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PANEL ATTRITION IN NEPS STARTING COHORT 6

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An Analysis of Survey Participation, Refusals and Non-contacts in Waves 2 to 7

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Panel Attrition in NEPS Starting Cohort 6. An Analysis of Survey Participation, Refusals and Non-Contacts in Waves 2 to 7.[1]

Abstract

In this paper, we describe panel attrition processes of the National Educational Panel Study Starting Cohort 6 (NEPS-SC6) to provide a comprehensive and easily accessible overview of changes in realized sample size and composition with respect to key variables from wave 2 to wave 7, based on the scientific-use file 7.0.0. First, we describe changes in the size and composition of the NEPS-SC6 subsamples over time with respect to the key variables of the NEPS adult survey: educational attainment, reading competence, employment status, income, migration background, employment status and socio-economic status. Second, we estimate multinomial logit models predicting the probability of interview participation, refusal, and non-contact in follow-up waves after the first interview for the different NEPS-SC6 subsamples. Here, we control for the NEPS core variables as well as for other respondent characteristics, respondents' previous interview experiences and interviewer characteristics. Both aspects – the detailed description of the realized subsamples by subgroups with respect to the key variables and the differentiation of nonresponse by refusals and non-contacts – complement the official weighting report of the NEPS-SC6 scientific use files by Hammon, Zinn, Aßmann and Würbach (2016) who focus on the documentation of sample sizes and on the calculation of weights predicting response and nonresponse.

Keywords

Panel attrition, NEPS starting cohort 6, nonresponse bias, key survey variables

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1. Introduction

The aim of this paper is to describe panel attrition processes of the National Educational Panel Study (NEPS) adult cohort (Starting Cohort 6, SC6)[2]. In this context, we analyse changes in the composition of wave 2 to 7 samples of the NEPS adult cohort and examine determinants of non-contacts and refusals.

The main objective of NEPS is to collect data about educational processes and competence development from early childhood to late adulthood. NEPS is thus not a single study, but a system of six parallel panel studies, which cover different age groups (for an introduction, see Blossfeld and von Maurice, 2011). The adult cohort comprises the oldest participants of the NEPS, people of working age. Thus, it targets people living in private households in Germany, who are born between 1944 and 1986 (Allmendinger et al., 2011; Zinn, Aßmann and Würbach, 2015). It aims at observing educational trajectories and employment biographies, participation in adult education, returns to education, as well as assessing competence development in adult life. In our analyses, we thus focus on compositional changes in the process of panel attrition with regard to the core variables of the adult study: participants' educational attainment, competencies, employment status, income, migration background and socio-economic status.

Panel attrition arises from permanent or temporary dropout of panel members. In this context, the synonyms panel mortality or panel selectivity are often used. In general, panel attrition is a form of unit nonresponse in panel studies, which means the failure to obtain subsequent information from a sample member (Haunberger, 2011). In detail, panel attrition is not a well-defined term. Lugtig (2014), for example, regards panel attrition as the permanent dropout of a sample member from a panel study, i.e. the failure to obtain any information about an initially cooperative panel member in a certain wave and all subsequent waves. In contrast, Behr, Bellgardt and Rendtel (2005) subsume temporary dropouts under panel attrition as well. A temporary dropout is defined as a sample member who does not participate in a particular wave but in one or more subsequent waves. We follow the latter understanding of the term panel attrition and consider permanent dropouts as well as temporary dropouts.

Panel attrition may cause several problems: on the one hand it reduces sample size and therefore the statistical power and precision of estimates. On the other hand, it may induce biased estimates if respondents and nonrespondents differ in certain characteristics, that is, if attrition is not completely at random (Groves, 2004; Haunberger, 2011). Note that we do not want to investigate nonresponse bias in the initial interview of sample members, which arises from systematic differences between the target population and the realized sample. In the NEPS study, individuals belonging to the initial target sample, who did not participate in the first NEPS wave, were regarded as permanent dropouts and thus were never contacted again. In later waves, individuals who fail to respond in two or more subsequent waves without explicitly showing the will to participate (e.g. by making an appointment) are regarded

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[2] This paper uses data from the National Educational Panel Study (NEPS): Starting Cohort Adults, doi:10.5157/NEPS:SC6:7.0.0. From 2008 to 2013, NEPS data was collected as part of the Framework Program for the Promotion of Empirical Educational Research funded by the German Federal Ministry of Education and Research (BMBF). As of 2014, NEPS is carried out by the Leibniz Institute for Educational Trajectories (LIfBi) at the University of Bamberg in cooperation with a nationwide network.

as permanent dropouts. Thus, the NEPS does not try to track all members of the initial target sample in every wave regardless of their response behaviour in previous waves.

Nonresponse bias in the first survey wave was examined by Kleinert, Ruland and Trahms (2013). Comparing the respondent characteristics of the realized sample with data from the *Mikrozensus*, they found, amongst others, a bias regarding education, age and migration background. Individuals with low education are underrepresented whereas academics are overrepresented. Furthermore, older (aged 40 to 50) and younger persons (aged around 20) and participants with migration background are underrepresented.

Bias due to nonresponse can be considered in analyses by weighting data. To this end, Hammon, Zinn, Aßmann and Würbach (2016) provide weights based on multivariate analyses on response probability in initial and subsequent waves, which are documented in the official weighting report of the NEPS-SC6 scientific-use file.[3] They find that particularly younger, umarried and lower educated participants, and participants with a non-German mother language have a lower response probability. Additionally to these official results, Kleinert, Christoph and Ruland (2015) report that sample members with lower competence proficiencies have a lower response probability in subsequent waves. Analysing panel attrition in the third wave of the NEPS adult cohort, Hoch (2013) finds that respondents generally have a higher probability of staying in the panel the more cooperative they were in the previous NEPS wave. In order to differentiate between contactability and cooperation Hoch (2013) also provides results obtained from a multinomial logistic regression model. Whereas respondents' education, survey mode and cooperation in the previous wave seems to influence both cooperation and contactability, age and household size only play a role when it comes to contacting the participant and migration background only influences cooperation.

We take these results as a starting point for our survey paper. Our analyses complement previous findings, because we are able to assess the impact of NEPS key variables on survey participation for five NEPS-SC6 waves. Since many research questions analysed with NEPS data are related to key survey variables such as participants' educational attainment, competence proficiencies and migration background as well as returns to education like employment status or income, we provide an overview of the change of the composition of later wave samples regarding these variables.[4] This comprehensive and easily accessible overview of realized sample size and changes in sample composition with respect to key variables from wave 2 to wave 7[5] complements the documentation of nonresponse by Hammon, Zinn, Aßmann and Würbach (2016). A further contribution of our paper is that we secure our findings about the relationship between interview participation and NEPS key variables with

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[3] For initial waves, they consider variables that are available for every sample member like birth year, sex and residence. For subsequent waves, they also consider information provided by survey data like marital status, household size, income and educational attainment.

[4] Another NEPS-SC6 target variable, participation in adult education, is not included, because studies suggest that reporting of participation may be affected by panel conditioning (Warren & Halpern-Manners, 2012).

[5] The scientific use file (SUF) only contains data about sample members who participated at least in one NEPS wave. For NEPS participants from the prequel study ALWA *(Arbeiten und Lernen im Wandel)*, the SUF also provides data from the ALWA study. In the following, we follow the NEPS data provision logic, which counts the ALWA study (2007/08) as wave 1, the first NEPS wave (2009/10) as wave 2 and so on. Since the SUF does not contain the complete set of realized interviews from the ALWA study (wave 1), we confine our analyses to NEPS waves 2 to 7.

multivariate analyses, differentiating nonresponse by refusal and non-contact. This is also done by Hoch (2013), but only for one wave.

In the next section we give an overview over previous findings on attrition in panel studies. In section 3 we describe the sample and design of the NEPS-SC6, the data and the analysed sample characteristics in more detail. Section 4 contains the descriptive and multivariate results and section 5 gives a short synopsis of our findings.

2. Previous research on panel attrition and relevance of this paper

The phenomenon of attrition has been studied for a variety of German and European panel studies, for example for the *European Community Household Panel* (ECHP; Behr, Bellgardt, & Rendtel, 2005), for the *Panel Analysis of Intimate Relationships and Family Dynamics* (pairfam; Müller & Castiglioni, 2015), for the Panel *Labour Market and Social Security* (PASS; Trappmann, Gramlich, & Mosthaf, 2015), for the *German Socio Economic Panel* (SOEP; Kroh, 2014) and for the *Swiss Household Panel* (SHP; Lipps, 2007; Vandecasteele & Debels, 2007). As diverse as the mentioned panel studies are, as diverse are the variables that are investigated as factors which might influence panel attrition.

Depending on the authors either three or four groups of factors that have been shown to correlate with panel attrition can be identified (Haunberger, 2011; Kleinert, Ruland, & Trahms, 2013; Watson & Wooden, 2009): respondent characteristics and their previous survey experiences, survey characteristics and interviewer characteristics. Respondent characteristics are understood to be sociodemographic features such as age, sex, socioeconomic status, education and income (e.g. Haunberger, 2011; Hoag, 1981; Schräpler, 2000). Haunberger (2011) also subsumes household characteristics (mobility, size, number of children, age composition) and residence characteristics (size of community, crime rate; Couper & Groves, 1996) under respondent characteristics. Respondent experiences comprise experiences with previous panel waves such as cooperation and fatigue in the previous interview, item nonresponse in the previous interview or mode and length of the previous interview (Watson & Wooden, 2009). Survey characteristics include the sponsor and purpose of the study (Fox, Crask, & Kim, 1988), data privacy statements (Singer, von Thurn, & Miller, 1995), if there are advance notices and reminders and if these are personalized (de Leeuw, Callegaro, Hox, Korendijk, & Lensvelt-Mulders, 2007) and incentives (Berger, 2006). The survey design is also part of this group of factors (Hox & de Leeuw, 1994): survey mode, presence of an interviewer, amount of social interaction, invasivity, medium of presentation and answering and method of contact may play a role. If present, also interviewer characteristics may influence attrition (Haunberger, 2010), for example sociodemographic characteristics, personality, social skills, experience, motivation, attitudes and – especially in panel studies – if it is the same interviewer as in previous waves.

Despite the fact that attrition studies often have to rely on observable correlates of participation such as respondent or survey characteristics, it is interesting to think about the mechanisms that underlie these correlations: What causes differences in the participation resp. dropout behaviour between different population groups? Considering, for example, the finding that education is positively correlated with participation probability (see Haunberger, 2011, and references therein) Goyder (1985) argues that individuals with higher education are more likely to understand the scientific value of surveys, are more interested in the topics covered and relate more strongly to the interviewers that are mostly from higher educated

population groups themselves. People with long working hours, in contrast, are rarely at home and thus have a lower chance to be contacted in personal interviews. Even when interviewers reach this group, time restrictions make them more unwilling to arrange an interview date than other groups of workers.

But why should we investigate panel attrition at all? If those who do not participate either because they cannot be reached or because they refuse to participate would not differ from those who participate regarding their answers, that is, if dropout would be completely at random, there would indeed be hardly any reason to study it. Estimation would be less efficient and precise due to a lower number of cases but unbiased, and the validity of results would not be impaired. If, in contrast, respondents and nonrespondents differ in certain characteristics, results cannot be generalized and conclusions might be wrong (Groves, 2004; Haunberger, 2011). These problems apply to all kinds of unit nonresponse, in cross-sectional as well as in longitudinal studies.

Nevertheless, there are several differences between cross-sectional studies or first waves of panel studies and subsequent waves of panel studies. Schnell (1997) states that non-contactability is a less important factor for nonresponse than refusal in subsequent waves of panel studies. This is plausible because original contact details or even the name and address of a person informed about the whereabouts of the target person are known in later panel waves. Moreover, Groves & Couper (1998, p. 23) "suspect that the length of the initial wave's interview, the sensitivity of questions in the first wave interview, the cognitive demands of the respondent task in the first wave interview, and the rapport built with the first wave interviewer make the process of continued cooperation in a longitudinal survey quite distinctive from that of granting first time survey requests." Furthermore, in subsequent waves of panel surveys "respondents are likely to base their decision to participate on their experiences in the first wave" (Groves & Couper, 1998, p. 49 f.). This is why nonresponse in first waves and subsequent waves of panel studies should be analysed and interpreted separately. Hoag (1981) comes to a very similar conclusion. Her investigation of several smaller-scale panel studies in Germany shows that there are substantial differences between the realized sample in the first wave and the realized samples in subsequent waves. Therefore, a panel study should not be regarded as a repeated questioning of the same random sample; in fact, a distillation process takes place–particular in later stages of a panel as in NEPS-SC6.

However, this distillation process does not necessarily impair the representativeness of the survey results, but it depends on the outcome variables of interest. As results based on *ECHP* data suggest, attrition bias occurs with regard to social class and education (Vandecasteele & Debels, 2007) but not to income (Behr et al., 2005). Also, Fitzgerald, Gottschalk, and Moffitt (1998) find substantial attrition in the *Michigan Panel Study of Income Dynamics* but it induces only a low bias. Panel attrition could even lead to a decrease in the initial nonresponse bias in panel studies, as Rendtel (2013) points out. Note, however, that this paper does not intend to analyse the bias induced or diminished by attrition, but to describe and explain the changing composition of the sample throughout the NEPS waves.

Nevertheless, for researchers working with NEPS-SC6 data it is important to know who stays in the panel and who drops out at some point to be able to assess whether their substantial results could be biased. As already mentioned above, selective dropout can be corrected using weights. Based on selectivity analyses, cross-sectional and longitudinal weights for the adult

cohort of the NEPS are provided in the NEPS SUF and therefore can be easily implemented. The weighting scheme for waves 2 to 6 is described in detail in Hammon, Zinn, Aßmann and Würbach (2016). The surplus of our analyses is threefold: First, we provide detailed descriptive analyses regarding the NEPS key survey variables. This inspection of sample sizes will help researchers to estimate whether subgroups are represented in sufficient numbers in particular waves. Namely, we will present descriptive results for educational attainment, reading competency, migration background, income, employment status and socio-economic status. Second, our analyses help to evaluate survey bias when the longitudinal weights provided in the NEPS-SC6 scientific use file cannot be applied, which often is the case when analytical samples consist of population subgroups or are composed from different waves or points in time. Third, in our multivariate analyses we adopt state-of-the-art approaches to identify factors that decide about contactability and cooperation using multinomial logistic regression models. We go beyond previous research by introducing the NEPS key target variable 'reading competency'.

