

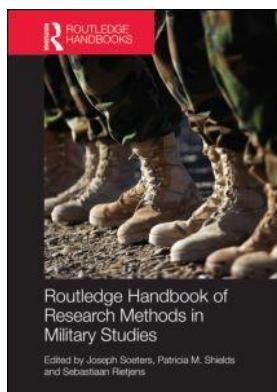
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Joseph Soeters, Patricia M. Shields, Sebastiaan Rietjens

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Jing Han, Manon Andres

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LONGITUDINAL DESIGN IN USING SURVEYS IN MILITARY RESEARCH

Common challenges and techniques

Jing Han and Manon Andres

J. Han, L.J. Xiao, and J. Han (2011) ‘The adjustment of new recruits to military life in the Chinese Army: The longitudinal predictive power of MMPI-2,’ *Journal of Career Assessment* 19(4): 392–404.

The purpose of this study is to investigate the validity of the Minnesota Multiphasic Personality Inventory–2 (MMPI-2) as a screening tool for selecting candidates with the potential for adjusting to Chinese army life and for detecting recruits with psychological problems. The unique military environment and the intense training often lead to young recruit’s maladjustment, and results in serious consequences such as reducing a troop’s training quality as well as its combat effectiveness. One of the critical practices for ensuring the successful adjustment of military recruits is screening recruits with psychological assessment tools such as MMPI-2. These tests identify recruits with psychological problems or mental illness and then prevent them from entering the military in the first place. MMPI-2 is the most widely used and researched multi-scale psychopathology measurement tool in the world. In the early 1990s, MMPI-2 was also introduced and adopted as a personnel selection tool for duty in special operations within the Chinese military. However, there has been no empirical evidence about the validity of MMPI-2 in predicting the adjustment of Chinese military recruits. Because of this, it is unclear if MMPI-2 should even be used as a selection tool to ensure the quality of the military personnel, if its use cannot predict long-term success.

In order to contribute to a better understanding of the validity of MMPI-2 in predicting new recruit’s adjustment in military life, the authors conducted a longitudinal study in the Chinese People’s Liberation Army in Gansu Province. The authors obtained approval for the study from the brigade commander and assistance from the new recruits’ training company commanders. Measures were obtained at four points in time. All 326 new recruits participated in the first round survey and completed the survey of MMPI-2. Using the new recruits’ roster, authors randomly grouped these 326 participants into 10 teams of approximately 30 soldiers each. The authors distributed surveys

within each team and used the standardized instructions to all the participative teams. The authors tracked the same respondents and asked them to finish the measurement of the army life adjustment survey three more times, at the 3rd, the 9th, and 15th month. Because there was a conflict between data collection and the respondents' military duties, there was an attrition problem. Specifically, 192 of the original 326 soldiers who had participated in round one of the survey completed the final survey. Of these 192 respondents, 100 provided complete and usable responses across all four measurement-periods, resulting in a final response rate of 30.7 percent.

The authors adopted the latent growth modeling (LGM) approach to examine the longitudinal predictive power of MMPI-2 on the initial level of adjustment, as well as on the subsequent change rate of a new recruit's adjustment. The results showed that latent mean changes were positive for both interpersonal adjustment and training adjustment, indicating that, on average, these two forms of adjustment improved incrementally over time. In addition, MMPI-2 scores were negatively related to interpersonal adjustment at the initial stages as well as with the linear rate of change in interpersonal adjustment. Similarly, MMPI-2 had a significant negative relationship with training adjustment at initial stages as well as with the linear rate of change in training adjustment. Based on these findings, the authors concluded that mental health was a good indicator of adjustment that should be considered during the selection of military personnel. Recruits deemed mentally healthy based on the MMPI-2 would have fewer problems during the subsequent training process as compared to those who had poorer mental health.

The use of longitudinal design is gaining currency in military research (e.g. Gray et al. 2004; Milliken et al. 2007; Smith et al. 2011). The purpose of longitudinal (sometimes also referred to as cohort, panel, or time series) studies is to assess changes that occur in knowledge, opinions, actions, or perceptions in study samples over the course of time and the factors that influence the change. As such, it is a prospective way of studying phenomena: looking forward instead of looking back.

The illustrative study raises several interesting issues we plan to discuss throughout this chapter:

- 1 How to determine the time intervals between the measurement points?
- 2 How to maintain study participation over time and deal with attrition problems?
- 3 How to deal with sensitivity and privacy issues in military research?
- 4 How to match data across time?
- 5 How to analyze the longitudinal data?

