

Encyclopedia of Social Science Research Methods

Longitudinal Research

Contributors: Scott Menard

Editors: Michael S. Lewis-Beck & Alan Bryman & Tim Futing Liao

Book Title: Encyclopedia of Social Science Research Methods

Chapter Title: "Longitudinal Research"

Pub. Date: 2004

Access Date: November 27, 2013

Publishing Company: SAGE Publications, Inc.

City: Thousand Oaks

Print ISBN: 9780761923633

Online ISBN: 9781412950589

DOI: <http://dx.doi.org/10.4135/9781412950589.n516>

Print pages: 597-602

This PDF has been generated from SAGE knowledge. Please note that the pagination of the online version will vary from the pagination of the print book.

<http://dx.doi.org/10.4135/9781412950589.n516>

Longitudinal research may best be defined by contrasting it with cross-sectional research. CROSS-SECTIONAL research refers to research in which data are collected for a set of cases (individuals or aggregates such as cities or countries) on a set of variables (e.g., frequency of illegal behavior, attitudes toward globalization) and in which data collection occurs specifically (a) *at* a single time and (b) *for* a single time point or a single interval of time (hereafter, both will be referred to as *periods*). Analysis of purely cross-sectional data can examine *differences between cases* but not *changes within cases*. Different disciplines define *longitudinal research* differently, but a broad definition would include research in which (a) data are collected *for* more than one time period, (b) possibly but not necessarily involving collection of data *at* different time periods, and (c) permitting analysis that, at a minimum, involves the measurement and analysis of change over time within the same cases (individual or aggregate). Longitudinal data have been collected at the national level for more than 300 years, since 1665, and at the individual level since 1759, but longitudinal research in the social sciences has really flourished since the 1970s and 1980s (Menard, 2002).

Although some researchers would consider the collection of data *at* different time periods to be a defining characteristic of longitudinal research, it is also possible in principle to collect *retrospective* data, in which the data are collected *at* a single period but *for* more than one period. For example, a respondent may be asked to report on all of the times he or she has been a victim of crime, or has committed a crime, over a span of years up to and including her or his lifetime. In contrast to retrospective studies, *prospective* longitudinal data collection involves the repeated collection of data with usually short recall periods: crimes committed or victimizations experienced in the past week, month, or year or data on attitudes, beliefs, and sociodemographic characteristics at the instant the data are collected.

Longitudinal research serves two primary purposes: to describe patterns of change and to establish the direction (positive or negative, from *Y* to *X* or from *X* to *Y*) and magnitude (a relationship of magnitude zero indicating the absence of a relationship) of causal relationships. Change is typically measured with respect to one of two continua: chronological time (for historical change) or age (for developmental change). Sometimes, it is difficult to disentangle the two. If older individuals are less criminal than younger individuals, is this because crime declines with age, or is it possible that

older individuals were always less criminal (even when they were younger) and younger individuals will remain more criminal (even as they get older), or some combination of the two? With cross-sectional data, it is not possible to disentangle the effects of history and development. Even with longitudinal data, it may be difficult, but with data on the same individuals both at different ages and different time periods, it at least becomes possible.

