

**The Wisconsin Longitudinal Study:  
Designing a Study of the Life Course<sup>1</sup>**

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**Introduction**

The Wisconsin Longitudinal Study (WLS) is just over 50 years old, and it has become the most enduring study of its scope and size in the United States and, perhaps, in the world. What began as a state-inspired survey in the late 1950s of what happens to Wisconsin youth after high school has become a biosocial study of health, cognition, and well-being in the retirement years as well as a vehicle for studies of intergenerational social and economic stratification. A lone investigator at the University of Wisconsin-Madison has been replaced by a loosely coordinated team of several dozen researchers that spans the nation. A once-private and distinctly modest data resource has evolved into a complex combination of survey operations and administrative record links with a web-based system for public distribution of massive data files, extensive documentation, powerful search and extraction tools, and hundreds of publications.<sup>2</sup>

The importance of the WLS as a resource for studies of the life course depends on the extensive data that have been collected from 1957 onward – or even earlier in some cases – and on the investments that the National Institute on Aging has made in the study since the early 1990s (Sewell, Hauser, Springer, & Hauser, 2004). The WLS can contribute to basic knowledge about social, behavioral, and biological processes in three fundamental ways. The first is by providing new information about the consequences of childhood and adolescent conditions and experiences. A second major contribution of the WLS is to provide new information about the

extent to which early life conditions affect later life outcomes, above and beyond the known effects of the conditions and experiences of adulthood. Finally, because of its rich, complete, and contemporaneous records of careers and family events – the WLS provides unique opportunities to analyze the characteristics of whole-life trajectories that may affect the quality and length of later life.

Today's research and policy environments are far different from those of the late 1950s. On the one hand, both the feasibility and the scientific value of longitudinal studies of the life course are well established. Such studies have become the backbone of observational research in psychology, sociology, and economics. In the realms of human development and health, by dint of the well-known Barker hypothesis (Barker, 2001; Kuh & Ben-Shlomo, 1997), life course research now extends back into the womb, and a national study of child development aims to follow health and development from couples' childbearing intentions to offspring at age 21. In each decade since the 1970s the National Center for Education Statistics has followed a cohort of youth from secondary school to the end of the school years. The Bureau of Labor Statistics has fielded three waves of longitudinal studies of adolescent youth since the late 1960s. The National Institute on Aging supports longitudinal studies of aging in the U.S. – including the WLS – and in many foreign nations, but its premier data resource, the Health and Retirement Study, now provides continuous longitudinal coverage of the U.S. population aged 50 and above.

In current and future work, the WLS will be used to explore the implications of the changing social, political, economic, and technological contexts of the early 21<sup>st</sup> century for the well being of a large cohort of men and women transitioning to old age. Among the most

important social and economic changes is the deinstitutionalization and individualization of retirement. That is, retirement is no longer a well-defined economic status—simply a matter of leaving the labor market—but rather a distinct and expected, but highly variable stage of the life course in which time spent in paid work tends to decline and may be replaced by unemployment, leisure, or disability.

Over the past 20 years, both the government and employers have shifted more of the responsibility associated with planning and managing the retirement years towards individuals. The capacity of individuals to make good choices about their investments, medical care, insurance, and other domains of increased uncertainty and personal responsibility will be an important determinant of both financial and health-related well-being in old age. Moreover, technological advances – ranging from the expansion of the Internet to the development of life-extending medical technologies– also offer older adults an unprecedented number of options about health insurance, choice of health care providers, and types of medical treatments. The contexts in which people are making these choices will play a significant role in shaping the quality of those choices, and ultimately, in the quality of life for older Americans.

Among other questions, WLS data will be used to ask, “What are the psychological, cognitive, social, and health contexts in which WLS graduates are planning for and then actually managing health and financial arrangements in the retirement years?” In short, what kinds of resources and constraints frame the process of their decision making? Because decisions about the retirement years are increasingly in the hands of individuals, it is critical that we adequately understand the contexts that shape peoples’ lives. How do these provisions affect the lives of

their survivors in the event of their death? A second, key question is, “What are the earlier life factors, both individual and contextual, that lead to better outcomes in the post-retirement years?” How is the quality of later life affected by childhood circumstances and their repercussions across the life course? Are there lagged effects of early life conditions, or of job and familial trajectories across the life course, or are circumstances in the later years connected to childhood only through intervening circumstances? We expect that analyses of the cumulated WLS survey and biomarker data, along with rich administrative and public data, will resolve old questions and open new areas of interdisciplinary inquiry about health, aging, and the life course.

I wish that I could write that the evolution of the WLS followed a well-established plan, or at least an aspiration, that from the outset the WLS was intended to track the entire life course of thousands of Wisconsin youth and to become a resource for a research team in Madison and for hundreds of other researchers across the globe. But in the late 1950s there was no such intention, nor were there appropriate theoretical or methodological templates for such an endeavor. Rather, the study has been like Topsy: “It just grew.” To be less flippant, the evolution of the WLS has paralleled that of the human life course; it began and has changed as a consequence of its initial location in time and place, social and intellectual connections, individual initiatives, and adaptation across time to external events (Giele & Elder, 1998). In this chapter, with its focus on the development of the WLS, I will draw repeatedly on this parallel, but more important, I will try to highlight some of the decisions – regarding content, design, and method – that have shaped the project.