Longitudinal design: What, how and why

Definition and types of longitudinal research

The longitudinal research design involves collecting data (e.g. through an experiment, survey, or archive) from a sample drawn from a specified population at two or more points in time; this is distinct from cross-sectional designs consisting of measurements at a single occasion. Three main types of longitudinal design can be distinguished: panel, cohort, and times series designs.

In the longitudinal panel survey, a representative sample of respondents (a panel) is surveyed repeatedly, over time. A researcher could, for example, select a group of university alumni and survey them at different points in time and ask them similar questions, for instance, to assess (individual) changes in their habits. Cohort studies track a specific subpopulation over time of individuals who share a predetermined event or characteristic (e.g. individuals who were born or married in the same year). A researcher could, for example, select a group of university alumni who graduated in a certain year and monitor them at regular intervals for a specified amount of time. Whereas panel and cohort studies sample individuals, times series designs examine aggregated organizational data over time. In time series designs, the same variables are studied at different points in time (e.g. monthly or annually), usually with the aim of examining trends and explaining variability over time. For instance, these studies can address annual military expenditures or rates of domestic violence or alcohol use in certain areas at various points in time.

Usually the purpose of longitudinal studies is to examine causalities among variables, and explain or predict changes, developments, and dynamics over time. Researchers need to tailor the research design to the research purpose and questions.

Different aims and designs

If the purpose is to examine specific behavioral or attitudinal changes across time, researchers usually trace the same respondents and measure the targeted behaviors or attitudes repeatedly. The illustrative study tracked the same 326 new recruits in the Chinese military and measured their military life adjustment three times in order to have a dynamic view of adjustment changes over time. A longitudinal study conducted in the Netherlands, which followed military personnel and their spouses along the cycles of deployment to an operation abroad (e.g. Andres et al. 2012a/b), is another example. Survey data were collected at three points in time: before, during and after the deployment separating the partners. One of the main aims of this study was to assess changes over time, for instance with respect to couples' relationship satisfaction.

If the research objective is to assess the power of independent variables (X) in predicting changes in a dependent variable (Y), one possible design is to measure the independent and dependent variables separately at different times. As described in the illustrative study, the researchers aimed to examine the predictive power of MMPI-2 on new recruits' adjustment to military life and therefore distributed a four-wave survey. In the first round, respondents filled out the surveys that contained the measurement of the independent variable: MMPI-2. Then, researchers tracked the same respondents across multiple follow-up measurements and asked them to fill out the forms measuring the dependent variable, which was adjustment to military life.

Another strategy is to repeatedly assess the same variables, which was done in the aforementioned Dutch study, in order to control for earlier scores on the variables (see also Britt and Dawson 2005). For instance, relationship satisfaction before the deployment was considered to be an important predictor of relationship satisfaction afterwards. That is, if couples are less satisfied or already experience relationship problems before the separation, they are likely to experience the same or worse afterwards. Applying this design allows the researchers to examine what best predicts relationship satisfaction after deployment, controlling for the effects of earlier relationship satisfaction. Moreover, this design allows for the examination of relationships between the variables within (cross-sectional) and across time frames (longitudinal). For instance, it is interesting to assess the specific stressors and levels of distress in each phase of the deployment, in addition to the prediction of distress over time.

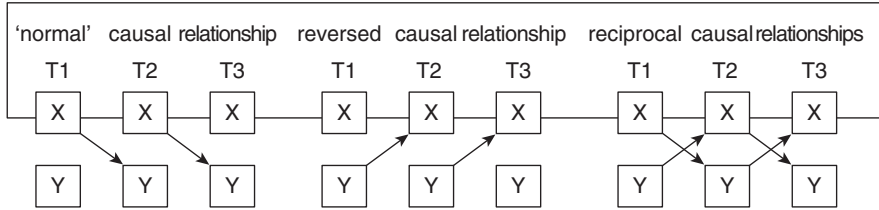


Figure 17.1 Three types of causal relationships

In general, if the research question is about testing the causal relationship between two constructs, one can collect data from the same respondents or independent samples drawn from the same population at two or more points in time (see Lang et al. 2011; Schuman et al. 1985). Between-wave changes in the independent variables (X) should be mirrored by between-wave changes in the dependent variable (Y). Four criteria must be met to interpret an effect as a causal effect.

