the effects of children's prospects on the life course of their parents, differential access to health care services, the behavioral precursors of high cognitive functioning and cognitive decline, and the influence of life course events and conditions on the structure and functioning of the brain. No smaller agenda will justify the long-term investment that investigators, students, funding agencies, and an exceptionally generous cohort of research participants have made in the Wisconsin Longitudinal Study.

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Robert M. Hauser is Vilas Research Professor of Sociology and director of the Center for Demography of Health and Aging at the University of Wisconsin–Madison. His current research interests include trends in educational progression and social mobility in the

United States among racial and ethnic groups, the uses of educational assessment as a policy tool, the effects of families on social and economic inequality, and changes in socioeconomic standing, health, and well-being across the life course. He has worked on the Wisconsin Longitudinal Study since 1969 and directed it since 1980. In 1998, he chaired the National Academies Panel on the Appropriate Use of High Stakes Tests (High Stakes: Testing for Tracking, Promotion, and Graduation, edited by Jay Heubert and Robert M. Hauser, Academy Press, 1999). Other recent publications include "Progress in Schooling: A Review" (in Social Inequality, Katherine Neckerman, ed., New York: Russell Sage Foundation, 2004) and "As We Age: The Wisconsin Longitudinal Study, 1957–2001" (with William H. Sewell, Kristen W. Springer, and Taissa S. Hauser) (in Research in Social Stratification and Mobility, Kevin Leicht, ed., Elsevier, 2003).