## **The Wisconsin Longitudinal Study: Its Origin and Research Context**

The Wisconsin Longitudinal Study (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 post-secondary educational institutions. At that time, most of the units of the present University of Wisconsin System were state and county teachers colleges. J. Kenneth Little, Professor in the School of Education at the University of Wisconsin, 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).

In 1962, William H. Sewell, one of the academic leaders who brought the behavioral and social sciences into NIH (Sewell, 1988), 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 between generations in the United States. Only in 1962 was the first large national study of social mobility in America conducted (Blau & Duncan, 1967). Researchers could do little more than speculate about the processes of selection and socialization that accounted for social stability or social movement.

Sewell selected a random, one-third sample of the graduates, consisting of 10,317 cases, for further study. He then added information on the measured mental ability of each student from files of the Wisconsin State Testing Service, which had, since 1929, conducted a testing program covering all high school students in the state (Froehlich, 1941; Henmon & Holt, 1931; Henmon & Nelson, 1946, 1954). While Sewell's collection of the test score data followed naturally from his interest in post-secondary educational entry and completion, that measure has proved to be one of two key variables that have sustained the value of the WLS data. Moreover, the files of the State Testing Service have subsequently provided test scores for other participants in the study, including siblings of the graduates and spouses of the graduates and siblings.

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, educational and occupational plans, and perceived influence of significant others on educational plans—and then added these to each student's card. Finally, using secondary sources, he constructed relevant measures of school, neighborhood, and community contexts. These included the socioeconomic composition of each senior class (Sewell & Armer, 1966a, 1966b, 1972), 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 (Anderson, Bowman, & Tinto, 1972). However, the second key variable in the WLS was a four-year average of parents' incomes from 1957 to 1960 that Sewell was able to obtain from files of the Wisconsin Department of Revenue; unlike many other longitudinal studies, up to the present day, he

obtained a direct and highly reliable measure of economic standing in adolescence. Thus began a research program that is in its sixth decade and that now focuses on the life-long antecedents of health and aging.

In the early years WLS research focused mainly on the ways in which adolescent achievements and aspirations were formed and then influenced post-secondary schooling and occupational careers. This work led to the so-called “Wisconsin Model of Status Attainment” (see Figure 2.1), which became a template for subsequent research on the life course – and for critical attention to the social psychological theory of status attainment (Sewell, Haller, & Ohlendorf, 1970; Sewell, Haller, & Portes, 1969; Sewell, *et al.*, 2004).

**Insert Figure 2.1 about here**

The essential ideas of the 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 much of the influence 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 is also simple in a second, more important sense, that it is a modified causal chain. Not every earlier

variable affects every later variable in the scheme. Of fifteen possible paths from antecedent variables in Table 1, only the seven paths marked with an asterisk (\*) carry large effects.

It is well-known that the Wisconsin Model is a social-psychological elaboration of the Blau-Duncan (1967) model of intergenerational occupational stratification, but the marriage of that model with the social psychological theories of Sewell and his colleagues was neither accidental nor inevitable (Sewell & Hauser, 1992). It grew out of the close personal and intellectual relationship between William Sewell and Otis Dudley Duncan. Sewell had been hired in 1937, fresh out of the University of Minnesota, by Otis Durant Duncan, who was then chair of the Department of Sociology at the Oklahoma State University in Stillwater. Sewell and the elder Duncan were neighbors in Stillwater, and Otis Durant's son, Dudley, was first babysitter for Sewell's children, then academic advisee, and, by the 1960s, scientific advisor to Sewell.

The distinctive scientific contributions of the Wisconsin project lie not merely in proposing the model, but in testing it by means of careful measurement – and repeated measurement – of key variables across the entire adult lives of the vast majority of participants in the study. These two features of the study work hand-in-hand, for repeated measurements are costly to obtain, requiring either sample retention or proxy reports (from well-informed others), and their analytic use requires sophisticated statistical modeling. The Wisconsin Model serves to illustrate these points, though other analytic work in the WLS might also have been chosen.

It is patent that, to follow occupational and economic achievement across the life course, one needs repeated measurement. Thus, the Wisconsin Model has repeatedly been estimated and

validated as the cohort has aged, starting with the original and modified versions of Sewell and colleagues (Sewell, et al., 1970; Sewell, et al., 1969), continuing with the addition of earnings as an outcome variable (Sewell & Hauser, 1972, 1975), adding occupational standing at midlife (Sewell, Hauser, & Wolf, 1980), and culminating in a model of occupational achievement from school-leaving to the pre-retirement years (Robert M. Hauser, Warren, Huang, & Carter, 2000).

However, in research that followed introduction of the model, both that based on WLS data, and in the hundreds of replications and extensions that followed (Sewell, et al., 2004), the central social psychological argument – that the process followed a modified causal chain – was forgotten, and researchers simply estimated recursive models in observable variables. This practice began as early as the second paper based on the model (Sewell, et al., 1970), where additional paths were added to the model based on the size and significance of simple regression estimates from observed variables.

I joined the WLS project in the summer of 1969. Otis Dudley Duncan, who had been my advisor at the University of Michigan, had suggested me to William Sewell as a possible collaborator. I arrived at Madison only after the two formative status attainment papers had been completed, and my early work with Sewell mined the same vein – running recursive models in observable variables (Sewell & Hauser, 1972, 1975). However, I also began collaborating with David L. Featherman to undertake a modified version of the Blau-Duncan study (Featherman & Hauser, 1975, 1978; Robert M. Hauser & Featherman, 1977). Largely because of the economist Samuel Bowles' critique of measurement in the Blau-Duncan survey (Bowles, 1972), Featherman and I commissioned follow-up surveys of small samples of black and white men in

which we obtained repeated measurements of key socioeconomic variables. This led to a series of papers in which we estimated Blau-Duncan type models with correction for measurement error, and we learned that these corrections had substantial effects – though not as anticipated by Bowles (Bielby & Hauser, 1977; Bielby, Hauser, & Featherman, 1977). Among other findings, we learned that – after taking account of response error – the process of socioeconomic attainment appeared to be more similar among blacks and whites than we had previously believed.