Four criteria to interpret an effect as a causal effect (De Lange et al. 2003)

- The independent and dependent variables that attempt to measure the underlying theoretical concepts in the hypotheses correlate significantly.
- The independent variable precedes the dependent variable in time.
- The effect is not due to third variables.
- There is a plausible theoretical argument for the effect of X on Y.

Examining the nature, magnitude and (causal) direction of relationships between constructs is an important part of longitudinal research. Various kinds of causal relationships can be distinguished, including the “normal” causal relationships (i.e. hypothesized cause and effect; X causes Y), reversed causal relationships (i.e. effects opposite to the hypothesized cause and effects; Y causes X), and reciprocal causal relationships (X and Y mutually influence each other over time) (Figure 17.1) (De Lange et al. 2003; Zapf et al. 1996). The study among Dutch military personnel (Andres, Moelker and Soeters, 2012b) demonstrated, for instance, that work–family interference was significantly correlated with turnover intentions, within and across time frames. Although turnover intentions have usually been regarded as an outcome of work–family interference, the data showed that this relation can not be viewed as unidirectional. That is, taking other relevant variables into account, the variables mutually influenced each other over time. The authors provide a plausible theoretical reasoning for this – related to employees who think about leaving the job being more vulnerable to experiencing work–family conflict – but also urge for more empirical evidence and refining theory.

Advantages and disadvantages of longitudinal designs

A number of advantages are associated with longitudinal design. The greatest advantage is that one can identify individual variations in growth and test causal hypotheses with longitudinal data. As illustrated earlier, one can examine whether prior levels of an independent variable

can predict changes over time in a dependent variable. One can also examine whether changes over time in an independent variable correspond to changes in a dependent variable over the same period of time. The illustrative study adopted the longitudinal design with the purpose to test the predictive power of MMPI-2 on the new recruits' adjustment changes over time. They found that new recruits' low scores of MMPI-2 (meaning the new recruits have little mental health problems) during the soldiers' first week in the military training camps predicted an increasing adjustment towards military life assessed the 3rd, the 9th, and 15th month after the new soldiers' formal incorporation into the military companies. Another advantage of longitudinal design in the illustrative study is that it helps reduce the common method bias (i.e. variance that is attributable to the measurement method rather than the constructs the measures represent; see Podsakoff et al. 2003) caused by both self-report measures of MMPI-2 and adjustment. The correlation between MMPI-2 and adjustment can be simply a reflection of response bias, that is one's tendency to keep consistent in one's responses at one particular time of measurement, rather than the genuine correlation between the two constructs. Therefore, using longitudinal design and separating the measurement times of MMPI-2 and adjustment can reduce the effect of such response bias. Additional advantages of the longitudinal design include, yet are not limited to (1) no reliance on self-reported retrospective data, (2) the flexibility of adding new variables after the first data collection, and (3) the accumulation of a large number of variables.

Despite the advantages, longitudinal studies also have disadvantages. First, longitudinal studies are more time-consuming and costly than cross-sectional studies because of the personnel costs, the techniques needed to maintain contact with respondents over time, the costs of incentives, and the need for detailed documentation of data. Second, respondents tend appear consistent in their responses across studies, especially in longitudinal surveys. Therefore, respondents may be reluctant to report any opinions or behaviors that appear inconsistent with what they had reported during earlier studies, which may mask the genuine changes over time. Or, the other way around, participation in the initial study may sensitize respondents to the issues under investigation. As a result, respondents may give special attention to these issues, which may influence their responses in the follow-up study.

Challenges and techniques

Besides the above-mentioned advantages and disadvantages, there are many challenges researchers encounter during the process of conducting longitudinal studies in military settings. We summarize the common challenges and provide some general techniques and tips to solve these problems.

How to determine the time intervals between the measurement points?

Longitudinal design fundamentally involves collecting data at multiple times, so first researchers must decide the number and time points of the measurements. The length of longitudinal research projects range between several days or weeks to many years. How the measurement occasions are defined can affect the efficiency of the study. The longer the period in which the study takes place, the more likely it is that some external changes occur possibly affecting the data collected. Individuals may also change over the course of data collection procedures. Therefore, the passage of time may cause changes in hypotheses or even research questions. It is assumed that at least three measurement occasions allow for an accurate estimate of change, but the more measurement occasions, the more accurate the estimation of change over time (Mroczek 2007; Ployhart and Vandenberg 2010).