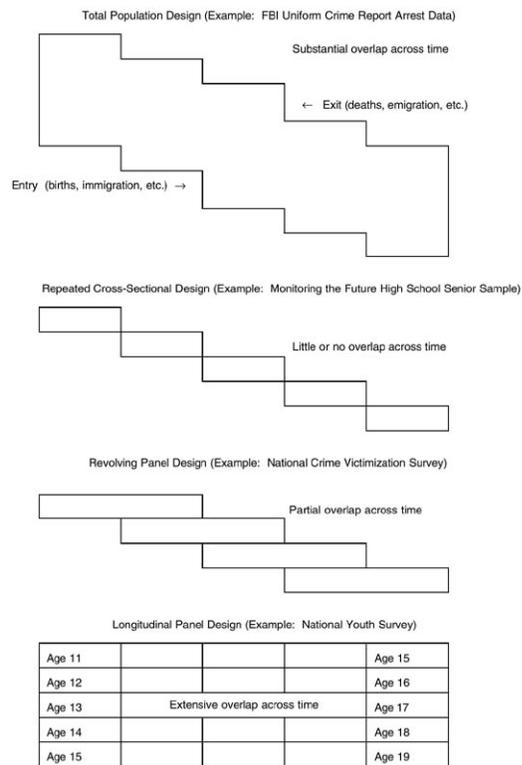
There are several different types of longitudinal designs (Menard, 2002), as illustrated in [Figure 1](#). In each part of [Figure 1](#), the columns represent years, and the rows represent subjects, grouped by time of entry into the study. Thus, subjects enter the population or sample (“rows”) at different times (“columns”), and subjects who have entered the study at different times may be in the study at the same time (more than one row outlined in the same column), except in the *repeated cross-sectional design*, in which different subjects are studied at each different time (no two rows outlined in the same column).

In a *total population design*, we attempt to collect data on the entire population at different time periods. An example of a total population design would be the Federal Bureau of Investigation’s (annual) *Uniform Crime Report* data on arrests and crimes known to the police. Although coverage is not, in fact, 100% complete (the same is true for the decennial census), the intent is to include data on the entire U.S. population. From year to year, individuals enter the population (by birth) and exit the population (by death), so the individuals to whom the data refer overlap substantially but differ somewhat from one period to the next and may differ substantially over a long time span (e.g., from 1950 to the present). FBI data are used to measure aggregate rates of change or trends in arrests and crimes known to the police. The same design structure is present in the *Panel Study of Income Dynamics* (Hill, 1992), which is not a total population design but in which individuals may exit the sample by death or enter the sample by birth or marriage.

Repeated cross-sectional designs collect data on different samples in different periods. Because a new sample is drawn each year, there is in principle no overlap from one year to the next (although it is possible that independent samples will sample a few of [\[p. 598 ↓ \]](#) the same individuals). A good example of a repeated cross-sectional design is the General Social Survey, an annual general population survey conducted by the National Opinion Research Center, which covers a wide range of

topics (including marriage and family, sexual behavior and sex roles, labor [p. 599 ↓] force participation, education, income, religion, politics, crime and violence, health, and personal happiness) and emphasizes exact REPLICATION of questions to permit comparisons across time to measure aggregate-level change (Davis & Smith, 1992).

Figure 1 Types of Longitudinal Designs



Adapted from Menard (2002).

Revolving panel designs are designs in which a set of respondents is selected, interviewed for more than one time period, then replaced by a new set of respondents. The revolving panel design is used in the National Crime Victimization Survey (NCVS; Bureau of Justice Statistics annual). Households are selected and interviewed seven times over a 3-year period: once at the beginning, once at the end, and at 6-month

intervals between entry and exit. At the end of the 3-year period, a new household is selected to replace the old household. Replacement is staggered, so every 6 months, approximately one sixth of the households in the NCVS are replaced. It is important to note that the NCVS has historically been a sample of households, not individuals; whenever an individual or a family moved from a household, interviews were conducted not with the original respondents but with the (new) occupants of the original household. Because each household is replaced after 3 years, only short-term longitudinal data are available for individuals. At the national level, however, the NCVS is one of the most widely used sources of data on aggregate changes over time in rates of crime victimization and, by implication, the rate at which those offenses included in the NCVS (limited to offenses with identifiable victims) are committed.