3. Data and methods

3.1. NEPS-SC6: Sample, design and analysis data

NEPS-SC6 represents people who live in private households in Germany, who were born between 1944 and 1986. The sample was drawn from German resident registers in a two-stage process: first, a German-wide representative sample of communities was selected, and second, from the registers in these communities addresses from members of the target groups were drawn randomly (for a detailed description of sampling, see Aust et al. 2011).

The study consists of three subsamples. The first subsample (*ALWA*) are participants of the study *Arbeiten und Lernen im Wandel (Working and Learning in a Changing World)* which was conducted by the Institute for Employment Research (IAB) in 2007/08 (Kleinert et al., 2011). Participants of the ALWA study, who agreed to be contacted again, were part of the initial sample of NEPS starting cohort 8.[6] The second subsample (*NEPS1*) comprises a refreshment sample covering the same birth cohorts as the ALWA sample (1956 to 1986) and an augmentation sample covering older respondents born from 1944 to 1954. Both of these subsamples form the initial NEPS sample, which was interviewed for the first time in 2009/10 (NEPS wave 2). Subsequently, respondents were interviewed in yearly intervals. In wave 4, (2011/12), another refreshment sample was drawn (*NEPS2*), which covers the whole range of birth cohorts from 1944 to 1986.

In NEPS-SC6 interviews are conducted annually in a mixed-mode design – either as computer assisted personal interviews (CAPI) or as computer assisted telephone interviews (CATI). In wave 2 and later waves with even numbers the default mode is a computer assisted telephone interview. In every odd-numbered wave competence assessments take place and therefore data are collected mainly by computer assisted personal interviews. In wave 3, ALWA and NEPS1 participants were randomly assigned to take part either in the reading assessment, or in the mathematics assessment, or in both tests. In wave 5 participants from the ALWA and NEPS1 subsamples were asked to take part in assessments on scientific literacy and information and communication literacy. Participants from the NEPS2 subsample were asked

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[6] As for the scientific use file, the ALWA study is counted as wave 1.

to take part in the same reading assessment as ALWA and NEPS1 participants in wave 3. In order to keep attrition at bay, persons who refuse the personal interviews are contacted again via telephone and asked the same questions as in the personal interview, albeit without the assessments.

For our analyses we use the Scientific Use Files Release 7.0.0 (doi:10.5157/NEPS:SC6:7.0.0). These files include data from first seven NEPS waves of starting cohort 6. We use this data to perform attrition analyses for wave 3 to 7 for the ALWA and NEPS 1 subsamples and for wave 5 to wave 7 for the NEPS 2 subsample. An attrition analysis for the ALWA subsample from wave 1 to wave 2 is not possible, because the SUF does not contain information on individuals that have either not agreed to be contacted again after wave 1 or have never completed an interview in later waves. For a detailed analysis of nonresponse bias and selectivity in the ALWA study see Kleinert, Ruland and Trahms (2013).

3.2. Variables

The focus of our analyses is on NEPS-SC6 key survey variables, which represent specific respondent characteristics: educational attainment, competence proficiency, migration background, income, employment status and socio-economic status. Bias in these variables is particularly detrimental because many research questions analysed with NEPS data refer to these characteristics.[7]

For measuring **educational attainment** we use the CASMIN classification. For each participant, the highest educational attainment at the time of the first interview is identified. The CASMIN classes are then collapsed into five categories: (1) participants with at most medium schooling *(Mittlere Reife)* without vocational training certificate, (2) participants with lower schooling *(Hauptschulabschluss)* plus vocational training certificate, (3) participants with medium schooling plus vocational training certificate, (4) participants with university entrance certificate *([Fach-]Hochschulreife)* and (5) participants with higher education, i.e. a university or university of applied science degree.

The scientific use files provide Weighted Maximum Likelihood Estimates (WLE) for **reading and math proficiency**. For both competencies, we classify these WLEs into three groups using terciles. Note that the reading proficiency results originate from wave 3 for the ALWA and NEPS1 subsamples and from wave 5 for the NEPS2 subsample. Math proficiency results are only available for the ALWA and NEPS1 subsamples and originate from wave 3. A fourth category consists of individuals who refused the test but conducted an interviews, and a fifth one includes persons for whom the test was not administered. While descriptive tables are provided for reading competencies only, we include a combined metric measure for reading and math proficiency in the multivariate models. Non-participants in the assessments get assigned the value 0. An additional dummy variable indicates non-participation in the test(s).

Persons are classified to have no **migration background** if both they themselves and their parents were born in Germany. Individuals with migration background are classified into first

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[7] Besides, respondents' sex and birth cohort are important demographic characteristics. Therefore we report the trends in distribution over time in Tables and Figures in the Appendix.

generation migrants who were born abroad and second generation migrants who were born in Germany and have at least one parent born abroad (Olczyk, Will and Kristen 2014).

Three survey variables, all measured at the time of the first interview, indicate important returns to education: Regarding respondents' main **employment status** we distinguish seven groups: education, employment, unemployment, family care, retirement, other, and no information available. For cases with parallel activities at the time of the first interview only one status is chosen. For this selection, we sort main activities before side activities. If several of them are performed simultaneously, we use the following (descending) rank order to choose one state: military and other state service, schooling, vocational training, vocational preparation, unemployment, parental leave, other activities, employment.

The respondents' **socio-economic status** is represented by the International Socio-Economic Index of Occupational Status 2008 (ISEI-08; Ganzeboom, 2010). If participants were not employed at the time of the first interview, the last ISEI score before the first interview is used; if they were never employed, we assign them an ISEI score of 0. If participants held several jobs simultaneously, the highest ISEI score is used. For the descriptive analyses the values are classified using terciles. We do not include this indicator in the multivariate models due to its relatively high collinearity with educational attainment and income.

Furthermore, we show results for the net equivalence **household income** according to the OECD square root scale (OECD, 2013), which requires the monthly household net income to be divided by the square root of the number of household members. For the descriptive as well as for the multivariate results, the resulting monthly equivalence income is classified into groups for less than 1,250 EUR, 1,250 EUR to less than 2,500 EUR, and 2,500 EUR or more. These groups are based on the distribution of the net equivalence income in Germany in 2014 (75% resp. 150% of the median net equivalence income; Statistisches Bundesamt, 2016). A forth groups indicates persons who refused to state their income.

In a second step, we estimate the likelihood of interview participation in every wave based on the mentioned survey key variables of interest with multinomial logistic regressions. Here, we use a categorical dependent variable indicating whether a person had completed an interview in the respective wave, was contacted in the respective wave but did not complete an interview, or could not be contacted. This approach differs from the calculation of NEPS-SC6 weights which are based on logistic regression models with a dichotomous outcome: response and nonresponse (Hammon, Zinn, Aßmann and Würbach, 2016). Persons who were ineligible[8] in a particular wave are excluded from our analyses.

Besides the mentioned key survey variables described above, we include several control variables in our models. First of all, we control for further respondent characteristics, namely broad groups of cohort, sex, household composition as well as municipality size, again all measured at the time of the first interview. Second, we measure respondents' experiences with previous NEPS-SC6 interviews. Here we use cooperation and fatigue in the previous interview (both rated by the interviewer) as well as item-nonresponse in the previous wave

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[8] Persons are classified ineligible if they died, moved abroad, were out of the sample or had been already interviewed. These response codes concern only few cases, at most 39 persons per wave and subsample.

(in % of total number of items). Third, we include interviewer interviewers' experience, age, and education.

We estimate multinomial logit models separately for each wave and subsample. As we are interested in panel attrition, we confine our analyses to follow-up waves in the different subsamples. Since we have no information on the complete wave 1 sample in the ALWA subgroup, we start these models with wave 3. To account for the fact that interviewers usually conduct a large number of interviews and thus might influence response jointly, standard errors are calculated using a robust sandwich variance estimator, which takes intragroup correlation into account. In order to compare effects between models, results are displayed using average marginal effects (AME).

4. Results

4.1. Describing attrition in NEPS

4.1.1. General trends in sample size

All in all, 17,140 individuals completed at least one NEPS interview. Numbers of realized interviews by wave and subsample are presented in Figure 1. All following sample sizes are based on the scientific use files provided for the NEPS-SC6.[9]
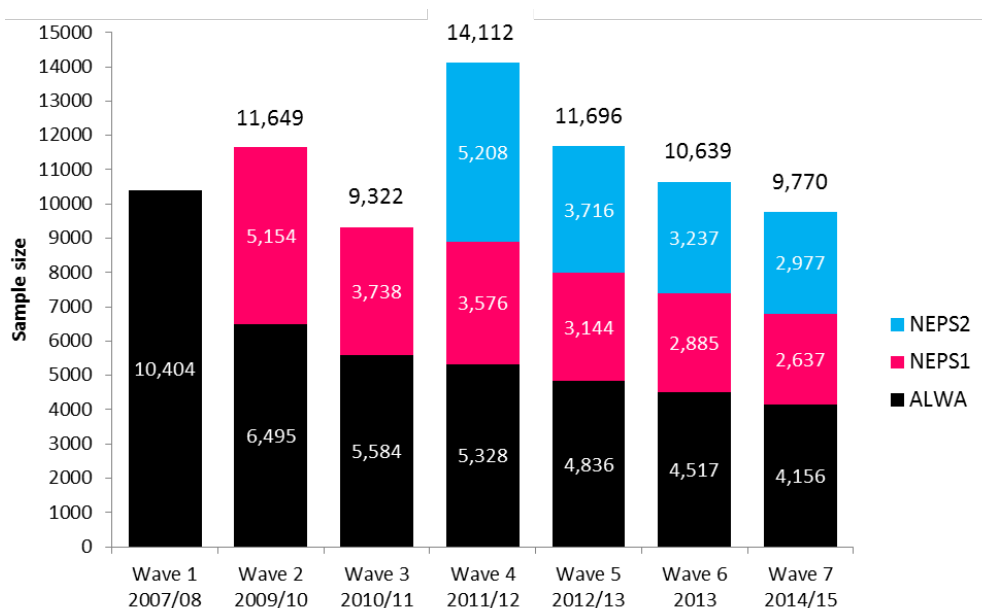
Figure 1. Number of completed interviews per wave by subsamples

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[9] In the following, numbers of realized interviews are reported for educational attainment, reading and math proficiency, migration background, employment status, socio-economic status, and household income.The corresponding SUF variables are tx28101 (educational attainment), rea3_sc1 and rea5_sc1 (reading competence), maa3_sc1 (math competence), t400500_g1 (migration background), ts23201_g14 (socio-economic status), and t510010_g1 and t510010_v1g1 (household income). Employment status is determined from the spell type (sptype) in the episode split of the biography data (for details, see Rompczyk and Kleinert 2017). .

The relative development of sample size per subsample is depicted in Figure 2. In all three groups the drop in sample size is highest from the first to the second interview wave. It is particularly high in the ALWA subsample, which might be due to several reasons: (1) the longer time interval between the first and second survey wave, (2) less investment in panel maintenance from wave 1 to wave 2, and (3) the younger age structure. The ALWA subsample only includes cohorts born in between 1956 and 1986, while the two NEPS subsamples additionally observe older persons, who were born from 1944-1955, and usually are easier to reach and more likely to participate in surveys.

In subsequent follow-up waves survey size drops without a clear pattern. A striking difference between the subsamples is the considerable lower dropout in the second follow-up wave in the NEPS2 subsample compared to ALWA and NEPS1. These differences result in highly different attrition rates in the three samples over time. Finally, there is slight evidence that attrition is a bit higher in uneven survey waves (3, 5, and 7), in which respondent burden is particularly high due to competence assessments and personal interviews, than in even survey waves, which are shorter and primarily conducted via telephone.
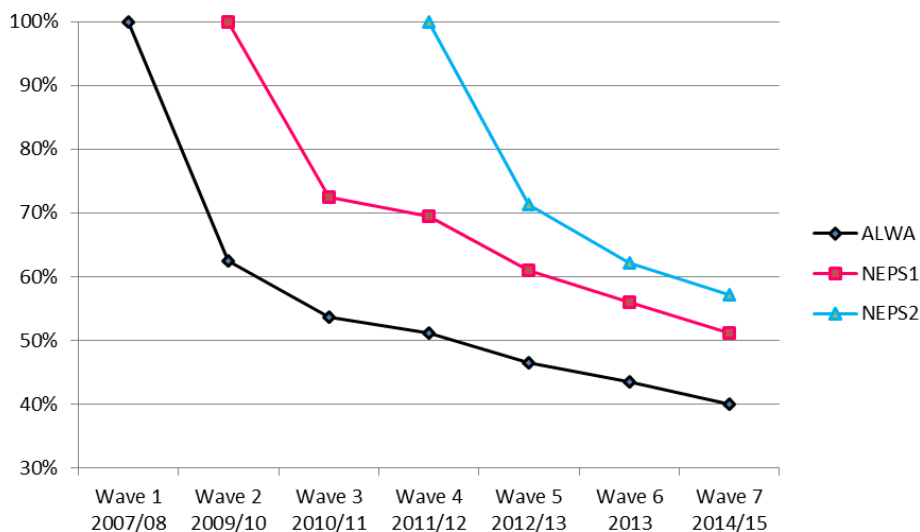

Figure 2. Relative trend in survey participation by subsamples

In the following sections trends in sample size are broken down for six key survey variables. For each variable, we provide the same information: (1) a table which shows numbers and percentages of subsample participants according to the respective key variable by survey wave, and (2) a figure which depicts relative panel attrition among key variable group members based on the first interview, again separately for all three subsamples. In these figures, we assume the dropout rates from wave 1 to wave 2 in the ALWA subsample to be the same in all three groups of migration background, corresponding to the overall attrition. This assumption is necessary because the complete wave 1 data are not included in the NEPS SUF. Later attrition rates are calculated by deriving the relative attrition rate based on wave 2 and by multiplying (weighting) this rate with the overall wave 1-wave 2 attrition rate. Note that due to this limitation relative attrition rates in the ALWA subsamples do not necessarily reflect the true relative attrition rates based on the complete wave 1 sample, but are likely to understate the true increase in nonresponse bias.