Collins (2006) argues that theory informs about the appropriate time lag between measurements. For instance, different time points may be determined if change is assumed to be recurrent or to happen at specific moments. Additionally, a thorough literature search of previous studies will provide a reliable guideline in selecting time intervals. In practice, researchers need to choose time intervals according to their research purposes and in accordance with practical constraints such as costs, respondent burden, recall difficulties, and the frequency of transitions of interest.

In the illustrative study, measures were obtained at four points in time. The first measurement of MMPI-2 was conducted during the soldiers' first week in the military training camps, when they were acquiring basic military knowledge and skills. The researchers selected this period of time to measure MMPI-2 because one of the research goals was to test the predictive power of MMPI-2 on new recruits' adjustment of military life. As said, they then tracked the same respondents and asked them to finish the measurement of the army life adjustment survey three more times, at the 3rd, the 9th and 15th month after the new soldiers' formal incorporation into the military companies. The time intervals were selected based on prior literature of newcomers' adjustment, which gave a better view of the dynamic changes of new recruits' adjustment to military life. Moreover, equal spacing among time intervals has been suggested to be either optimal or close to optimal for all situations considered (Morrison 1970).¹

In the Dutch study, military personnel and their families were followed along the cycles of deployment to the operation abroad. The researchers aimed at collecting data at each stage of the deployment, that is, the preparation phase, the actual separation, and the reintegration phase. This was done in order to examine the specific challenges and experiences in each stage of the deployment as well as to assess changes in experiences, attitudes, and perceptions over time. The specific times of measurement were chosen on the basis of a literature review. For instance, literature suggests that service members' reintegration into family life after their return may be a turbulent time and that family functioning generally stabilizes within three months after the reunion. Therefore, the researchers chose to perform the final measurement three months after the return. The time intervals between the data waves were equally spaced and were four or five months, depending on the length of the deployment to the mission abroad (which varied between four and six months).

How to maintain study participation over time and deal with attrition problems?

Perhaps every researcher in longitudinal study has to cope with the problem of participants' attrition. The main causes of attrition are losing track of participants and refusal to continue to participate for various reasons, such as research fatigue. Particularly in military settings, keeping track of respondents over time is challenging as military personnel acquire other positions, move to other bases, or are sent abroad on a regular basis. Moreover, given the specific conditions in which they engage (e.g. challenging situations that require all their time and effort) and the amount of research attention already paid to military personnel, they may feel reticent about study participation or just may be research-tired. However, participant retention is crucial to the success of the study; high attrition rates threaten the internal validity and generalization of the study results. Therefore, researchers should include procedures to maintain participants' cooperation throughout the study.

Although attrition cannot be avoided, researchers can employ various techniques to keep track of respondents and to keep participants motivated and engaged with the study. In this way researchers can maximize retention and minimize non-response. Such techniques include

for instance sending a reminder letter or postcard (Welch et al. 2009); having personal contact between the data collections to obtain up-to-date address information and maintain interest in the study; keeping participants informed about the nature, purpose and progress of the study and sharing preliminary descriptive results (e.g. through websites, newsletters, or information packages); and providing incentives for participation (see for instance Hunt and White 1998 for a detailed discussion on tracking and retaining participants in longitudinal studies). Incentives that are valued by the respondents, such as a small cash award, a voucher or gift card, have been shown to have a positive effect on the response rate (Armstrong 1975).

In addition to encouraging participation and expressing appreciation for cooperation in the study, it is important that researchers foster participants' perceptions of the importance of the study. Moreover, researchers should disclose fully and clearly why participants' responses are valued and how the data will be used. Laurie et al. (1999) have delineated several important points, including quality control at all stages of the longitudinal study, a specified number of follow-up visits, telephone contact, and clarity of survey content. In addition, researchers can use a repeated cross-sectional design, revolving panel design, or multiple cohort panel design to prevent or reduce the problem of participant attrition (see Menard 2002 for details).

In the illustrative study conducted in the Chinese military, the researchers used their military contact and obtained approval for the study from the brigade commander and assistance from the new recruits' training company commanders. We explained to the respondents that the test was used for research purposes only. This top-down approach of getting access to the sample ensured the response rate to a certain extent; however, the attrition problem still existed because there was a conflict between data collection and the respondents' military duties.