The *longitudinal panel design* is the design most generally recognized in different disciplines as a true longitudinal design. An example of the longitudinal panel design is the National Youth Survey (NYS) (see, e.g., Menard & Elliott, 1990). The NYS first collected data on self-reported illegal behavior, including substance use, in 1977 but for the preceding year, 1976. It then collected data at 1-year intervals, for 1977 to 1980, and thereafter at 3-year intervals, for 1983 to 1992, and (as this is being written) additional data are being collected on the original respondents and their families in 2003. Unlike all of the types of longitudinal research discussed so far, there is no entry into the sample after the first year. The respondents interviewed in the most recent year were a subset of the respondents interviewed in the first year: Some of the original respondents were not interviewed because of death, refusal to participate, or failure to locate the respondent. In contrast to the General Social Survey, FBI, and NCVS data, the NYS is used less to examine aggregate historical trends in crime than to examine intraindividual developmental trends, and causal relationships to test theories of crime. In this latter context, the NYS has been used to study the time ordering of the onset of different offenses and predictors of offending and to construct cross-time CAUSAL MODELS that can only be tested using longitudinal data (Menard & Elliott, 1990).

Potential Problems in Longitudinal Research

Longitudinal research potentially has all of the problems of cross-sectional research with respect to internal and external measurement validity; measurement RELIABILITY; SAMPLING ERROR; refusal to participate or nonresponse to particular items; the appropriateness of questions to the population being studied; effects of interactions between subjects or respondents and interviewers, experimenters, or observers; relevance of the research; and research costs. Some of these issues are even more problematic for longitudinal research than for cross-sectional research. For example, biases in sampling may be amplified by repetition in repeated cross-sectional designs, and costs are typically higher for a multiple-year longitudinal study than for a single-year cross-sectional study. There are also additional dangers. As already noted, respondent recall failure may result in underreporting of illegal behavior if long recall periods are used. Respondents who are repeatedly interviewed may learn that giving certain answers results in follow-up questions and may deliberately or unconsciously avoid the burden imposed by those questions, a problem known as panel conditioning. Relatedly, the potential problem of interaction between the respondent or subject and an experimenter, interviewer, or observer producing invalid responses may be exacerbated when there is repeated contact between the experimenter, interviewer, or observer and the respondent or subject in a prospective longitudinal design. In later waves of a prospective panel study, respondents may have died or become incapable of participating because of age or illness or may refuse to continue their participation, or researchers may have difficulty locating respondents, resulting in panel attrition. In retrospective research, the corresponding problem is that individuals who should have been included to ensure a more REPRESENTATIVE SAMPLE may have [p. 600 ↓] died or otherwise become unavailable before the study begins. Particularly in prospective longitudinal sample survey research, an important question is whether attrition is so systematic or so great that the results of the study can no longer be generalized to the original population on which the sample was based.

Measurement used at the beginning of a longitudinal study may come to be regarded as obsolete later in the study, but changing the measurement instrument means that the data are no longer comparable from one time to the next. An example of this is the change in the way questions were asked in the NCVS in 1992. The new format produced a substantial increase in reported victimizations. A comparison was made between the rates of victimization reported using the old and the new method but only in a single year. Thus, it remains uncertain whether attempts to “adjust” the victimization rates to produce a closer correspondence between the old and the new methods are really successful, especially for examining long-term trends in victimization. In developmental research, a parallel problem is the inclusion of age-appropriate measures for the same concept (e.g., prosocial bonding) across the life course. For example, in adolescence, bonding may occur primarily in the contexts of family of orientation (parents and siblings) and school, but in adulthood, it may occur more in the contexts of family of procreation (spouse and children) and work. One is then faced with the dilemma of asking age-inappropriate questions or of using different measures whose comparability cannot be guaranteed for different stages of the life course.

In cross-sectional research, we may have missing data because an individual refuses to participate in the research (missing subjects) or because the individual chooses not to provide all of the data requested (missing values). In longitudinal research, we have the additional possibility that an individual may agree to participate in the research and provide the requested data at one or more periods but may refuse or may not be found at one or more other periods (missing occasions). Some techniques for analyzing longitudinal data are highly sensitive to patterns of missing data and cannot handle series of unequal lengths, thus requiring dropping all cases with missing data on even a single variable on just one occasion. Problems of missing data may be addressed in longitudinal research either by imputation of missing data (replacing the missing data by an educated guess, based on other data and the relationships among different variables in the study, sometimes including imputation of missing occasions) or by using techniques that allow the use of partially missing data in the analysis (Bijleveld & van der Kamp, 1998, pp. 43–44).