4.1.2. Educational attainment

Table 1 shows survey participation by highest educational attainment at the time of the first interview. A comparison of the realized sample in wave 2 with *Mikrozensus* data shows an initial bias regarding education: individuals with lower education are underrepresented in NEPS wave 2 (Zinn et al., 2015). This initial bias is particularly high in the ALWA subsample: Here, the shares of persons with university entrance degree are considerably higher than in the other two subsamples and the share of individuals in the two lowest educational groups is lower. Kleinert et al. (2013) suspect this to be due not only to differential willingness to participate, but also to a different diffusion of landline connections among educational groups. Distributions of educational attainment are comparable in the two NEPS subsamples. NEPS2 participants are a bit higher educated than NEPS1 participants, which might reflect their older age at first interview time.

Table 1. Trends in participation by educational attainment at first interview (N, *%*)

		Wave 2	Wave 3	Wave 4	Wave 5	Wave 6	Wave 7
		2009/10	2010/11	2011/12	2012/13	2013/14	2014
ALWA	Max MR w/o traing	358	279	269	239	213	186
		5.5	*5.0*	*5.0*	*4.9*	*4.7*	*4.5*
	Hauptschule with training	830	704	642	561	521	471
		12.8	*12.6*	*12*	*11.6*	*11.5*	*11.3*
	Mittlere Reife w training	2,091	1,786	1,707	1,55	1,446	1,326
		32.2	*32.0*	*32.0*	*32.1*	*32.0*	*31.9*
	Abitur	1,583	1,366	1,304	1,191	1,103	1,029
		24.4	*24.5*	*24.5*	*24.6*	*24.4*	*24.8*
	University	1,628	1,446	1,404	1,292	1,231	1,141
		25.1	*25.9*	*26.4*	*26.7*	*27.3*	*27.5*
	Missing	5	3	2	3	3	3
		0.1	*0.1*	*0*	*0.1*	*0.1*	*0.1*
	Total	6,495	5,584	5,328	4,836	4,517	4,156
		100.0	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*
NEPS1	Max MR w/o training	485	308	282	240	210	190
		9.4	*8.2*	*7.9*	*7.6*	*7.3*	*7.2*
	Hauptschule with training	1,343	949	887	766	672	612
		26.1	*25.4*	*24.8*	*24.4*	*23.3*	*23.2*
	Mittlere Reife w training	1,407	1,016	957	846	779	714
		27.3	*27.2*	*26.8*	*26.9*	*27.0*	*27.1*
	Abitur	694	519	517	453	428	393
		13.5	*13.9*	*14.5*	*14.4*	*14.8*	*14.9*
	University	1,207	938	927	834	794	725
		23.4	*25.1*	*25.9*	*26.5*	*27.5*	*27.5*
	Missing	18	8	6	5	2	3
		0.3	*0.2*	*0.2*	*0.2*	*0.1*	*0.1*
	Total	5,154	3,738	3,576	3,144	2,885	2,637
		100.0	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*

Table 1. continued

		Wave 2 2009/10	Wave 3 2010/11	Wave 4 2011/12	Wave 5 2012/13	Wave 6 2013/14	Wave 7 2014
NEPS2	Max MR w/o training			391	242	188	166
				7.5	*6.5*	*5.8*	*5.6*
	Hauptschule with training			1,150	807	665	618
				22.1	*21.7*	*20.5*	*20.8*
	Mittlere Reife w training			1,582	1,146	1,016	933
				30.4	*30.8*	*31.4*	*31.3*
	Abitur			825	589	521	477
				15.8	*15.9*	*16.1*	*16.0*
	University			1,249	926	845	781
				24.0	*24.9*	*26.1*	*26.2*
	Missing			11	6	2	2
				0.2	*0.2*	*0.1*	*0.1*
	Total			5,208	3,716	3,237	2,977
				100.0	*100.0*	*100.0*	*100.0*

Figure 3 shows that in all three subsamples dropout rates are highest among the two lowest educated groups and lowest among higher educated persons. Two factors might contribute to the fact that relative panel attrition seems to be higher in the two NEPS subsamples than in the ALWA subsample: First, their initial educational selectivity is lower, and second, the differential dropout behaviour between the educational groups may be concealed in the ALWA subsample, because we cannot calculate attrition by education in wave 2 here. In all the following figures (except for Figure 4) the calculation of relative attrition in the ALWA subsample differs from the two NEPS subsamples. Thus trends in relative attrition cannot be compared between them.
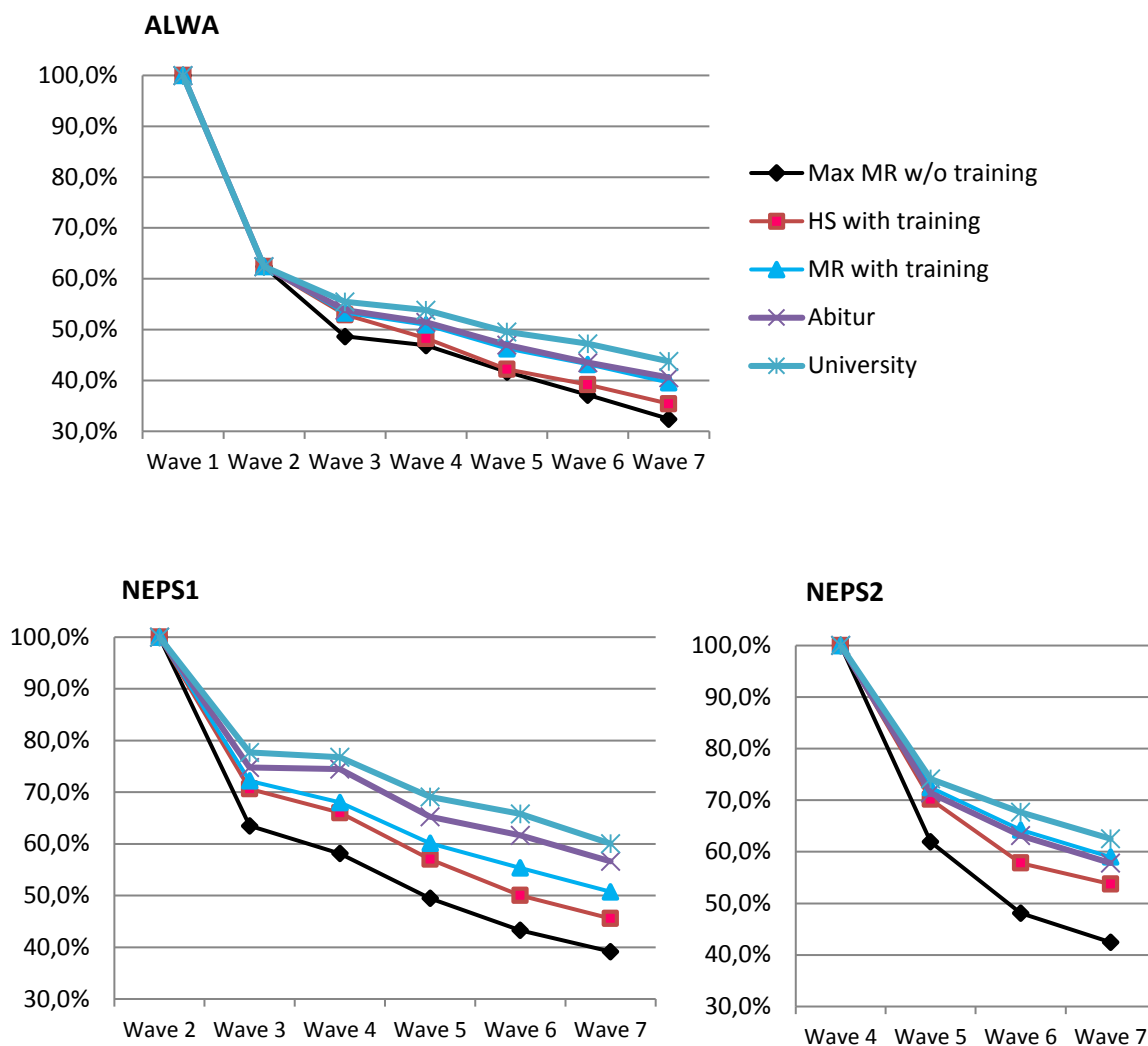
Figure 3. Panel attrition by educational attainment

4.1.3. Reading proficiency

In all three subsamples a considerable share of participants took part in the interview, but refused to complete the reading test in wave 3, or respectively in wave 5 (Table 2). Furthermore, in the ALWA and NEPS1 subsamples the reading assessment was not administered for about 25% of the participants, who instead were asked to perform a math assessment. In the NEPS2 subsample all the participants were asked to do the reading test. Among those who completed the reading test there is a clear difference in the shares of the three proficiency groups in the ALWA subsample and the two NEPS subsamples. In the ALWA subsample the largest group in all three waves is formed by persons with high reading skills followed by the groups with middle and low reading skills. In the NEPS1 and NEPS2 subsamples this order is reversed. These findings are in line with the lower age composition and the educational bias of the ALWA subsample.

Table 2. Trends in participation by reading proficiency in wave 2 (N, *%*)

		Wave 3 2010/11	**Wave 4** 2011/12	**Wave 5** 2012/13	**Wave 6** 2013/14	**Wave 7** 2014
ALWA	Not administered	1,378	1,657	1,437	1,339	1,221
		24.7	*31.1*	*29.7*	*29.6*	*29.4*
	Refused	1,063	896	728	670	578
		19.0	*16.8*	*15.1*	*14.8*	*13.9*
	Low	698	597	565	525	487
		12.5	*11.2*	*11.7*	*11.6*	*11.7*
	Middle	1,095	972	937	869	811
		19.6	*18.2*	*19.4*	*19.2*	*19.5*
	High	1,350	1,206	1,169	1,114	1,059
		24.2	*22.6*	*24.2*	*24.7*	*25.5*
	Total	5,584	5,328	4,836	4,517	4,156
		100.0	*100.0*	*100.0*	*100.0*	*100.0*
NEPS1	Not administered	933	1,176	970	879	807
		25.0	*32.9*	*30.9*	*30.5*	*30.6*
	Refused	625	522	426	397	324
		16.7	*14.6*	*13.5*	*13.8*	*12.3*
	Low	887	732	669	605	551
		23.7	*20.5*	*21.3*	*21.0*	*20.9*
	Middle	728	631	593	554	533
		19.5	*17.6*	*18.9*	*19.2*	*20.2*
	High	565	515	486	450	422
		15.1	*14.4*	*15.5*	*15.6*	*16.0*
	Total	3,738	3,576	3,144	2,885	2,637
		100.0	*100.0*	*100.0*	*100.0*	*100.0*
NEPS2	Not administered			0	213	174
				0.0	*6.6*	*5.8*
	Refused			566	446	370
				15.2	*13.8*	*12.4*
	Low			1,239	946	890
				33.3	*29.2*	*29.9*
	Middle			999	838	782
				26.9	*25.9*	*26.3*
	High			912	794	761
				24.5	*24.5*	*25.6*
	Total			3,716	3,237	2,977
				100.0	*100.0*	*100.0*

Figure 4 illustrates differential attrition by reading proficiency. It shows a clear trend for all three subsamples: The higher the result of the reading assessment, the higher the probability of staying in the panel. This patterns is more pronounced in the two NEPS subsamples than in the ALWA subsample; probably due to the fact that the latter has been already more selective when the tests were conducted. Since the figures for math proficiency show essentially the same attrition pattern as reading proficiency, but fewer persons participated in these tests, they are not shown.
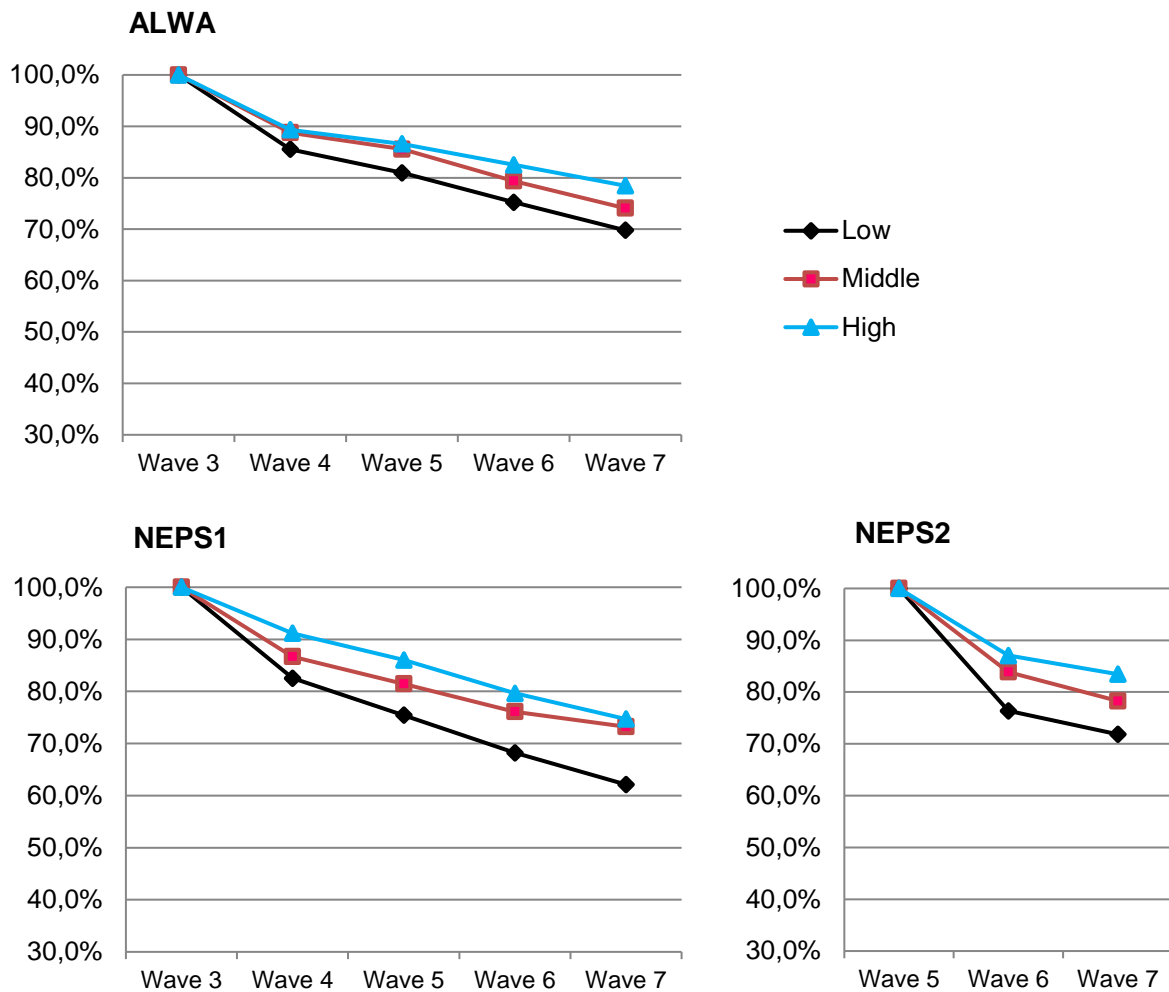

Figure 4. Panel attrition by reading proficiency

4.1.4. Migration background

Across all waves and subsamples individuals without a migration background constitute the vast majority, which is higher in the ALWA subsample than in the two NEPS subsamples (Table 3). The remaining fifth of the samples are equally shared between second and first generation immigrants.