Obtaining detailed information about the reasons for non-response helps understanding participant loss. Furthermore, non-response analysis is needed to assess whether those who dropped out along data collection procedures differ significantly from those who completed all measurements. Non-response analyses include: examining whether demographic characteristics differ at baseline and in follow-up data waves to see if non-response is selective; assessing whether respondents and drop-outs significantly differ on their scores on the study-variables at baseline; and examining whether the relations between the study-variables differ for respondents and drop-outs at baseline. It is important to realize that these non-response analyses are not solutions to the non-response problem, but rather means of attempting to reduce its biasing effect on the survey estimates. Detailed technical aspects of these analyses are beyond the goal of this chapter (see Kalton 1983).

How to deal with sensitivity and privacy issues in military research?

Confidentiality and anonymity are two distinct and very important concepts, which need to be considered by researchers in designing and managing the research project. The privacy of the study participants should be protected in any research, though it may require extra attention in longitudinal designs. Respondents are more likely to drop out or refuse to participate if they do not perceive their information to be held in confidence. For instance, in studies that aim at examining changes over time, the researcher needs to link or match individual data collected at multiple points in time. Usually, a code is used to be able to do this (we discuss this in more detail in the next section). Hence, in some cases one cannot claim that the research design is strictly anonymous. If a study is completely anonymous, it is impossible for the researcher to link the data to an individual. Similarly, if face-to-face or telephone interviews are conducted, the researcher knows who provided the data.

Thus, researchers should ensure confidentiality and inform research participants about the procedures of data collection and the use of data. It is wise to receive both individual informed consent and institutional approval when conducting a study in military settings.

Researchers should also explain and make sure that personal information of the participants, such as names and home addresses – necessary for the researcher to collect data of the same respondents at multiple points in time – are kept in a safe place, which is only accessible to the researcher and that the information will be destroyed once the research will have been completed. Moreover, in the dissemination of the study results, researchers should make sure that data or information cannot be traced to individuals on the basis of demographic characteristics. In military settings, this means being careful when presenting results while providing for instance information about gender, rank, and unit. When the number of individuals who meet that profile is very small (e.g. one female general in unit X), readers of the research report may easily identify the person who provided that particular information.

In the illustrative study, the researchers randomly grouped 326 new recruits into 10 teams. Surveys were distributed in each team with the standardized instructions. Participants were explained that the test was used for research purposes only and that the results would be interpreted at the aggregated level. The researchers emphasized that individual responses were kept confidential, so that respondents would have less evaluation apprehension and provide answers as candidly as possible.

In addition to the aforementioned ethical issues on anonymity and confidentiality, some research projects deal with sensitive topics. These topics may be central to the research objectives, but are perceived by participants as private or may produce some kind of risk or conflict (Lee 1993). Demonstrative of this issue is the study conducted among families of military personnel (e.g. Andres et al. 2012 a/b). Family issues such as the quality of family relationships are typically perceived to be private and personal. Hence, family members were approached with prudence and the researchers emphasized that participation in this study was voluntary and that one was free (not) to answer any question. Participants were reassured confidentiality in the introduction of the questionnaire and again when introducing the sensitive topics.

Sensitive questions should not be asked at the beginning of questionnaires; it is better to include these near the end. Respondents should be drawn into the process with easy and comfortable questions and become committed to complete the questionnaire. When research includes sensitive topics, researchers should be conscious of the methodological issues. For instance, participants may react differently to sensitive topics: they may be reluctant to answer the questions honestly if they are afraid of possible negative consequences, or they may be reluctant to answer sensitive questions at all.

How to match data across time?

One important goal of longitudinal research is to examine dynamics, changes and developments in behaviors or attitudes over time. Therefore, researchers may need to match data collected at multiple points in time. Several techniques can be applied to do this. Using identification codes (i.e. giving respondents a numerical designation) is a commonly used procedure in longitudinal research (Lee 1993). In the illustrative study, researchers got the roster of all the new recruits in a Chinese military garrison. They assigned a unique code to each new recruit, and pre-typed the code on the questionnaire before distributing the survey. This unique code was kept the same and used in the follow-up surveys in order to keep track of each participant and match their responses. Similar procedures were used in the Dutch study among military personnel and

their families. The codes in this study were constructed by the researcher and only known by her. By using an invented code, rather than soldiers' registration numbers for instance, there were no chances that answers could be traced back to identifiable individuals by anyone other than the researcher. The codes solely allowed the researcher to re-contact respondents on subsequent data waves to send follow-up surveys and to link the data collected during the different data waves. The link between the codes and the personal information of the respondents was kept in a separate and secure place, accessible only to the researcher, and destroyed once the data collection was completed. The purpose of the identification codes was expounded in the accompanying letter.