With this work in mind, I began to wonder whether it would be possible to estimate the Wisconsin Model with corrections for errors in variables and whether such estimates would sustain or invalidate the social psychological theory that motivated the model. In order to carry out this agenda, we needed repeated measures of all of the variables in the model. Thus, in the 1975 telephone survey of graduates – our first direct contact with them since high school graduation – we not only ascertained information about military experiences, careers, family formation, and social participation across the previous 18 years, but we also re-measured social background characteristics, educational and occupational aspirations, educational attainments, and early occupations.

Working with Shu-Ling Tsai, a brilliant student from Taiwan, Sewell and I were able to estimate error-corrected models using Jöreskog and Sörbom's LISREL program (R. M. Hauser, Tsai, & Sewell, 1983; Jöreskog & Sörbom, 1996). Back around 1980, this was a very tedious process; we worked on the paper for two and a half years, and estimating a single variant of our

model took days on the computers of that era. Now, it takes only a few seconds to estimate those models on an ordinary desktop or portable personal computer.<sup>1</sup>

The main finding from this study was that the original, parsimonious version of the Wisconsin Model was correct, that the theoretically specified relationships were even stronger than initial estimates suggested and that the unexpected relationships, later added to the model, were negligible. Unfortunately, the main lesson from this analysis has not been widely heeded, and almost all researchers continue to estimate models of social stratification “on the cheap,” declaring as plain truth whatever comes out of simple regressions in observable variables.

One other example of the value of correcting for measurement error is the series of random effect models of sibling resemblance, largely based on data from the WLS, in which response error biases “within-family” but not “between-family” regressions. Hauser and Mossel (1985, 1988) provide a primer in the design and estimation of such models.

Yet a more striking example is provided by stratification research that compares models of aspiration and attainment between black and white youth in the U.S. Across more than 30 years, the standard finding has been that the estimated coefficients of such models are much smaller for blacks than for whites, leading researchers to conclude that the corresponding processes are different in the two populations and directing them toward competing “structural” explanations of attainment differences (Kerckhoff, 1976, 1989; Porter, 1974; Portes & Wilson,

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<sup>1</sup> LISREL code to estimate the two key versions of our model is available from the author.

1976). For many years, these ideas could not be tested directly because there were no longitudinal data with repeated measurements of key variables: social background, academic achievement, aspirations, and attainments. Such data are at last available from the National Educational Longitudinal Study of 1988 (NELS88). Megan Andrew and I find that, when appropriate corrections are made for response error in all of the relevant variables, there are essentially no differences in educational attainment processes among black, Hispanic, and white-non-Hispanic youth (Andrew & Hauser, 2008).

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, Little and Sewell were by no means alone in focusing on adolescent circumstances and aspirations as the stepping-stone to adult lives. Other influential studies of American youth included James Coleman's *Adolescent Society* (1961) and Albert J. Reiss, Jr.'s studies of Nashville youth (Reiss & Rhodes, 1961; Rhodes, Reiss, & Duncan, 1965). Sociologists of that time—and later times—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, which had long been in progress, such as the studies of exceptionally able youth initiated by Lewis Terman (Burks, Jensen, & Terman, 1959; Oden, 1968; Terman, 1925; Terman & Oden, 1959a, 1959b) and the two small studies of youth in California communities that were made famous by Glen Elder (1974) and John Clausen (1991, 1993).

In addition, the WLS was soon followed by large, national longitudinal studies of youth, first among which was the ill-fated Project Talent of 1960 (University of Pittsburgh, 1964, 1966). Three highly successful school-based national longitudinal studies of youth have followed—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 (the class of 1992). However, none of these larger studies has continued more than 15 years. In my judgment, it is tragic that the division of labor among federal agencies has precluded a level of cooperation and integration that could have extended these studies across working life and into the retirement years. The National Longitudinal Studies of Labor Market Experience began with cohorts of 14 to 24 year-old women and men in the late 1960s, but the male sample was soon abandoned because of high attrition rates. Only with the aging of the cohorts in the 1979 National Longitudinal Study of Youth—who are only 43 to 50 years old in 2008—is there likely to be a national longitudinal study of women and men that compares favorably with the WLS both in size and coverage of the life course.

### **From Adolescence to the Life Course**

Over the years, the WLS has collected data in many different ways—and always protected it carefully regardless of its source. Figure 2.2 provides a succinct overview of data available to the WLS or under development. After the 1957 survey of graduates, the next two waves of survey data were collected from the graduates and their parents in 1964 and 1975, respectively. In 1964, Sewell and his colleagues sent a very brief mail survey to parents of WLS graduates in the belief that, seven years after high school graduation, youth would be unlikely to

respond to such queries, while parents always like to talk about their children. The questionnaire – just one side of a folded post-card – asked about educational attainment, marital status, military service, and occupation of the graduate and – in the case of women – the occupation of the graduate’s husband. After five waves of mailing and a telephone reminder, the response rate was 87 percent. This rate of coverage in a large-scale study across a seven-year interval was unprecedented at the time, and it demonstrated feasibility for the large national studies that followed.