Table 3. Trends in participants by migration background (N, *%*)

		Wave 2 2009/10	**Wave 3** 2010/11	**Wave 4** 2011/12	**Wave 5** 2012/13	**Wave 6** 2013/14	**Wave 7** 2014
ALWA	None	5,414	4,663	4,459	4,065	3,820	3,515
		83.4	*83.5*	*83.7*	*84.1*	*84.6*	*84.6*
	1st generation	451	373	354	306	276	253
		6.9	*6.7*	*6.6*	*6.3*	*6.1*	*6.1*
	2nd generation	630	548	515	465	421	388
		9.7	*9.8*	*9.7*	*9.6*	*9.3*	*9.3*
	Total	6,495	5,584	5,328	4,836	4,517	4,156
		100.0	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*
NEPS1	None	4,055	3,002	2,889	2,551	2,370	2,172
		78.7	*80.3*	*80.8*	*81.1*	*82.1*	*82.4*
	1st generation	669	413	382	310	269	237
		13.0	*11.0*	*10.7*	*9.9*	*9.3*	*9.0*
	2nd generation	430	323	305	283	246	228
		8.3	*8.6*	*8.5*	*9.0*	*8.5*	*8.6*
	Total	5,154	3,738	3,576	3,144	2,885	2,637
		100.0	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*
NEPS2	None			4,131	3,013	2,660	2,457
				79.3	*81.1*	*82.2*	*82.5*
	1st generation			608	361	278	263
				11.7	*9.7*	*8.6*	*8.8*
	2nd generation			469	342	299	257
				9.0	*9.2*	*9.2*	*8.6*
	Total			5,208	3,716	3,237	2,977
				100.0	*100.0*	*100.0*	*100.0*

The relative trend in sample size shows that the latter group seems to be especially problematic regarding panel participation (Figure 5). After six waves of interviews, only 35% of the initial first generation participants of the ALWA and NEPS1 subsamples stay in the panel, but more than 50% of the participants in the other two groups. The same trend is visible after three interview waves in the NEPS2 subsample. In contrast, second generation individuals show similar dropout behaviour as persons without migration background. These findings might possibly be explained by poorer language skills among first generation immigrants, which increases interview burden, or by higher mobility.

ALWA

NEPS1

NEPS2
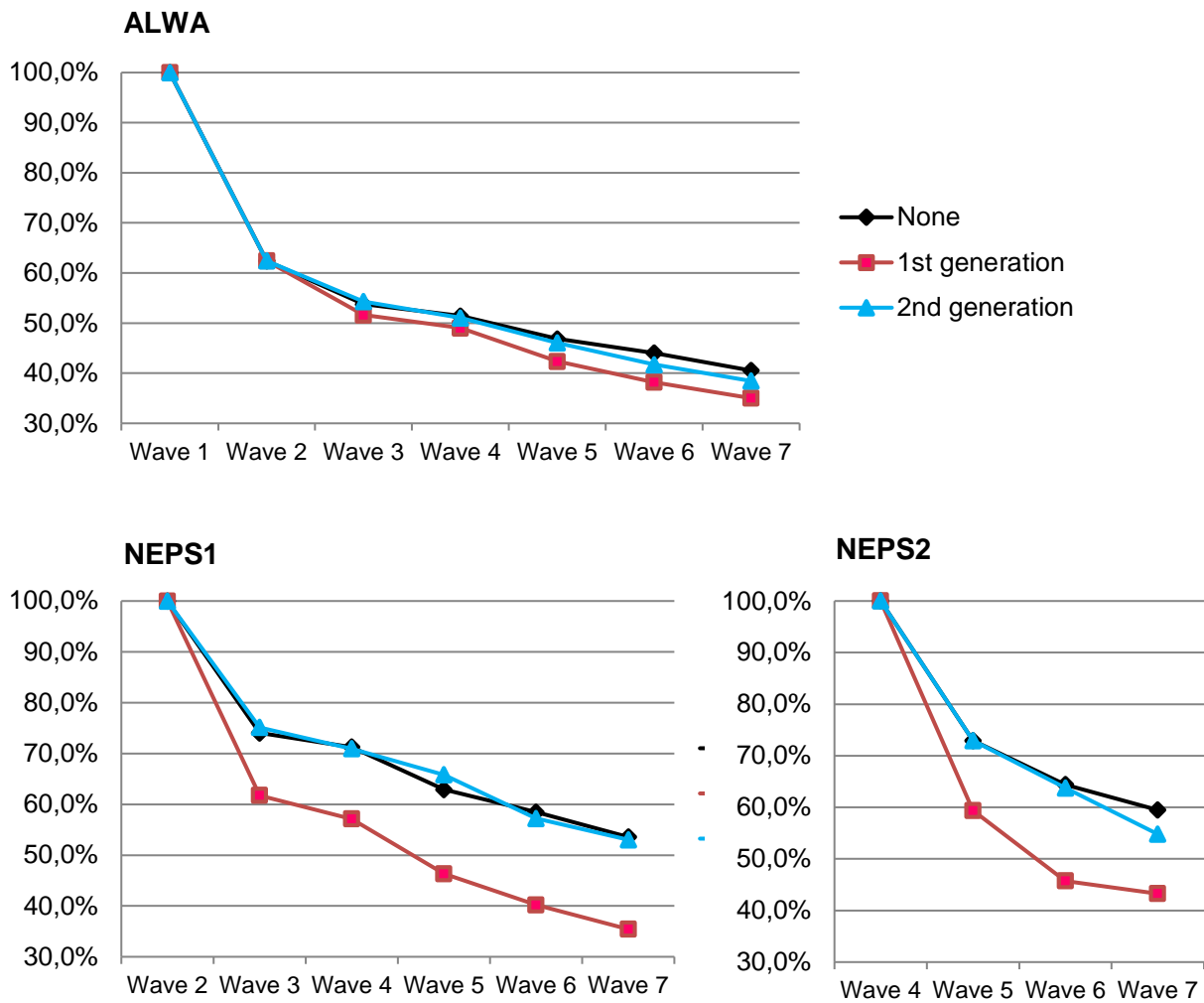
Figure 5. Panel attrition by migration background

4.1.5. Income

Table 4 shows sample development by monthly net equivalence household income at the time of the first interview. There are substantial differences between subsamples regarding their income composition. First, in the ALWA subsample there are much more persons without information on income. Furthermore, here the group with middle income (1,250 EUR to less than 2,500 EUR) is by far the largest group across all waves. The lowest income group (less than 1,250 EUR) accounts for 18-19%, whereas the highest income group (2,500 EUR or more) amounts to only some 14%. In the NEPS1 and NEPS2 subsamples the middle group is still the largest group, but considerably smaller. The lowest income group is proportionately slightly larger; the highest income group is substantially larger. These differences may be explained well by the different age distributions in the subsamples.

Table 4. Trends in participation by monthly net equivalence income (N, *%*)

		Wave 2 2009/10	Wave 3 2010/11	Wave 4 2011/12	Wave 5 2012/13	Wave 6 2013/14	Wave 7 2014
ALWA	Up to 1,250 €	1,183	1,049	973	914	837	785
		18.2	*18.8*	*18.3*	*18.9*	*18.5*	*18.9*
	1.250 to 2,500 €	3,316	2,846	2,767	2,477	2,323	2,129
		51.1	*51.0*	*51.9*	*51.2*	*51.4*	*51.2*
	2,500 € +	924	796	757	692	658	594
		14.2	*14.3*	*14.2*	*14.3*	*14.6*	*14.3*
	Missing	1,072	893	831	753	699	648
		16.5	*16.0*	*15.6*	*15.6*	*15.5*	*15.6*
	Total	6,495	5,584	5,328	4,836	4,517	4,156
		100.0	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*
NEPS1	Up to 1,250 €	1,456	1,003	933	826	732	661
		28.2	*26.8*	*26.1*	*26.3*	*25.4*	*25.1*
	1.250 to 2,500 €	2,405	1,791	1,732	1,532	1,423	1,299
		46.7	*47.9*	*48.4*	*48.7*	*49.3*	*49.3*
	2,500 € +	1,015	794	762	663	624	578
		19.7	*21.2*	*21.3*	*21.1*	*21.6*	*21.9*
	Missing	278	150	149	123	106	99
		5.4	*4.0*	*4.2*	*3.9*	*3.7*	*3.8*
	Total	5,154	3,738	3,576	3,144	2,885	2,637
		100.0	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*
NEPS2	Up to 1,250 €			1,244	841	718	653
				23.9	*22.6*	*22.2*	*21.9*
	1.250 to 2,500 €			2,617	1,948	1,702	1,577
				50.2	*52.4*	*52.6*	*53.0*
	2,500 € +			1,082	785	699	645
				20.8	*21.1*	*21.6*	*21.7*
	Missing			265	142	118	102
				5.1	*3.8*	*3.6*	*3.4*
	Total			5,208	3,716	3,237	2,977
				100.0	*100.0*	*100.0*	*100.0*

Finally, the lowest income group in the NEPS1 and NEPS2 subsamples shows higher attrition than the other two groups (Figure 6). In the ALWA subsample this result might be concealed by the fact that we cannot examine panel attrition in wave 2, and by the higher amount of educational selectivity in wave 1, which was described above.

ALWA

NEPS1

NEPS2
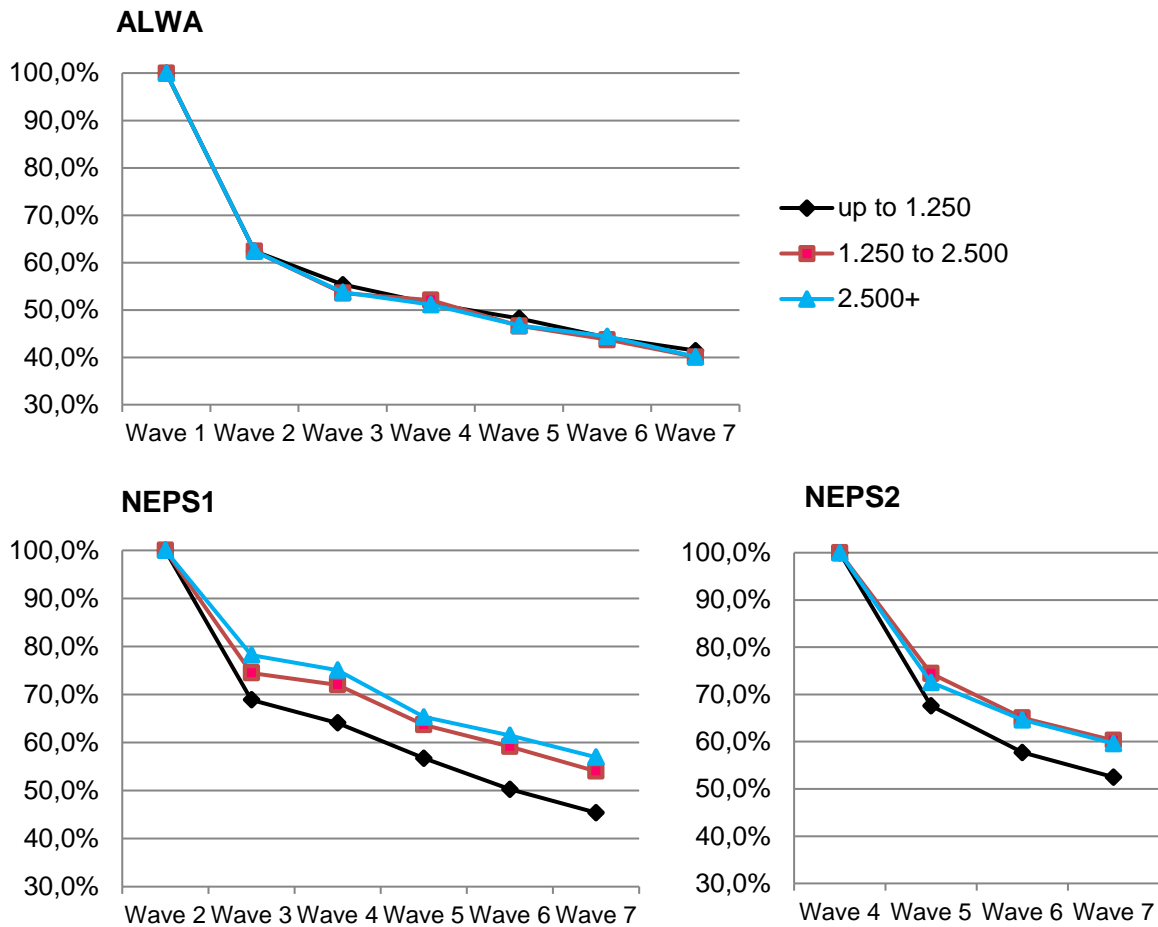
Figure 6. Panel attrition by monthly net equivalence income

4.1.6. Employment status

Table 5 shows trends in interview participation by participants' main employment status at the time of the first interview. The largest group by far is formed by people in paid work in all three subsamples and waves. The distribution among the groups differs between the three subsamples due to their different age composition. The ALWA subsample only comprises the birth cohorts 1956 to 1986, whereas the two NEPS subsamples comprise the birth cohorts 1944 to 1986. For this reason the group of retirees is virtually non-existent in the ALWA subsample (and thus is collapsed with the groups of "Others" in Table 5 and Figure 7), while it amounts to more than 10% the NEPS1 resp. 11% in the NEPS2 subsample. In contrast, the share of people in education is substantially higher in the ALWA subsample and the share of unemployed persons is slightly lower than in the other two subsamples.