Another strategy is to let the participants generate their own unique code (e.g. Yurek et al. 2008). They need to receive clear and specific instructions in order to make sure that the code will be unique for each participant and the same at each data wave. Usually, the code is a combination of personal information (letters and numbers/dates; see Yurek et al. 2008 for an example). Although errors and omissions can occur, this strategy is more anonymous, as the researcher is unable to link the data to an individual, though is able to link the data across time points.

How to analyze the longitudinal data?

Longitudinal studies usually generate large amounts of data and various techniques can be applied to analyze the data (e.g. Singer and Willett 2003), depending on the research questions to be answered, the assumptions of the statistical tests, and the presence of missing data. In longitudinal research, missing data is quite common. Respondents may drop out in the course of data collection or, for instance in the case of sensitive topics, may leave certain questions unanswered. Researchers should decide how to deal with missing data. Various approaches exist: there is not one best method (see for instance Menard 2002 for a detailed description; Collins 2006). Furthermore, if necessary or preferred, weight variables could be used to mitigate under-representation of certain groups of people (Ruspini, 2000), such as service members in certain ranks.

Exploratory quantitative data analyses may focus on assessing means and standard deviations to see if the scores on the variables significantly differ at different points in time. Furthermore, exploratory analyses usually include analyses of correlations to assess (a) cross-sectional correlations between the different variables at each data wave, (b) correlations between the same variables at different data waves (i.e. stabilities or autocorrelations), and (c) longitudinal or cross-lagged correlations between the different variables at different data waves. Subsequently, hierarchical regression analyses can be performed to examine cross-sectional and longitudinal predictors of (change in) the dependent variable. Control variables must be included in the first step. In the next steps, one can include the dependent variable at Time 1, the independent variables at Time 1, and the independent variables at Time 2; to examine whether changes in the dependent variable are related to changes in the independent variable (Zapf et al. 1996). In order to assess or rule out reverse causation, that is, whether Y may also influence X, one can perform the same procedure, treating the independent as the dependent variable and the dependent as the independent variable.

Researchers should be aware that when they measure the same individuals repeatedly, the observations are not independent. The repeated observations in longitudinal studies are usually (positively) correlated. The sequential nature of the measures also indicates that certain types of correlation structures may arise. Therefore, longitudinal data often requires more sophisticated statistical techniques to address the issues of linear dependence and autocorrelation of variables

(see Singer and Willett 2003 for a review). Structural equation modeling (SEM) techniques are popular to analyze longitudinal data in order to control for the measurement errors across measurement occasions (Chan and Schmitt 2000; Lang et al. 2011). A popular method for the analysis of longitudinal data is Hierarchical Linear Modeling (HLM, see Porter and Umbach, 2001). In the Chinese illustrative study, researchers adopted the latent growth modeling (LGM) approach to examine the longitudinal predictive power of MMPI-2 on new recruits' adjustment. There are a number of advantages to using LGM for modeling individual differences in change trajectories such as initial status and change functions (see Chan and Schmitt 2000 for a detailed review).

Conclusion

Conducting longitudinal research is a complex and time-consuming process. It has several advantages over cross-sectional designs. However, being aware of the purpose of longitudinal research and the advantages and disadvantages, researchers should consciously consider which design is necessary for meeting their objectives, and how to tackle potential problems associated with their research design.

Although we mainly focused on quantitative longitudinal research, longitudinal research designs can also be qualitative. Depending on the study objectives, researchers can choose for either a quantitative or qualitative approach, or a combination of the two. Where longitudinal quantitative research designs usually aim at measuring the extent of change and what factors are related to the change, a longitudinal qualitative research design can provide a deeper understanding of why change occurs and how the factors or mechanisms that produce change operate (Molloy et al. 2002). Just as in cross-sectional designs, a mixed-method longitudinal design can be a powerful mix, and provide complementary insights.

Note

- 1 There are different opinions regarding the necessity of ensuring equal spacing in measurement occasions (see Mitchell and James, 2001). We suggest it is more important that measurement occasions occur with enough frequency to be able to detect the hypothesized changes.

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