**Insert Figure 2.2 about here**

In 1975, after demonstrating the feasibility of tracing virtually all graduates for 18 years after high school graduation (Clarridge, Sheehy, & Hauser, 1977), the WLS carried out one hour telephone interviews with the graduates in which more than 90 percent of the survivors participated. Taken together, the 1964 and 1975 waves of the WLS 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. Data on the occupational careers of male graduates were supplemented by Social Security earnings histories from 1957 to 1971 (Sewell & Hauser, 1975).

We have continued to come up with new ways of learning more about the early lives of the graduates. Recently, state archival data on high school district resources from 1954 to 1957

and from elementary schools in the early childhood of the cohort have been added. A creative and energetic graduate student, Sheri Meland, became interested in the long-term effects of facial attractiveness. She thought of the WLS as a source of appropriate data and was able to collect, scan, rate, and scale senior high school yearbook photos for thousands of WLS graduates by borrowing yearbooks from schools and libraries – beginning with the larger schools in urban areas. Meland developed visually-anchored scales of facial attractiveness and a computer-based protocol for applying the scales to individual photographs (Meland, 2002). The success of this effort has led to studies of the Duchenne smile (Freese, Meland, & Irwin, 2006) and – by extension of the scaling method to facial mass – to a study of the long-term consequences of adolescent obesity (Reither, Hauser, & Swallen, forthcoming). The high school yearbooks also filled another gap in the early history of the WLS cohort by providing a comprehensive record of extracurricular activities in high school.

With all of these resources in mind, we decided to obtain yearbooks for all of the WLS graduates. Early in 2007, we designed a multi-purpose contact with the graduates. We distributed reports of findings from the most recent (2004-05) surveys, along with a short questionnaire about experience with the Medicare Part D prescription drug benefit, and, in addition, we enclosed a personalized letter asking if we could borrow a high school yearbook from each student for whom we had not already borrowed and scanned one. The response was exceptional, and we now have coverage of 99 percent of the original graduates, whether or not they participated in later rounds of the study.

## **Linking Lives through Data Collection**

In the 1975 telephone survey, the combination of two circumstances led us to obtain a roster of living siblings and choose a focal sibling at random for each graduate (plus all twins). First, I was strongly impressed by the work that Otis Dudley Duncan (1968) and Christopher Jencks and colleagues (Robert M. Hauser & Dickinson, 1974; Jencks, et al., 1972) had done with survey data on the resemblance of siblings in cognitive ability and socioeconomic attainment. They had each made the most of the fragmentary data available at the time, and much as I admired their methods and models, I hoped that it might be possible to create a complete set of sibling resemblance data with the WLS. Second, in the early 1970s, I had witnessed many complaints that so-called “status attainment research” was excessively individualistic, that it did not take a relational approach to social stratification or consider the networks and social structures in which individual lives were embedded. While I strongly disagreed with such arguments, I also concluded that we would do well to situate the lives of graduates firmly in their social contexts.

With this in mind, we proceeded on four fronts. First, we asked each graduate to name their three best, same-gender friends in their own high school graduating class. Using this definition, about half the graduates have a named peer in the sample (of which many are reciprocated choices). We chose not to ask women about men or vice-versa because – at that time – women tended to date older men, and men to date younger women. Similarly, in order to maximize the chances of matches within the sample, we limited choices to the graduate’s own high school. Second, we obtained a roster of all children born to graduates by age and gender,

chose a focal child at random, and asked the graduate about their hopes and expectations for that child. Third, we asked about the current social and economic characteristics of spouses and about their social origins. Fourth, as noted above, we obtained a roster of siblings that included age, gender, first name, and highest level of completed schooling. Then, we chose a focal sibling at random (or the graduate's twin), and we asked about the occupation and the full name and address of the focal sibling. Our uses of these linked data are described below.

Figure 2.3 suggests a way of looking at the WLS study design in terms of the set of relationships about which the study provides information. While the WLS data originally centered on the 1957 graduates, we now find it useful to think of them as focal points in sets of relationships with parents, spouses, adult children, and siblings, as well as relationships with the localities and social institutions through which they have passed—high schools, military service, colleges, and employers. Available WLS files include 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 first been obtained from spouses (and widows) in the 2004-06 wave of the study, and we hope to add (adult) children eventually.

**Insert Figure 2.3 about here**

Going back to the files of the Wisconsin Testing Service, we were able to locate adolescent cognitive ability test scores for 6619 of the focal siblings of graduates (75%). In 1977, with support from the Spencer Foundation, we interviewed a highly stratified sample of 2100 of

these randomly selected siblings – controlling the number of female-female, male-male, female-male, and male-female pairs, among other variables. These relational data proved so useful that we have included all selected siblings in the two subsequent waves of the study. Briefly, our work with the sibling data has shown that resemblance between siblings is greater with respect to ability than educational attainment and greater with respect to educational attainment than later occupational and economic success. Moreover, the economic resemblance of siblings gradually declines as they grow older (Robert M. Hauser, 1984, 1988; Robert M. Hauser & Mossel, 1985, 1988; Robert M. Hauser & Sewell, 1986; Robert M. Hauser, Sheridan, & Warren, 1999; Robert M. Hauser & Wong, 1989; Warren, Sheridan, & Hauser, 2002).