The development of sample sizes in the different employment status groups is shown in Figure 7. All in all, no systematic bias is visible, that is, no employment group stands out by especially high or low dropout rates. Note that for the ALWA subsample the retirees are left out because sample sizes are extremely small.

Table 5. Trends in participation by main employment status (N, *%*)

		Wave 2 2009/10	Wave 3 2010/11	Wave 4 2011/12	Wave 5 2012/13	Wave 6 2013/14	Wave 7 2014
ALWA	Education	770	646	604	554	508	476
		11.9	*11.6*	*11.3*	*11.5*	*11.2*	*11.5*
	Employment	4,848	4,179	3,999	3,615	3,38	3,111
		74.6	*74.8*	*75.1*	*74.8*	*74.8*	*74.9*
	Unemployment	319	286	259	248	236	210
		4.9	*5.1*	*4.9*	*5.1*	*5.2*	*5.1*
	Family care	439	372	364	335	319	291
		6.8	*6.7*	*6.8*	*6.9*	*7.1*	*7.0*
	Other	104	78	83	66	60	54
		1.4	*1.4*	*1.5*	*1.3*	*1.3*	*1.3*
	Missing	25	23	19	18	14	14
		0.4	*0.4*	*0.4*	*0.4*	*0.3*	*0.3*
	Total	6,495	5,584	5,328	4,836	4,517	4,156
		100.0	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*
NEPS1	Education	168	112	113	104	92	79
		3.3	*3.0*	*3.2*	*3.3*	*3.2*	*3.0*
	Employment	3,256	2,376	2,269	2,004	1,837	1,691
		63.2	*63.6*	*63.5*	*63.7*	*63.7*	*64.1*
	Unemployment	520	356	350	297	264	246
		10.1	*9.5*	*9.8*	*9.4*	*9.2*	*9.3*
	Family care	339	242	226	204	192	169
		6.6	*6.5*	*6.3*	*6.5*	*6.7*	*6.4*
	Retirement	689	537	508	436	403	364
		13.4	*14.4*	*14.2*	*13.9*	*14.0*	*13.8*
	Other	114	86	80	73	72	64
		2.2	*2.3*	*2.2*	*2.3*	*2.5*	*2.4*
	Missing	68	29	30	26	25	24
		1.3	*0.8*	*0.8*	*0.8*	*0.9*	*0.9*
	Total	5,154	3,738	3,576	3,144	2,885	2,637
		100.0	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*
NEPS2	Education			212	161	133	129
				4.1	*4.3*	*4.1*	*4.3*
	Employment			3,620	2,588	2,261	2,072
				69.5	*69.6*	*69.8*	*69.6*
	Unemployment			386	246	222	199
				7.4	*6.6*	*6.9*	*6.7*
	Family care			344	235	205	194
				6.6	*6.3*	*6.3*	*6.5*
	Retirement			538	413	354	321
				10.3	*11.1*	*10.9*	*10.8*
	Other			81	61	54	53
				1.6	*1.6*	*1.7*	*1.8*
	Missing			27	12	8	9
				0.5	*0.3*	*0.2*	*0.3*
	Total			5,208	3,716	3,237	2,977
				100.0	*100.0*	*100.0*	*100.0*

ALWA

NEPS1

NEPS2
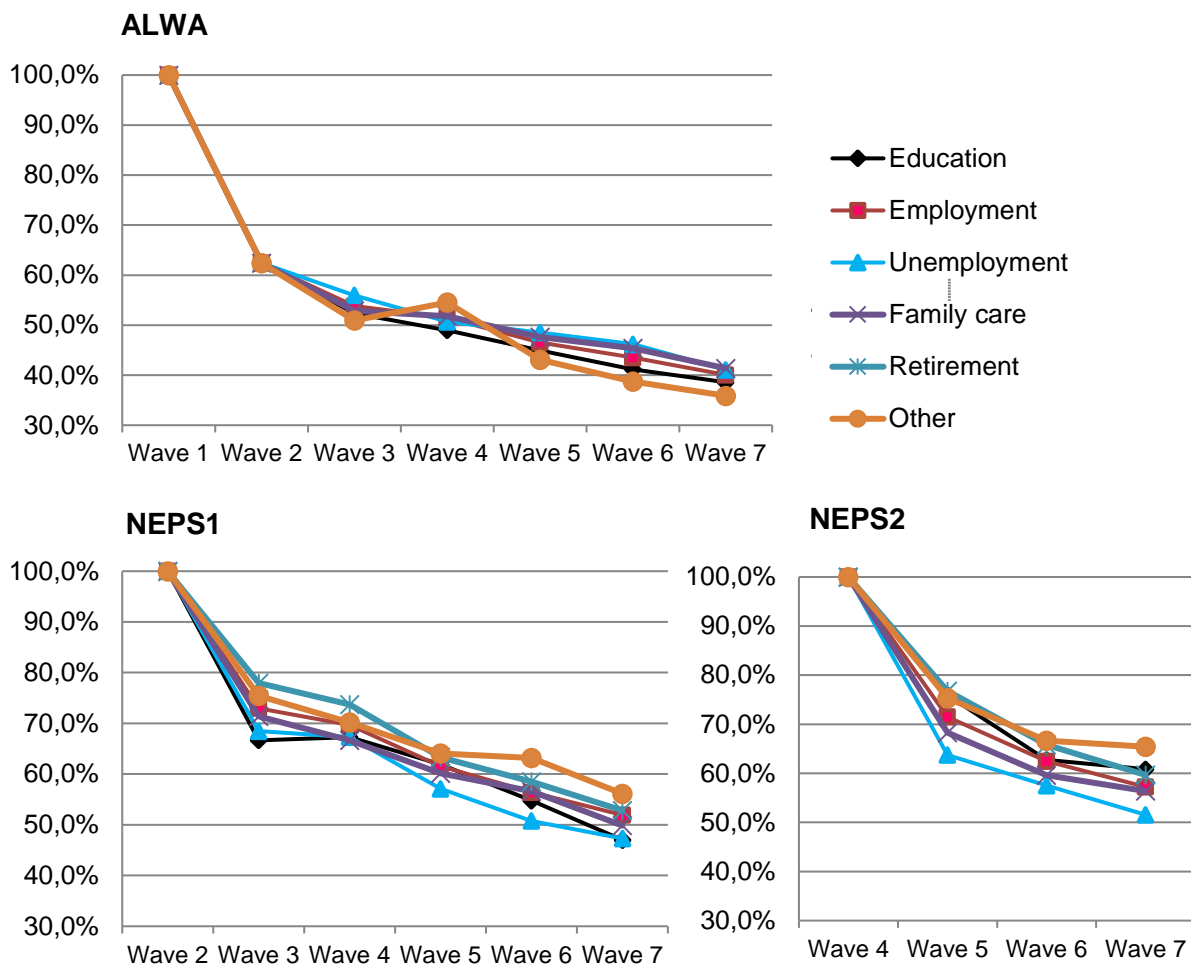
Figure 7. Panel attrition by main employment status

4.1.7. Socio-economic status

Table 6 shows panel attrition for three socio-economic status groups, measured by terciles of their ISEI-08 scores at the time of the interviews (or earlier in case they were not employed during that time). In the first follow-up wave the distribution among the two NEPS subsamples is roughly uniform, whereas persons in the ALWA subsample have a slightly higher socio-economic status.

Table 6. Trends in participation by socio-economic status (ISEI-08) (N, %)

		Wave 2	**Wave 3**	**Wave 4**	**Wave 5**	**Wave 6**	**Wave 7**
		2009/10	2010/11	2011/12	2012/13	2013/14	2014
ALWA	Low	1,978	1,675	1,569	1,415	1,298	1,185
		30.5	*30.0*	*29.4*	*29.3*	*28.7*	*28.5*
	Medium	2,200	1,886	1,810	1,640	1,522	1,411
		33.9	*33.8*	*34.0*	*33.9*	*33.7*	*34.0*
	High	2,317	2,023	1,949	1,781	1,697	1,560
		35.7	*36.2*	*36.6*	*36.8*	*37.6*	*37.5*
	Total	6,495	5,584	5,328	4,836	4,517	4,156
		100.0	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*

Table 6. Continued

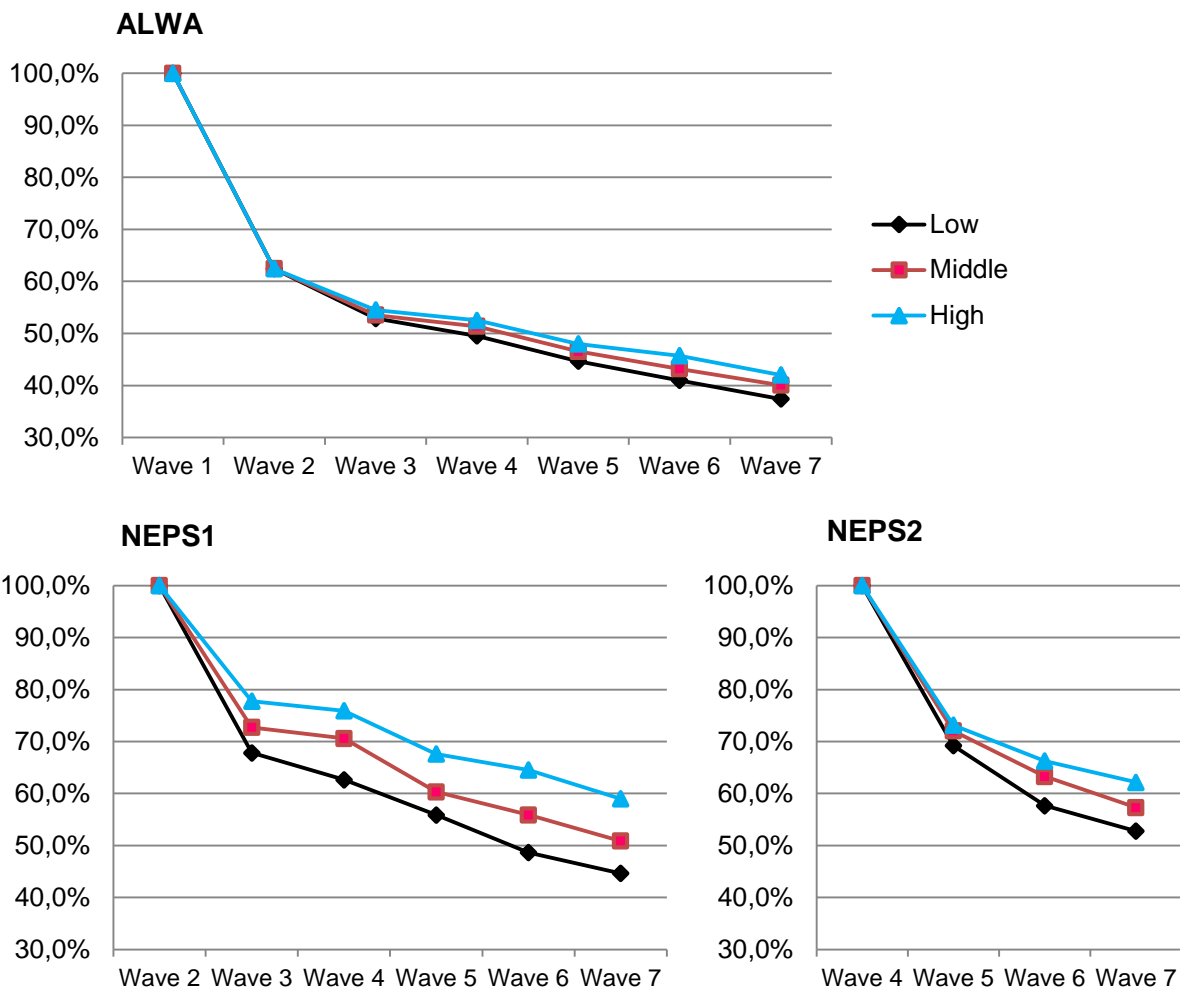|		Wave 2 2009/10	Wave 3 2010/11	Wave 4 2011/12	Wave 5 2012/13	Wave 6 2013/14	Wave 7 2014
NEPS1	Low	1,877	1,273	1,176	1,049	913	838
		36.4	*34.1*	*32.9*	*33.4*	*31.6*	*31.8*
	Medium	1,653	1,202	1,167	997	924	841
		32.1	*32.2*	*32.6*	*31.7*	*32.0*	*31.9*
	High	1,624	1,263	1,233	1,098	1,048	958
		31.5	*33.8*	*34.5*	*34.9*	*36.3*	*36.3*
	Total	5,154	3,738	3,576	3,144	2,885	2,637
		100.0	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*
NEPS2	Low			1,916	1,326	1,105	1,011
				36.8	*35.7*	*34.1*	*34.0*
	Medium			1,656	1,193	1,048	949
				31.8	*32.1*	*32.4*	*31.9*
	High			1,636	1,197	1,084	1,017
				31.4	*32.2*	*33.5*	*34.2*
	Total			5,208	3,716	3,237	2,977
				100.0	*100.0*	*100.0*	*100.0*

Figure 8. Panel attrition by socio-economic status (ISEI-08)

Figure 8 shows that over time substantial differences in dropout behaviour arise between the three socio-economic groups: among those with a higher socio-economic status a higher share of initial participants remains in the panel. In all three subsamples, this share drops with decreasing socio-economic status. The reason for this bias lies in the tight connection of the ISEI score to educational attainment. It remains to be seen in the multivariate analyses whether socio-economic status has a distinguishable effect on panel participation or whether it only reflects bias in educational attainment.

4.2. Multivariate results

Tables 7, 8 and 9 show the results of multinomial logistic regression models for every follow-up wave separately for the three subsamples.[10] As already mentioned above, our findings complement the nonresponse analysis provided in the NEPS-SC6 weighting report (Hammon, Zinn, Aßmann and Würbach 2016) due to the fact that we differentiate nonresponse by refusals and non-contacts. Another benefit is that we control for additional variables, particularly key survey variables, respondents' experiences in previous surveys and interviewer characteristics respondents' previous interview experiences and interviewer characteristics in our models. Since most variables in our models contain only a few missing values, analysis of complete cases excluding observations with missing values is employed, which include more than 97% of each subsample. Due to the high share of missing values in the income variable, they were coded as a separate category ("no info"), so that these observations could be included into the models.