Longitudinal Data Analysis

Longitudinal research permits us to use dynamic models, models in which a change in one variable is explained as a result of change in one or more other variables. Although we often phrase statements about causal relationships as though we were analyzing change, with cross-sectional data, we are really examining how *differences* among individuals in one variable can be explained in terms of *differences* among those same individuals in one or more predictors. It has been relatively commonplace to draw conclusions about *intraindividual change*, or change within an individual respondent, from findings about *interindividual differences*, or differences between different respondents. Under certain conditions, it is possible to estimate dynamic models using cross-sectional data, but those conditions are restrictive and relatively rare in social science research (Schoenberg, 1977). It is generally more appropriate to use longitudinal data and to analyze the data using statistical techniques that take advantage of the longitudinal nature of the data. Longitudinal data analysis techniques, as described in Bijleveld and van der Kamp (1998), Menard (2002), and Taris (2000), include time-series analysis for describing and analyzing change when there are a large number of time periods (e.g., changes in imprisonment rates as a function of changes in economic conditions), latent GROWTH CURVE MODELS and HIERARCHICAL LINEAR MODELS for describing and analyzing both short and long-term change within individual subjects or cases and relationships among changes in different variables (e.g., changes in violent criminal offending as a function of changes in illicit drug use), and EVENT HISTORY ANALYSIS to analyze influences on the timing of qualitative changes (e.g., timing of the onset of illicit drug use as a function of academic performance).

Cross-sectional research cannot disentangle developmental and historical trends, and the description and analysis of historical change require the use of longitudinal data. The description and analysis of developmental trends can be attempted using cross-sectional data, but the results will not necessarily be consistent with results based on longitudinal data. Testing for the time ordering or sequencing of purported causes and effects in developmental data can [p. 601 ↓] only be done with longitudinal data. Although there are cross-sectional methods for modeling patterns of mutual causation,

more powerful models that allow the researcher to examine such relationships in more detail, including the explicit incorporation of the time ordering of cause and effect, require longitudinal data. Briefly, no analyses can be performed with cross-sectional data that cannot (by analyzing a single cross section) be performed with longitudinal data, but there *are* analyses that can be performed only with longitudinal, not cross-sectional, data. Cross-sectional data remain useful for describing conditions at a particular period, but increasingly in the social sciences, longitudinal data are recognized as best for research on causal relationships and patterns of historical and developmental change.

Scott Menard

<http://dx.doi.org/10.4135/9781412950589.n516>

References

Bijleveld, C. C. J. H., & van der Kamp, L. J. Th. (with Mooijaart, A., van der Kloot, W. A., van der Leeden, R., & van der Burg, E.). (1998). *Longitudinal data analysis: Designs, models, and methods*. London: Sage.

Davis, J. A., & Smith, T. W. (1992). *The NORC General Social Survey: A user's guide*. Newbury Park, CA: Sage.

Hill, M. S. (1992). *The panel study of income dynamics: A user's guide*. Newbury Park, CA: Sage.

Menard, S. (2002). *Longitudinal research*. Thousand Oaks, CA: Sage.

Menard, S., Elliott, D. S. Longitudinal and cross-sectional data collection and analysis in the study of crime and delinquency . *Justice Quarterly* vol. 7 pp. 11–55 (1990).

Schoenberg, R. Dynamic models and cross-sectional data: The consequences of dynamic misspecification . *Social Science Research* vol. 6 pp. 133–144 (1977).

Taris, T. W. (2000). *A primer in longitudinal data analysis*. London: Sage.