The 1980s were difficult years for the WLS. Until then, the project had been supported very well by the National Institute of Mental Health by dint of its focus on the antecedents and consequences of aspirations. However, the Reagan administration had no use for such studies, and we were summarily told that NIMH would no longer consider proposals for support from the WLS. The project managed to survive through a combination of local resources and small grants from the National Science Foundation, and in the absence of data collection activities I was able to focus more on analytic issues, including the development of statistical models of repeated measurements and of sibling resemblance.

### **New Focus on Aging, Retirement and Health**

By the early 1990s, we realized that the years of work and child-rearing were ending and that, if the WLS were to continue, it ought to focus on health, well-being, and retirement. We immediately regretted that we had failed to ascertain even the most rudimentary information

about health in the previous round of the study. All the same, we decided to change the direction of the project, and we began to work with staff of the National Institute on Aging (NIA).

In 1993-94, the WLS conducted four major surveys with NIA support: telephone and mail surveys of graduates and nearly identical telephone and mail surveys of an expanded random sample of focal siblings. 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 1993-94, the 1-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.

By 2001, when we were planning proposals for a new round of surveys, it was evident that the project would not survive if its content were limited to the interests of sociologists, economists, and psychologists, as traditionally conceived. This was the beginning of the era of biosocial surveys, and science of the life course was moving rapidly toward a truly interdisciplinary mix of traditional social science, epidemiology, neuroscience, medicine, and

genetics. A series of excellent panel reports from the National Research Council charts this movement and provides guidance to researchers (National Research Council, 2000, 2001, 2006a, 2006b, 2008). The existing group of WLS investigators was ill-equipped to move in this direction, so we reached out for new collaborators.

New surveys of WLS participants were carried out, beginning late in 2003, when graduates were 63 and 64 years old. As in the 1992-94 round of the study, WLS graduates and the sample of their brothers and sisters were first interviewed by telephone for about one hour, and more than 80 percent of survivors participated. Telephone interviews were followed by mail-out, mail-back surveys, which were longer than in 1992-94 – more than 50 pages in some forms. I was at first overwhelmed by the number of items that my colleagues offered for this instrument. However, in a chance meeting with Don Dillman (1991; Dillman & Dillman, 2000), an expert in mail and other self-administered surveys, I was assured that there is no documented relationship between response rates and the length of a well-designed instrument. In fact, eighty-nine percent of persons interviewed by telephone completed the mail survey.

In the 1993-94 round of the WLS, we sent mail instruments only to those participants who had completed a telephone interview, on the assumption that mailing to telephone refusers was hopeless. However, we learned that many of the telephone refusers in 2004-06 had said that they would fill out a questionnaire if one were sent to them. We initially took this as a form of polite refusal, but then decided to learn if that were true. We sent mail instruments to a random pilot sample of telephone refusers, and forty percent responded, so we did the same for all telephone refusers. In the full sample, forty percent of those who did not complete the telephone

survey did complete the mailout, which we modified to update basic demographic information that had been included only in the telephone protocol. In fact, despite survey attrition and deaths across the decade, we obtained a larger number of completed mailouts in 2004-06 than we did in 1993-94.

The telephone interview schedules build in supplementary sections for (a) graduates or siblings who were widowed and (b) who had a physically or mentally disabled child or have experienced the death of a child. Permission was obtained from almost all WLS participants to tape-record the telephone interviews for studies of respondent cognition and interaction with interviewers. To prepare the way for studies of joint survivorship and (eventual) widowhood – and to cross-validate reports from graduates and their siblings – shorter (30 minute) interviews have been carried out with spouses and with approximately 900 widows or widowers of graduates and siblings. These interviews focus mainly on health and family relationships.

### **Collection of Biomarkers**

None of these efforts satisfied our interest in obtaining biomarkers – other than those, like height and weight – that could be ascertained by self-report. For several years, WLS staff had attended an annual, NIA-sponsored workshop on biomarkers sponsored by the University of Chicago and Northwestern University. In 2006, we learned of a new DNA collection protocol, DNA/Genotek, that was non-invasive, could be collected by mail, and that yielded a very large sample of DNA in a solution that would be stable for years at room temperature. For example, our initial set of assays, now underway to identify 80 SNPs (single nucleotide polymorphism), will use less than one tenth of each of our samples.

Each participant first receives a mailing that contains a report of recent findings. A follow-up telephone call ascertains the willingness of the participant to donate DNA, and the next mailing includes the DNA/Genotek kit, a consent form, and a return mailer. The kit is rather like an oversized contact-lens case. The participant spits into the lower half up to a designated level. This is sometimes difficult for older persons, and the instructions suggest sucking a sugar cube and washing the mouth with water before filling the container with saliva. The upper half of the kit is sealed with a preservative that is released when the kit is closed.

Almost 70 percent of graduates who participated fully in the 2004-06 survey protocol completed DNA donation in the spring of 2007, a total of 4500 cases. This rate appears high – especially for a mailout operation – and it is comparable to response rates in some other biomarker data collection operations (but see Rylander-Rudqvist, Hakansson, Tybring, & Wolk, 2006). However, it does not meet our standards, and we expect to increase participation during forthcoming home interviews. One of the reasons that we are not satisfied with the current level of DNA donation is that we identified a very strong response differential by self-reported current health status. Respondents who classified themselves as in fair or poor health were far less likely to donate DNA than those who said they were in excellent health.