In the following, we summarize the most important estimation results. Note that only two of the three alternative outcomes (noncontact – nonresponse/refusal – interview) are shown in the tables. Since we show average marginal effects, the effects for the neglected outcome (nonresponse) can directly be calculated by using the following formula:

$$p \text{ (nonresponse)} = - [p \text{ (noncontact)} + p \text{ (interview)}]$$

For example, in Table 7 the effect of very low education (max. Mittlere Reife w/o training) on the likelihood of refusing participation for the ALWA subsample in wave 3 is -[0.006 + (-0.074**)] = -.068**.

Also note that the standard models shown in Tables 7-9 do not contain competence assessment results. Reading and math proficiencies have been measured in wave 3 for the ALWA and NEPS1 subsamples and in wave 5 for the NEPS2 subsample, thus they only may affect panel attrition in later waves. For this reason, we extended the standard models by these measures for later survey waves. We shortly present and discuss the results of these extended models at the end of the following section.

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[10] The results for the ALWA subsample (Table 7) should be treated with caution. The base of the regression results does not contain all ALWA members, but only persons who participated in wave 1 (the ALWA study), gave consent to participate in a panel study (aka NEPS) and who participated in NEPS at least once. The NEPS SUF does not contain information on those ALWA sample members who only fulfill the first two conditions, i.e. who were part of the NEPS wave 2 and later gross samples, but were never successfully re-interviewed.

4.2.1. Respondent characteristics

First of all, multivariate results corroborate descriptive findings for educational attainment to some extent. The group with a university degree shows a significantly higher probability of completing an interview compared to the reference group (medium schooling plus vocational training). This effect can be found for the ALWA and NEPS2 subsamples in all waves and for the NEPS1 subsample in waves 2-6. Likewise, university graduates have a significantly lower probability of nonresponse when they have been contacted. Moreover, in some of the models the two lowest educated groups show a lower probability of completing an interview and a higher probability of nonresponse than the reference group. In contrast, educational attainment does not affect the probability of being contacted.

Migration background affects attrition as well. First generation immigrants are consistently less likely to perform an interview in all waves in the two NEPS subsamples and in waves 6 and 7 in the ALWA subsamples than person without migration background. The higher attrition among persons born abroad is due to both a higher likelihood of nonresponse as well as a marginal higher likelihood of noncontact. Second generation immigrants do not differ from the reference group. The fact that effects are less pronounced in the ALWA sample may be caused by the fact that this subsample contained already less immigrants than the two NEPS subsamples in wave 1.

Regarding employment status, no clear pattern can be derived from the models, which is in line with the descriptive results. In some waves, persons in education seem to be more likely to participate in the survey than the reference group of employed persons. In the two NEPS subsamples, but not in the ALWA subsample, we also distinguish retired persons. In most waves of the NEPS1 subsample, but not in any of the models for the NEPS2 subsample, this group has a higher probability of participating in the interview and a lower probability of refusing the interview compared to the reference group. Not only employment status, but also the influence of household income on attrition seems to be negligible. Most of the coefficients fail to reach significance and if they do, they are quite small and in part contradictory. The most consistent pattern here shows the group that did not report their income in the first interview: they seem to be more likely to drop out of the panel in later waves due to nonresponse in the two NEPS subsample. A similar pattern does not show up in the ALWA subsample, which may be caused by different income measurement in wave 1.

While respondents' sex does not play a role, cohort membership affects panel attrition more consistently. In all three subsamples, participants born from 1976-1986 are less likely to stay in the panel and more likely to drop out due to nonresponse than the reference group (persons born 1956-65). In some models young respondents also show a higher probability of noncontact. Living in a rural or neighbourhood (again, at the time of the first interview) only has weak effects on panel attrition, mainly in the first or second follow-up wave and only in the ALWA and NEPS1 subsamples. Finally, in the ALWA and in the NEPS2 subsamples household composition seems to determine attrition. In most models for these groups, persons who lived with a partner and children under 18 in the household at the time of the first interview are more likely to complete an interview and more likely to be contacted again than singles. Moreover, these persons are somewhat less likely to refuse participation.

4.2.2. Respondent previous survey experiences

Among respondent experiences only cooperation in the previous interview, as rated by the interviewer, exhibits a clear pattern. As expected, persons who were rated as being cooperative have a higher probability of participating again and a lower probability of refusing. This pattern, however, only shows up in the two NEPS subsamples, but not in the ALWA subsample, possibly due to its higher initial selectivity, which we cannot control for. The amount of item nonresponse in the previous interview in general has a similar effect: the higher it was, the higher the likelihood of refusing the next interview and the lower the likelihood of participating again. However, this pattern does not show up consistently over waves and subsamples: we see it only for the ALWA subsample in wave 3, 5, and 7 and for the NEPS1 subsample in wave 5. Respondents' fatigue, again rated by the interviewers, does not influence panel attrition.

4.2.3. Interviewer characteristics

In general, interviewers affect survey attrition considerably. To interpret the effects correctly, we have to distinguish between uneven survey waves, which are conducted mainly in CAPI mode, and even survey waves, which are conducted mainly via telephone. Since in these two modes, different interviewer fields are deployed, it is likely that interviewer effects differ. Generally, most significant effects show in CAPI waves: Contrary to theoretical expectations, more experienced interviewers seem to be less successful than the reference group of freshly recruited interviewers in generating interviews, at least in all subsamples in wave 5. However, this association is inconclusive: in wave 7 the most experienced group of interviewers has a higher probability to realize interviews than newcomers. The effect of age is more systematically visible: older interviewers seem to be more successful than younger ones in face-to-face interviews, due to a lower likelihood for both noncontacts and nonresponse. Older interviewers thus might possess more efficient contacting strategies and they might be more trusted more by respondents. In contrast, in telephone fields older interviewers seem to be less successful, primarily due to a higher probability for noncontact. This effect shows up in all subsamples, but is not significant in all CATI waves. Possibly it points at different work time schedules of older CATI interviewers, which lead to a lower rate of contacts. Finally, interviewers' educational attainment does not have any systematic effect on panel attrition (neither does interviewers' sex, effects not shown).

Table 7. Probability of noncontact and interview in the ALWA subsample by wave (multinomial logistic regressions, average marginal effects)

	Noncontact					Interview				
	Wave 3	Wave 4	Wave 5	Wave 6	Wave 7	Wave 3	Wave 4	Wave 5	Wave 6	Wave 7
Educational attainment *(ref. group max. Mittlere Reife with training)*										
Max Mittlere Reife w/o training	0.006	0.009	0.011	0.012	0.013	-0.074**	-0.037	-0.054*	-0.048	-0.057
	(0.87)	(0.94)	(1.53)	(1.48)	(1.45)	(-2.89)	(-1.54)	(-2.21)	(-1.88)	(-1.94)
Hauptschule with training	-0.000	0.004	0.002	0.003	0.008	-0.024	-0.044**	-0.048*	-0.043*	-0.023
	(-0.05)	(0.52)	(0.29)	(0.33)	(1.35)	(-1.35)	(-2.83)	(-2.46)	(-2.28)	(-1.21)
Abitur	0.001	-0.006	0.005	0.005	0.009	0.031*	0.022	0.022	0.000	0.016
	(0.12)	(-1.21)	(1.20)	(0.95)	(1.48)	(2.19)	(1.45)	(1.57)	(0.02)	(1.11)
University	0.002	-0.003	-0.003	-0.002	0.003	0.049***	0.048***	0.040**	0.035**	0.037*
	(0.43)	(-0.49)	(-0.53)	(-0.36)	(0.67)	(3.93)	(3.87)	(2.88)	(2.59)	(2.48)
Migration background *(ref. group none)*										
Born abroad	-0.000	0.009	0.017	0.014	0.005	-0.014	-0.020	-0.031	-0.060**	-0.046*
	(-0.01)	(1.18)	(1.68)	(1.81)	(0.77)	(-0.73)	(-1.05)	(-1.59)	(-2.68)	(-1.99)
Parent(s) born abroad	0.003	-0.004	0.005	0.005	0.010	0.014	-0.006	-0.008	-0.021	-0.003
	(0.51)	(-0.74)	(0.66)	(0.78)	(1.43)	(0.84)	(-0.39)	(-0.51)	(-1.30)	(-0.18)
Employment status *(ref. group employment)*										
Education	-0.001	0.006	-0.007	-0.005	-0.003	0.002	-0.001	0.017	0.033*	0.044*
	(-0.14)	(0.89)	(-1.51)	(-0.96)	(-0.47)	(0.13)	(-0.05)	(1.06)	(2.06)	(2.51)
Unemployment	0.000	0.001	-0.001	-0.011	0.007	0.029	0.013	0.028	0.033	-0.004
	(0.01)	(0.08)	(-0.17)	(-1.59)	(0.72)	(1.26)	(0.60)	(1.31)	(1.61)	(-0.16)
Family care	0.008	-0.009	-0.002	-0.021***	-0.001	-0.038	-0.010	0.025	0.054**	0.007
	(0.92)	(-1.41)	(-0.27)	(-3.59)	(-0.10)	(-1.85)	(-0.41)	(1.23)	(2.78)	(0.30)
Other/no info	0.001	-0.006	-0.008	0.015	-0.004	0.005	0.077**	-0.014	-0.004	0.014
	(0.09)	(-0.64)	(-0.68)	(0.85)	(-0.36)	(0.17)	(2.61)	(-0.36)	(-0.11)	(0.35)
Income *(ref. group 1250 to 2500)*										
Up to 1250	0.004	0.008	0.012	-0.006	-0.001	0.023	-0.011	0.015	0.001	0.013
	(1.00)	(1.61)	(1.79)	(-1.16)	(-0.17)	(1.83)	(-0.83)	(0.93)	(0.09)	(0.91)
2.500+	0.008	0.006	0.005	-0.009	-0.009	-0.008	-0.035*	-0.021	-0.020	-0.034*
	(0.96)	(1.09)	(0.90)	(-1.53)	(-1.92)	(-0.57)	(-2.18)	(-1.39)	(-1.15)	(-2.07)
No info	0.013	0.006	0.015**	0.000	-0.011*	-0.006	-0.024	-0.012	0.012	0.039*
	(1.66)	(0.95)	(2.59)	(0.02)	(-2.54)	(-0.39)	(-1.15)	(-0.61)	(0.68)	(2.15)

Table 7. continued

	Noncontact					Interview				
	Wave 3	Wave 4	Wave 5	Wave 6	Wave 7	Wave 3	Wave 4	Wave 5	Wave 6	Wave 7
Birth cohort *(ref. group 1956-1965)*										
1966-1975	0.013**	0.006	0.007	-0.001	0.002	-0.015	-0.032**	-0.029*	-0.030*	-0.026*
	(3.25)	(1.07)	(1.56)	(-0.30)	(0.37)	(-1.50)	(-2.74)	(-2.33)	(-2.54)	(-2.01)
1976-1986	0.023***	0.012	0.018**	0.032***	0.007	-0.037*	-0.058***	-0.076***	-0.129***	-0.077***
	(3.31)	(1.82)	(2.59)	(4.13)	(1.25)	(-2.31)	(-3.78)	(-4.43)	(-6.97)	(-4.07)
Female	-0.001	-0.003	-0.006	0.001	-0.010*	0.006	0.015	-0.002	-0.004	0.015
	(-0.12)	(-0.77)	(-1.89)	(0.37)	(-2.35)	(0.58)	(1.50)	(-0.16)	(-0.35)	(1.31)
Household composition *(ref. group single)*										
Partner	-0.007	-0.006	0.002	-0.013*	-0.008	0.018	0.027	0.016	0.043*	0.062**
	(-1.01)	(-0.75)	(0.26)	(-2.06)	(-0.95)	(0.93)	(1.41)	(0.87)	(2.40)	(2.87)
Children<18	0.000	-0.005	-0.006	-0.010	-0.002	0.036	-0.028	0.045	0.022	0.027
	(0.02)	(-0.39)	(-0.56)	(-0.74)	(-0.14)	(1.18)	(-0.91)	(1.67)	(0.76)	(0.80)
Partner+children<18	-0.018**	-0.018**	-0.013	-0.014*	-0.019*	0.052**	0.061**	0.017	0.046*	0.068**
	(-2.74)	(-2.67)	(-1.81)	(-2.02)	(-2.25)	(2.80)	(3.07)	(0.98)	(2.43)	(3.23)
BIK categories of municipality size *(ref. group up to 20,000)*										
20-100,000	-0.006	0.001	-0.000	-0.003	0.007	-0.019	-0.021	-0.013	0.010	-0.020
	(-0.70)	(0.11)	(-0.01)	(-0.44)	(1.17)	(-0.98)	(-1.39)	(-0.65)	(0.51)	(-0.89)
100-500,000	0.002	0.005	0.005	-0.004	0.005	-0.042*	-0.027	-0.016	0.015	0.006
	(0.29)	(0.87)	(0.83)	(-0.50)	(1.06)	(-2.35)	(-1.95)	(-0.79)	(0.80)	(0.30)
500,000+	0.003	0.007	0.004	-0.003	0.006	-0.052**	-0.027	-0.023	0.005	-0.007
	(0.39)	(1.21)	(0.77)	(-0.35)	(0.87)	(-2.70)	(-1.84)	(-1.21)	(0.25)	(-0.31)
Cooperation, previous interview	0.002	0.002	-0.002	-0.012	0.002	0.045	0.045	0.092**	0.058	0.026
	(0.20)	(0.24)	(-0.26)	(-0.73)	(0.20)	(1.41)	(1.67)	(3.03)	(1.81)	(0.82)
Fatigue, previous interview	0.002	-0.002	0.002	-0.001	-0.000	-0.006	0.008	-0.004	0.001	0.002
	(1.02)	(-0.80)	(1.72)	(-0.77)	(-0.06)	(-1.48)	(1.65)	(-0.99)	(0.27)	(0.53)
% refusals, previous interview	0.254**	-0.151	-0.187	-0.159	0.425	-1.256*	-0.120	-3.188**	0.002	-2.919**
	(3.22)	(-0.60)	(-0.57)	(-0.41)	(1.69)	(-2.55)	(-0.34)	(-2.61)	(0.00)	(-3.12)

Table 7. continued

	Noncontact					Interview				
	Wave 3	Wave 4	Wave 5	Wave 6	Wave 7	Wave 3	Wave 4	Wave 5	Wave 6	Wave 7
Interviewer experience *(ref. group up to 2 years)*										
2-3 years	-0.002	0.006	0.022**	-0.007	-0.032*	0.044	0.001	-0.091***	-0.025	0.060
	(-0.30)	(0.96)	(2.92)	(-0.83)	(-2.47)	(1.36)	(0.02)	(-3.90)	(-1.07)	(1.54)
4-5 years	0.029	-0.007	0.013**	-0.013	-0.026	-0.062	0.048	-0.035	-0.029	0.073
	(1.96)	(-1.06)	(2.93)	(-1.32)	(-1.75)	(-1.61)	(1.30)	(-1.41)	(-0.87)	(1.78)
More than 5 years	-0.003	-0.002	0.029*	-0.017*	-0.027*	0.041	0.032	-0.091**	0.006	0.088*
	(-0.48)	(-0.32)	(2.45)	(-2.03)	(-2.05)	(1.25)	(0.87)	(-2.99)	(0.26)	(2.16)
Interviewer age *(ref. group up to 29 years)*										
30-49 years	-0.069*	0.003	-0.058*	0.009	0.011	0.226***	-0.053	0.115	-0.010	0.035
	(-2.22)	(0.80)	(-2.55)	(1.75)	(0.56)	(5.34)	(-1.56)	(1.90)	(-0.46)	(0.53)
50-65 years	-0.057	0.024***	-0.077***	0.019**	-0.024	0.256***	-0.069**	0.189***	-0.070**	0.112*
	(-1.76)	(3.30)	(-3.62)	(2.80)	(-1.44)	(6.54)	(-2.77)	(3.29)	(-2.96)	(1.99)
Older than 65 years	-0.075*	0.053*	-0.086***	0.052*	-0.018	0.289***	-0.080	0.239***	-0.109*	0.133*
	(-2.39)	(2.12)	(-3.69)	(2.21)	(-0.95)	(7.01)	(-1.63)	(4.08)	(-2.06)	(2.19)
Interviewer education *(ref. group Mittlere Reife)*										
Hauptschule	-0.017	-0.013	0.006	0.008	0.009	0.015	0.032	-0.007	-0.030	-0.053
	(-1.31)	(-1.21)	(0.66)	(0.74)	(0.76)	(0.42)	(0.84)	(-0.24)	(-0.71)	(-1.52)
Abitur	-0.006	-0.005	0.019***	0.009	-0.009	-0.023	-0.032	-0.053*	-0.003	0.007
	(-0.55)	(-0.61)	(3.30)	(1.74)	(-0.99)	(-0.92)	(-1.15)	(-2.35)	(-0.15)	(0.25)
N	6383	6527	6048	5332	5078	Significance levels: * p<.05, ** p<.01, *** p<.001				
Pseudo R²	0.077	0.038	0.066	0.060	0.059					
AIC	6499	6976	6550	5271	5348					
BIC	6959	7437	7006	5718	5792					

Table 8. Probability of no contact and interview in the NEPS1 subsample by wave (multinomial logistic regressions, average marginal effects)

	Noncontact					Interview				
	Wave 3	Wave 4	Wave 5	Wave 6	Wave 7	Wave 3	Wave 4	Wave 5	Wave 6	Wave 7
Educational attainment *(ref. group Mittlere Reife with training)*										
Max Mittlere Reife w/o train.	0.013	0.008	0.023	0.020	0.012	-0.028	-0.038	-0.021	-0.051	-0.045
	(1.07)	(1.01)	(1.50)	(1.45)	(1.00)	(-1.06)	(-1.62)	(-0.74)	(-1.71)	(-1.63)
Hauptschule with training	0.009	0.017*	0.004	0.012	0.006	-0.032	-0.043*	-0.033	-0.042*	-0.021
	(1.11)	(2.00)	(0.51)	(1.29)	(0.72)	(-1.89)	(-2.49)	(-1.79)	(-2.26)	(-1.04)
Abitur	0.009	-0.007	-0.004	0.001	-0.006	0.042*	0.062**	0.045*	0.024	0.011
	(0.99)	(-1.18)	(-0.53)	(0.16)	(-0.86)	(2.28)	(3.22)	(2.05)	(1.23)	(0.53)
University	0.006	0.004	-0.008	-0.005	-0.011*	0.047**	0.071***	0.078***	0.070***	0.027
	(0.77)	(0.63)	(-1.36)	(-0.70)	(-2.04)	(2.72)	(4.19)	(4.69)	(4.13)	(1.48)
Migration background *(ref. group none)*										
Born abroad	0.021	0.027**	0.019	0.038**	0.021*	-0.067**	-0.083**	-0.086***	-0.125***	-0.066*
	(1.79)	(2.62)	(1.71)	(2.65)	(2.10)	(-3.29)	(-3.27)	(-3.57)	(-4.25)	(-2.33)
Parent(s) born abroad	-0.001	0.004	-0.009	0.001	0.003	0.014	-0.010	0.022	-0.039	0.006
	(-0.08)	(0.56)	(-1.19)	(0.11)	(0.34)	(0.66)	(-0.46)	(1.13)	(-1.77)	(0.22)
Employment status *(ref. group employment)*										
Education	-0.002	0.025	-0.005	0.005	0.020	0.039	0.050	0.069*	0.023	-0.041
	(-0.15)	(1.42)	(-0.42)	(0.34)	(1.27)	(1.23)	(1.62)	(2.04)	(0.65)	(-0.97)
Unemployment	0.005	0.004	0.003	0.003	0.008	0.003	0.060**	0.000	0.008	0.024
	(0.44)	(0.50)	(0.32)	(0.25)	(1.06)	(0.15)	(3.09)	(0.02)	(0.35)	(0.97)
Family care	-0.009	0.004	-0.018*	-0.000	0.019	-0.001	-0.005	0.027	0.044	-0.017
	(-0.77)	(0.41)	(-2.55)	(-0.03)	(1.12)	(-0.06)	(-0.17)	(1.12)	(1.77)	(-0.66)
Retirement	-0.014	-0.003	-0.009	0.004	0.001	0.072***	0.070***	0.026	0.061**	0.048*
	(-1.88)	(-0.37)	(-0.93)	(0.34)	(0.13)	(4.16)	(3.65)	(1.07)	(3.18)	(2.12)
Other/no info	0.024	0.027	-0.021	-0.031***	0.002	-0.015	0.002	0.047	0.088**	0.012
	(1.17)	(1.61)	(-1.65)	(-6.46)	(0.14)	(-0.43)	(0.05)	(1.34)	(2.90)	(0.33)
Income *(ref. group 1,250 to 2,500)*										
Up to 1,250	0.019*	-0.005	0.021**	0.016*	0.009	-0.017	-0.041*	0.000	-0.032*	-0.044*
	(2.39)	(-0.90)	(2.60)	(2.08)	(1.38)	(-1.00)	(-2.51)	(0.02)	(-2.04)	(-2.47)
2,500+	-0.000	-0.007	0.005	0.012	-0.013*	0.007	-0.016	-0.023	-0.037	-0.007
	(-0.04)	(-1.09)	(0.85)	(1.26)	(-2.05)	(0.44)	(-1.10)	(-1.38)	(-1.92)	(-0.40)
No info	0.029	-0.001	0.010	-0.003	0.014	-0.118***	-0.082**	-0.032	-0.115**	-0.101*
	(1.70)	(-0.05)	(0.64)	(-0.26)	(0.86)	(-3.89)	(-2.98)	(-0.98)	(-3.05)	(-2.50)

Table 8. Continued

	Noncontact					Interview				
	Wave 3	Wave 4	Wave 5	Wave 6	Wave 7	Wave 3	Wave 4	Wave 5	Wave 6	Wave 7
Birth cohort *(ref. group 1956-1965)*										
1966-1975	-0.008	-0.001	-0.009	-0.017	0.005	-0.010	0.004	0.038	0.028	-0.010
	(-0.87)	(-0.08)	(-1.25)	(-1.76)	(0.85)	(-0.62)	(0.20)	(1.94)	(1.56)	(-0.53)
1966-1975	0.009	0.015	0.009	-0.004	-0.005	-0.079**	-0.100***	0.003	-0.040	-0.040
	(0.79)	(1.43)	(0.79)	(-0.34)	(-0.69)	(-3.06)	(-4.24)	(0.11)	(-1.64)	(-1.67)
1976-1986	0.019	0.030*	0.015	0.000	0.022*	-0.129***	-0.149***	-0.068**	-0.077*	-0.094***
	(1.50)	(2.35)	(1.36)	(0.00)	(2.45)	(-4.62)	(-5.49)	(-2.65)	(-2.41)	(-3.30)
Female	0.001	0.006	-0.002	-0.003	-0.013*	-0.001	0.006	-0.006	0.022	0.022
	(0.16)	(1.24)	(-0.23)	(-0.58)	(-2.15)	(-0.09)	(0.45)	(-0.45)	(1.51)	(1.37)
Household composition *(ref. group single)*										
Partner	-0.005	-0.002	-0.015	-0.012	-0.011	-0.003	-0.001	0.019	0.004	-0.007
	(-0.57)	(-0.31)	(-1.67)	(-1.42)	(-1.33)	(-0.20)	(-0.03)	(1.10)	(0.24)	(-0.39)
Children<18	0.003	-0.006	-0.014	0.008	-0.015	0.001	0.064	0.066	0.005	-0.016
	(0.13)	(-0.50)	(-1.11)	(0.39)	(-1.83)	(0.02)	(1.81)	(1.68)	(0.12)	(-0.38)
Partner+children<18	-0.008	-0.005	-0.018*	-0.012	-0.016	0.030	0.031	0.026	0.013	-0.021
	(-0.82)	(-0.60)	(-2.00)	(-1.30)	(-1.57)	(1.62)	(1.42)	(1.09)	(0.61)	(-1.04)
BIK categories of municipality size *(ref. group up to 20,000)*										
20-100,000	-0.008	0.017**	0.017	0.004	0.002	0.015	-0.044*	-0.018	-0.018	-0.014
	(-1.05)	(3.02)	(1.63)	(0.43)	(0.42)	(0.59)	(-2.29)	(-0.72)	(-0.82)	(-0.53)
100-500,000	0.014	0.019**	0.013	-0.005	0.013	-0.018	-0.038	-0.011	-0.013	-0.022
	(1.41)	(3.12)	(1.46)	(-0.49)	(1.92)	(-0.73)	(-1.94)	(-0.42)	(-0.62)	(-0.85)
500,000+	0.023**	0.021***	0.016	-0.001	0.016*	-0.030	-0.045*	0.009	-0.017	-0.006
	(2.64)	(3.94)	(1.77)	(-0.15)	(1.99)	(-1.26)	(-2.35)	(0.32)	(-0.81)	(-0.22)
Cooperation, previous interview	-0.016	-0.010	-0.015	-0.017	0.009	0.062**	0.101***	0.066*	0.105**	0.033
	(-1.23)	(-1.08)	(-1.14)	(-1.02)	(1.03)	(2.76)	(4.19)	(2.09)	(2.80)	(0.97)
Fatigue, previous interview	0.001	-0.001	-0.003	0.001	0.001	-0.004	-0.007	-0.007	-0.001	0.004
	(0.62)	(-0.46)	(-1.45)	(0.40)	(0.37)	(-0.92)	(-1.49)	(-1.36)	(-0.24)	(0.94)
% refusals, previous interview	-0.187	-0.089	0.512*	-0.001	0.342	-0.503	-0.748	-4.548***	-0.500	-0.234
	(-0.64)	(-0.55)	(2.07)	(-0.01)	(1.87)	(-1.08)	(-1.64)	(-3.77)	(-1.44)	(-0.34)

Table 8. Continued

	Noncontact					Interview				
	Wave 3	Wave 4	Wave 5	Wave 6	Wave 7	Wave 3	Wave 4	Wave 5	Wave 6	Wave 7
Interviewer experience *(ref. group up to 2 years)*										
2-3 years	-0.019	0.003	0.021**	0.002	-0.015	0.050	-0.018	-0.114***	-0.034	0.066
	(-1.40)	(0.34)	(3.17)	(0.17)	(-1.16)	(1.24)	(-0.48)	(-4.29)	(-1.34)	(1.79)
4-5 years	0.007	-0.016*	0.016	-0.006	-0.009	0.001	0.038	-0.090**	-0.033	0.037
	(0.37)	(-2.09)	(1.73)	(-0.55)	(-0.52)	(0.03)	(0.90)	(-2.68)	(-1.00)	(0.92)
More than 5 years	-0.017	-0.007	0.032**	-0.016	-0.027*	0.050	0.041	-0.109***	0.013	0.103**
	(-1.28)	(-0.85)	(2.64)	(-1.68)	(-2.03)	(1.20)	(1.13)	(-3.48)	(0.52)	(2.66)
Interviewer age *(ref. group up to 29 years)*										
30-49 years	-0.086***	0.004	-0.046	0.023**	0.008	0.252***	-0.074*	0.077	-0.006	0.019
	(-3.38)	(0.77)	(-1.88)	(2.98)	(0.42)	(4.93)	(-2.04)	(1.00)	(-0.28)	(0.23)
50-65 years	-0.078**	0.022**	-0.071**	0.037***	-0.020	0.309***	-0.087**	0.213**	-0.083**	0.104
	(-3.03)	(2.90)	(-3.07)	(4.00)	(-1.24)	(6.46)	(-3.27)	(3.00)	(-3.20)	(1.31)
Older than 65 years	-0.101***	0.035*	-0.089***	0.040*	-0.026	0.314***	-0.058	0.217**	-0.108*	0.119
	(-3.81)	(2.26)	(-3.73)	(2.20)	(-1.57)	(6.28)	(-1.34)	(3.02)	(-2.28)	(1.46)
Interviewer education *(ref. group Mittlere Reife)*										
Hauptschule	-0.022	-0.012	-0.001	-0.007	0.021	0.033	0.003	-0.001	0.002	-0.046
	(-1.47)	(-1.00)	(-0.17)	(-0.57)	(1.70)	(1.06)	(0.06)	(-0.04)	(0.05)	(-1.37)
Abitur	-0.007	-0.009	0.025***	-0.002	0.002	-0.041	-0.040	-0.057*	-0.006	-0.017
	(-0.50)	(-0.92)	(3.41)	(-0.27)	(0.27)	(-1.58)	(-1.77)	(-2.42)	(-0.20)	(-0.65)
N	4707	4580	4073	3472	3191	Significance levels: * $p<.05$, ** $p<.01$, *** $p<.001$				
Pseudo R^2	0.067	0.058	0.082	0.069	0.071					
AIC	5693	5408	4863	3742	3339					
BIC	6158	5871	5318	4185	3776					