As of spring 2008, the WLS is undertaking a major new challenge, interviewing graduates personally in their own homes. We have planned this change of mode for two major reasons, because hearing and comprehension problems may make it more difficult to carry out telephone interviews when the graduates are around 70 years of age and because it will be possible to extend the content of the study to include functional and more intensive cognitive

assessments, to collect additional biomarkers, and to obtain waivers for collection of Medicare and personal health records. This is challenging for at least two reasons. First, the cost of home interviews is far greater than that of telephone interviews. Survey costs will be about 50 percent greater to survey only the surviving graduates in 2009-10 than the cost to survey graduates, siblings, spouses, and widows in 2004-06. Second, because the sample is geographically dispersed, and travel costs are a large share of all survey costs, we will no longer be able to change instrumentation on the fly without affecting the integrity of the samples. That is, all of the protocols, subsampling designs, and alternate forms have to be fixed before we enter the field.

Many new purposes will be served merely by repeating measurements that we have ascertained previously, e.g., health, economic resources, preparation for the end of life, and psychological characteristics (e.g., cognitive performance, personality, well-being, depression, and anxiety). However, we also have extensive plans for new measurements that will, we hope, illuminate the ways in which the WLS cohort ages in a social environment where individual decision-making is increasingly the norm. These include anthropometric and functional assessments, more intensive cognitive assessments, measurements of health and financial literacy and Internet skills, experimental trials of impulsive and risk-averse preferences, waivers for access to Medicare and other medical records, and the experience with the deaths of family members.

In 1975, WLS concepts and measures resembled those of the Current Population Survey (CPS) and the 1973 Occupational Changes in a Generation Survey (OCG) (Featherman & Hauser, 1975, 1978; Robert M. Hauser & Featherman, 1977). In 1992, continuity was balanced

with comparability to other well-designed surveys, e.g., the Health and Retirement Study (HRS), National Survey of Families and Households (NSFH), NIH surveys of work and psychological functioning (Kohn & Schooler, 1983), and the NORC General Social Survey (GSS) (Davis & Smith, 1992). The WLS design was also coordinated with members of the MacArthur Foundation Research Network on Successful Midlife Development, with Michael Marmot's Whitehall II study (Marmot, et al., 1991), and with Michael Wadsworth's longitudinal cohort study of births in Great Britain in 1946 (Wadsworth, 1991).

Interview data from siblings and spouses are a special strength of the WLS. They provide unique data—self-reporting variables that cannot be obtained from proxies, cross-validating information about graduates and their families, and complementing accounts of inter-household (and intergenerational) exchanges. Analytically, the relational data permit construction of multi-level models of family and individual effects on life course outcomes.

The WLS has linked graduates and siblings to the National Death Index-Plus (NDI-Plus)—using Social Security numbers, names, and birth dates as identifiers—in order to obtain cause(s) of death and confirm date and place of death (Bilgrad, 1990; National Center for Health Statistics, 1994, 1999). Similar searches have been undertaken for parents of the graduates and for siblings. However, the data for parents are of limited value because many parents died before the baseline year of the NDI (1979), while many of the mothers of graduates never worked outside the home and thus did not have Social Security numbers. It has recently become possible to purchase regular updates of the Social Security Death Index (SSDI), and this has enabled us to

identify deaths among graduates and siblings on a timely basis and to focus searches for records of cause of death in NDI-Plus.

Since the 1970s, each phase of WLS survey operations—from tracing through coding—has been carried out in a series of 10 replicate subsamples within each major component of the design (graduates, siblings, and spouses). This had four advantages. First, it smoothed the flow of easy and of difficult cases, thereby evening out the workload. This accommodated the inevitable entry of new and inexperienced interviewers into the field operations, and it prevented the accumulation of a large backlog of hard-to-interview cases near the end of the field period. Second, it permitted us to estimate final response rates and costs early in the survey operation and to fix problems in the instruments without systematically biasing responses in the entire sample. Third, it gave us the opportunity to vary content systematically, both by using alternate forms for similar content and by adding and dropping content in known, random fractions of the samples. Last, it gave us the capacity to terminate survey operations at any of several thresholds without lowering the response rate among cases that had been entered into the field. In fact, because the University interrupted field operations with a building renovation project in the early 1990s that increased our fixed costs, we eliminated telephone interviews with the last two replicates of siblings who had not been interviewed in 1977—without affecting the response rate in other replicates.

In development of the 2004-06 round of the WLS, project staff decided that it would be desirable to record all of the telephone interviews. The original reason for our investigation of recording technology was that two of the collaborators, Nora Cate Schaeffer and Douglas

Maynard, wanted to obtain high quality recordings of about 1000 randomly selected interviews that could be used for intensive analysis of respondent-interviewer interaction in an older population. A second reason, which applied to parts of all interviews, was that some of the more attractive protocols for cognitive assessment could not be administered reliably unless the responses were recorded, and, furthermore, recordings could be used to validate appropriate administration of the assessments.

All respondents were asked at the beginning of the interview whether it could be recorded. If they agreed, the interview was recorded, and they were asked at the end of the interview if the recording could be retained for research purposes. If the respondent declined to be recorded at the beginning of the interview, the recording equipment was turned off, but the respondent was asked again, at the beginning of the cognitive assessments, to give permission for just that portion of the interview to be recorded.

Aside from the future value of the recordings in research, which has included an improved ability to edit the raw survey data, they also proved most useful in the process of instrument development in the WLS. For example, it was efficient for researchers to listen to each instance of a pretest telephone module, e.g., a family roster or employment history, in order to detect and solve problems in the logic and content of the instrument and to identify problems in interviewing that could then be addressed in training sessions. There has been just one major disadvantage to the recorded interviews – that while improving the quality of the survey data files, their existence has also permitted and encouraged endless data editing, perhaps beyond the point of diminishing returns.

## **The Wisconsin Study in 2000: Social Composition and Differential Non-Response**

Among Americans aged 60 to 64 in March 2000, 66.7% are non-Hispanic white women and men who completed at least 12 years of schooling and thus resemble the Wisconsin 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 through the mid-60s 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 60s. The WLS overlaps the youngest cohorts that entered the Health and Retirement Study (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 and 12 percent of spouses 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. 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 U.S. 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 10 years older to 10 years younger than the graduates.

From Sewell's 1964 parent survey onward, the WLS has done exceptionally well at maintaining a high overall level of survey participation. We cannot offer any definitive explanation of this success. Among the reasons that we can offer informally are the regional location of the sample in the northern Midwest, the educational level of the sample, and our efforts to identify participants with their state, their high school class, and their state university. But we have no evidence to support any of these ideas.

All the same, there are problems with differential response in the WLS. I have already noted the sharp differential in DNA donation by self-reported general health status. Another, pervasive problem is differential response by cognitive ability. Up through the 1975 to 1977 waves of the WLS, we were unable to detect any notable response differentials relative to variables that were available for all participants. One WLS investigator, Marsha Seltzer, showed me that in the 1993-94 surveys, and especially the mail component, there was a regular gradient in response by adolescent cognitive ability with a sharp fall-off among the bottom ten percent. Our surmise was that the cognitive demands of a lengthy interview and those required to read

and respond to hundreds of survey items were just too great for participants with limited cognitive skills.

Further investigation demonstrated that in the WLS the well-established survey response differentials by gender and socioeconomic status, favoring women and those of high status, were present in the 1993-94 data, but that they were entirely explained when adolescent test scores and rank in high school class were controlled (Robert M. Hauser, 2005). That is, it appears that there is a normative as well as a cognitive effect on survey response. Not only are cognitive skills a limiting factor, but women – who obtain better grades than men by dint of more normative behavior – are more likely to respond because that normative orientation persists across the life course.

To compensate at least in part for these differentials, in the 2004-06 round of the WLS we encouraged participants to complete telephone interviews in more than one session if they grew tired and, likewise, to take their time in filling out the mail instruments. In my judgment, the take-home lesson here is that for methodological as well as theoretical reasons, longitudinal surveys should obtain at least a brief cognitive assessment at an early stage and should use it to monitor survey response in subsequent waves. Contrary to earlier opinion, such assessments can be administered by telephone as well as in person, and almost all research participants agree to and enjoy completing a brief assessment.

### **Study Documentation**

When the WLS began, data documentation was primitive. A huge typed codebook with marginal distributions was supplemented only by the meticulous handwritten notes of William

Sewell's exceptional research assistant and co-author, Vimal P. Shah. Around 1970, my wife, Tess Hauser, established two permanent series of internal documents to record project research activities. Computer Operations Requests (CORS) were prepared before a programmer would undertake any new tabulations or estimates, and WLS Memos recorded substantive decisions, operations, findings, and methodological notes. Now, all documents are created electronically, and the early entries in each series have been scanned. As interactive computing has evolved, it is no longer practical to create a record of every computing operation, but final operations are documented fully, including computer code and intermediate data files. The goal of these efforts has always been the same, namely that any research carried out in the WLS project should be reproducible by others, even if all of the present staff and faculty were to disappear from the scene.

### **The Scope of the Wisconsin Longitudinal Study**

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 the women graduates in the WLS and more than a third of male graduates will live to at least 2022, when they will be 83 and 84 years old. Thus, the current round of the WLS is not an end, but a beginning.

As the WLS has become a full-fledged study of aging, it serves a very broad agenda of research and policy interests. Anonymous public data and documentation from the WLS have

long been available to qualified researchers (<http://www.ssc.wisc.edu/wlsresearch/>). Sensitive data are accessible through the secure data enclave in the Center for Demography of Health and Aging at the University of Wisconsin-Madison. The research agenda ranges from the effects of childhood circumstances and work life on late adult health and well being, to the effects of children's prospects on the life course of their parents, to differential access to health care services, to the behavioral precursors of high cognitive functioning and cognitive decline. 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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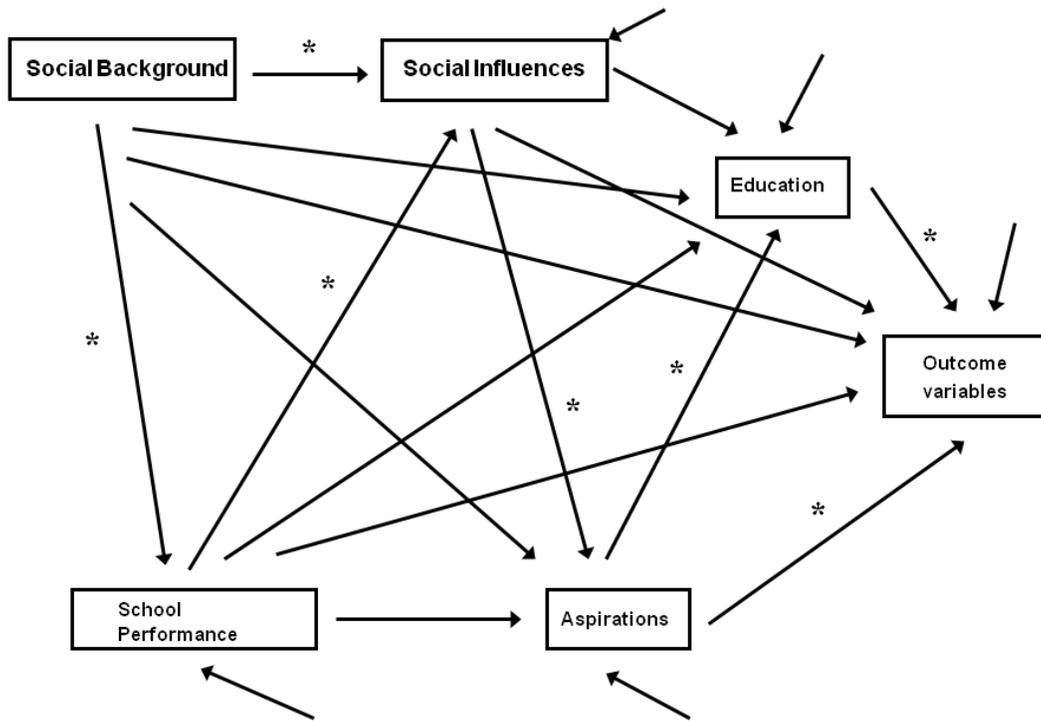
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Figure 2.1 The Wisconsin Model



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## Figure 2.2. Survey and Administrative Record Data in the Wisconsin Longitudinal Study

### Sources of Survey Data:

- 1957 Senior Survey of Graduates
- 1964 Postcard Survey of Parents
- 1975 Telephone Survey of Graduates
- 1977 Telephone Survey of Siblings
- 1993 Telephone/Mail Survey of Graduates
- 1994 Telephone/Mail Survey of Siblings
- 2003-07 Telephone/Mail Surveys of Graduates, Siblings, Spouses, and Widows
- 2007 Mail Survey about Medicare Part D enrollment
- 2009-10 Personal Home Interviews and Assessments (in development)

### Available Public or Administrative Record Data:

- Henmon-Nelson Mental Ability (9<sup>th</sup> and 11<sup>th</sup> grades for graduates, other years for siblings and spouses)
- Rank in High School Class
- High school yearbooks (including senior-year photos and extra-curricular activities)
- Parents' Adjusted Gross Income, 1957-60
- Male Graduate's earnings, 1957-71
- College Characteristics
- Employer Characteristics, 1975
- National Death Index-Plus (and Social Security Death Index)
- Elementary and high school resources (from Wisconsin state archives)
- Wisconsin health insurance plans
- Local health resources (Area Resource File and Interstudy data)
- Medicare enrollment and claim data (at present, only for older siblings)
- Wisconsin Worker's Compensation records

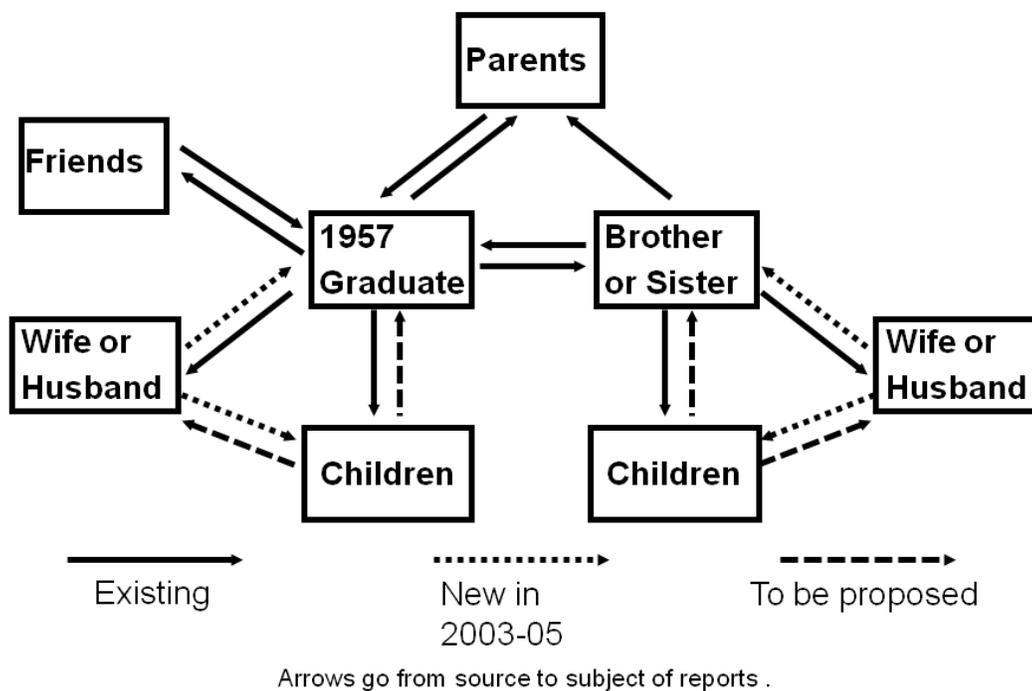
### Biomarkers

- DNA samples (graduates in 2007, siblings in 2008)

### Administrative Record Data in Process:

- Wisconsin state tumor registry
- Geocoded addresses across the life course

Figure 2.3 Some Social Links in the Wisconsin Longitudinal Study



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<sup>2</sup> See <http://www.ssc.wisc.edu/wlsresearch/> .