Table 9. Probability of no contact and interview in the NEPS2 subsample by wave (multinomial logistic regressions, average marginal effects)

	Noncontact			Interview		
	Wave 5	Wave 6	Wave 7	Wave 5	Wave 6	Wave 7
Educational attainment *(ref. group Mittlere Reife with training)*						
Max Mittlere Reife w/o train	0.007	0.064***	0.017	-0.056*	-0.128***	-0.127***
	(0.69)	(3.71)	(1.24)	(-1.99)	(-4.45)	(-3.78)
Hauptschule with training	0.020*	0.018	-0.006	-0.016	-0.071***	-0.033
	(2.26)	(1.87)	(-0.68)	(-0.93)	(-3.56)	(-1.43)
Abitur	0.009	0.008	-0.010	0.017	0.003	-0.006
	(1.08)	(0.80)	(-1.43)	(0.86)	(0.16)	(-0.26)
University	0.006	0.009	-0.014*	0.038*	0.053**	0.049**
	(0.79)	(0.92)	(-2.19)	(2.08)	(2.78)	(2.69)
Migration background *(ref. group none)*						
Born abroad	0.023*	0.024	-0.001	-0.081***	-0.130***	-0.078**
	(2.42)	(1.88)	(-0.21)	(-3.93)	(-4.95)	(-3.19)
Parent(s) born abroad	-0.001	-0.004	0.017	-0.001	-0.001	-0.025
	(-0.07)	(-0.45)	(1.41)	(-0.03)	(-0.06)	(-1.04)
Employment status *(ref. group employment)*						
Education	0.004	-0.008	-0.015*	0.091***	0.017	0.021
	(0.41)	(-0.63)	(-2.36)	(3.66)	(0.52)	(0.67)
Unemployment	0.033*	-0.006	-0.007	-0.003	0.022	0.010
	(2.41)	(-0.50)	(-0.77)	(-0.10)	(0.77)	(0.36)
Family care	0.005	-0.003	0.009	-0.029	0.003	0.046
	(0.40)	(-0.22)	(0.81)	(-1.20)	(0.13)	(1.56)
Retirement	-0.009	-0.028*	-0.002	0.021	0.033	0.013
	(-0.84)	(-2.42)	(-0.15)	(0.83)	(1.25)	(0.46)
Other/no info	0.029	0.003	0.027	-0.018	-0.039	0.055
	(1.12)	(0.11)	(1.01)	(-0.40)	(-0.75)	(1.14)
Income *(ref. group 1,250 to 2,500)*						
Up to 1,250	0.010	0.004	0.010	-0.032	-0.009	-0.031
	(1.42)	(0.40)	(1.35)	(-1.85)	(-0.49)	(-1.57)
2,500+	0.007	0.001	-0.004	-0.038*	-0.044*	-0.011
	(0.79)	(0.15)	(-0.64)	(-2.23)	(-2.37)	(-0.58)
No info	-0.004	0.020	0.013	-0.053	-0.035	-0.097*
	(-0.43)	(1.28)	(0.76)	(-1.56)	(-1.05)	(-2.43)
Birth cohort *(ref. group 1956-1965)*						
1944-1955	-0.014**	-0.018*	-0.007	0.051**	0.067***	0.044*
	(-2.69)	(-2.51)	(-1.16)	(3.16)	(3.84)	(2.28)
1966-1975	0.016	0.016	0.009	-0.064***	-0.040*	-0.029
	(1.91)	(1.84)	(1.21)	(-3.53)	(-2.25)	(-1.45)
1976-1986	0.028*	0.050***	0.036**	-0.114***	-0.093***	-0.077***
	(2.48)	(3.91)	(3.05)	(-5.45)	(-4.46)	(-3.37)
Female	-0.004	-0.018**	0.002	0.019	0.031*	0.016
	(-0.69)	(-2.78)	(0.38)	(1.34)	(2.28)	(1.06)

Table 9. continued

	Noncontact			Interview		
	Wave 5	Wave 6	Wave 7	Wave 5	Wave 6	Wave 7
Partner in household *(ref. group single)*						
Partner in HH	-0.003	-0.022*	-0.001	-0.002	0.010	0.008
	(-0.38)	(-2.25)	(-0.08)	(-0.10)	(0.55)	(0.47)
Children<18 in HH	-0.014	-0.002	-0.015	0.038	-0.014	0.026
	(-1.27)	(-0.09)	(-1.61)	(1.19)	(-0.40)	(0.73)
Partner+children<18 in HH	-0.020*	-0.037***	-0.016*	0.050**	0.063***	0.018
	(-2.32)	(-3.67)	(-2.20)	(3.10)	(3.31)	(0.95)
BIK categories of municipality size *(ref. group up to 20,000)*						
20-100,000	0.006	-0.010	-0.006	0.037	0.019	-0.027
	(0.58)	(-0.72)	(-0.77)	(1.29)	(0.71)	(-1.08)
100-500,000	0.004	-0.006	0.001	0.038	0.031	-0.039
	(0.40)	(-0.57)	(0.15)	(1.30)	(1.26)	(-1.53)
500,000+	0.014	0.009	0.015	0.034	0.012	-0.027
	(1.40)	(0.66)	(1.48)	(1.12)	(0.47)	(-1.00)
Cooperation previous interview	-0.024*	-0.063***	-0.018	0.088***	0.193***	0.137***
	(-2.01)	(-3.30)	(-1.17)	(3.56)	(5.71)	(4.12)
Fatigue previous interview	0.002	0.000	-0.001	-0.009*	-0.008	-0.005
	(1.53)	(0.11)	(-0.72)	(-2.21)	(-1.52)	(-1.10)
% refusals, previous interview	0.225**	0.143	0.075	-0.289	-0.999	-0.633
	(2.99)	(0.82)	(0.23)	(-0.72)	(-1.85)	(-0.70)
Interviewer experience *(ref. group up to 2 years)*						
2-3 years	0.018	0.006	-0.026	-0.097**	-0.059*	0.075
	(1.96)	(0.38)	(-1.71)	(-3.21)	(-2.01)	(1.58)
4-5 years	0.010	-0.005	-0.017	-0.047	-0.073	0.081
	(1.18)	(-0.30)	(-0.94)	(-1.82)	(-1.79)	(1.60)
More than 5 years	0.022	-0.024	-0.014	-0.081*	-0.001	0.089
	(1.75)	(-1.50)	(-0.83)	(-2.36)	(-0.03)	(1.91)
Interviewer age *(ref. group up to 29 years)*						
30-49 years	-0.056*	0.034**	-0.012	0.108	-0.058	-0.029
	(-2.42)	(3.23)	(-0.33)	(1.90)	(-1.86)	(-0.23)
50-65 years	-0.061**	0.052***	-0.044	0.198***	-0.090**	0.078
	(-2.69)	(4.93)	(-1.24)	(3.78)	(-2.98)	(0.66)
Older than 65 years	-0.074**	0.093***	-0.062	0.225***	-0.125**	0.051
	(-3.18)	(3.47)	(-1.70)	(4.16)	(-2.79)	(0.42)
Interviewer education *(ref. group Mittlere Reife)*						
Hauptschule	-0.006	-0.025	0.017	-0.075*	-0.037	-0.104*
	(-0.62)	(-1.68)	(1.29)	(-2.21)	(-0.74)	(-2.30)
Abitur	0.013	-0.011	0.002	-0.102***	-0.003	-0.047
	(1.47)	(-0.84)	(0.17)	(-4.12)	(-0.10)	(-1.57)
N	4875	4351	3909	Significance levels:		
Pseudo R²	0.064	0.083	0.062	* <.05, ** < .01, *** < .001		
AIC	6124	5808	4836			
BIC	6591	6267	5288			

Table 10. Effects of competence assessments on participation (multinomial logistic regressions, average marginal effects)[11]

		Noncontact				Interview			
		Wave 4	Wave 5	Wave 6	Wave 7	Wave 4	Wave 5	Wave 6	Wave 7
ALWA	Test proficiency	-0.003	0.000	0.004	0.002	0.017**	0.013*	0.017**	0.022***
		(-1.28)	(0.23)	(1.56)	(1.00)	(2.81)	(2.21)	(3.11)	(3.83)
	No test participation	0.017***	0.010**	0.017**	0.007	-0.211***	-0.196***	-0.118***	-0.119***
		(3.77)	(2.65)	(3.15)	(1.36)	(-18.35)	(-14.80)	(-9.21)	(-6.89)
NEPS1	Test proficiency	0.002	-0.006	0.002	-0.008*	0.026***	0.025***	0.013	0.027***
		(0.76)	(-1.89)	(0.59)	(-2.49)	(3.51)	(3.37)	(1.82)	(3.55)
	No test	0.027***	0.020**	0.020**	0.015	-0.268***	-0.202***	-0.110***	-0.135***
		(4.83)	(2.70)	(2.82)	(1.73)	(-15.31)	(-11.06)	(-6.91)	(-6.50)
NEPS2	Test proficiency			-0.001	-0.003			0.031***	0.027***
				(-0.19)	(-1.52)			(4.60)	(3.55)
	No test			0.052***	0.020**			-0.290***	-0.198***
				(5.50)	(3.01)			(-15.96)	(-10.01)

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[11] The effects shown here are estimated from extended models. Thus, they contain the same predictor and control variables as the models in tables 7 to 9 plus a metric variable denoting the test result and a dummy variable indicating non-participation in the test(s). The effects of the predictor and control variables educational attainment, migration background, employment status, socio-economic status, income, birth cohort, gender, household composition, municipality size, cooperation, fatigue, percentage of refusals, interviewer experience, interviewer age, and interviewer gender are not shown here.

4.2.4. Reading and math proficiency

Effects of competence assessments on subsequent panel attrition were tested in extended models for waves 4-7 for the ALWA and NEPS1 subsamples as well as for waves 6-7 for the NEPS2 subsamples, which include all the variables described above plus two additional indicators: a metric variable denoting the test result and a dummy variable indicating non-participation in the test(s). The estimation results in Table 10 show that both variables influence attrition consistently and significantly: the higher the test score, the lower the likelihood for nonresponse and the higher the likelihood for conducting an interview in all following waves. The test experience thus seems to have long-lasting results. Persons who did not participate in the test (either due to test refusal or to temporary dropout in the test wave) exhibit a higher probability for nonresponse and noncontact in later waves than persons who conducted the test(s). These effects are stronger in the first two follow-up waves after the tests than in later waves, and they are much stronger for nonresponse than for noncontact. Finally, including the test result in the extended models does not eliminate the effects of educational attainment on panel attrition: for most panel waves, highly educated persons still are more likely to be interviewed and less likely to refuse participation, independently of their assessment results.

5. Summary and conclusions

This paper aimed at describing panel attrition processes in the adult cohort of the National Educational Panel Study (NEPS-SC6), complementing the results documented in the NEPS-SC6 weighting report (Hammon, Zinn, Aßmann & Würbach, 2016). In contrast to estimating nonresponse in order to generate reliable survey weights, we aimed at providing a comprehensive and easily accessible overview of changes in realized sample size and composition with respect to key variables from wave 2 to wave 7.

To this end, we first described changes in the composition of the sample with respect to participants' educational attainment, reading and mathematics competencies, employment status, income, migration background, employment status and socio-economic status. The results show that participants' educational attainment, reading competence, and migration background are the most important key survey variables affected by attrition. In contrast, differences in attrition patterns by income, socio-economic status and employment status are not that pronounced. In sum, despite the evidence on differential dropout behaviour among different key variable groups, sample sizes in subgroups of particular interest like participants with lower educational attainment or first generation immigrants are still large enough to use weights and to provide robust findings in statistical analyses.

In order to secure the results of the descriptive analyses, multinomial logistic regression models predicting the probability of interview participation, refusal, and noncontact were estimated. Besides the mentioned key survey variables further respondent characteristics, respondent experiences in the previous interview, and interviewer characteristics are used as control variables. Results show that non-contact and refusal are influenced by different factors. Refusal is generally stronger affected by the variables in the model than noncontact, and thus leads to more nonresponse bias. For example, whereas higher educated persons have a lower probability of refusals, the probability of being contacted is not affected by educational attainment. In contrast, first generation immigrants have a higher likelihood to refuse participation as well as of not being contacted anymore. Competence testing warrants

special mention in this context. Low test results lead to a higher probability of non- response in subsequent panel waves, which might be caused by negative emotions like frustration and humiliation (for more information, see Kleinert et al. 2015). Other respondent characteristics show in general only marginal effects on both sources of nonresponse. Among respondents' previous interview experiences only cooperation in the previous interview has a substantially positive effect on the probability of participating again. Interviewer characteristics appear to be more important influence factors in the multivariate models than respondent characteristics, especially in CAPI waves. Most importantly, older interviewers have a lower probability of noncontact and nonresponse than younger ones. As for interviewers' experience, results are inconclusive.

In a nutshell, similar to other panel surveys the NEPS adult cohort suffers from differential dropout behaviour among different groups of participants, which is particularly high in the first follow-up waves after the initial interview and mostly decreases with every additional panel wave. This also accounts for some of the key survey variables in NEPS-SC6 such as educational attainment and migration background. This has to be born in mind when analysing research questions concerning these variables.

When designing future surveys similar to the NEPS adult cohort, this issue should be addressed more coherently from the start on. Since we know the main selectivity factors, a promising strategy to prevent them could be to place specific efforts in panel maintenance on those groups who are most at risk of dropping out, for example by targeting incentives. In order to test how useful such a strategy is, these incentives could be varied experimentally. However, our results show as well that nonresponse bias is particularly pronounced in the first interview wave. Targeted incentives do not help here, since we neither know educational attainment nor immigration status before interviewing the respondents. For this issue, other strategies should be developed.

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Appendix

Table A2. Number of participants by sex, waves and subsamples

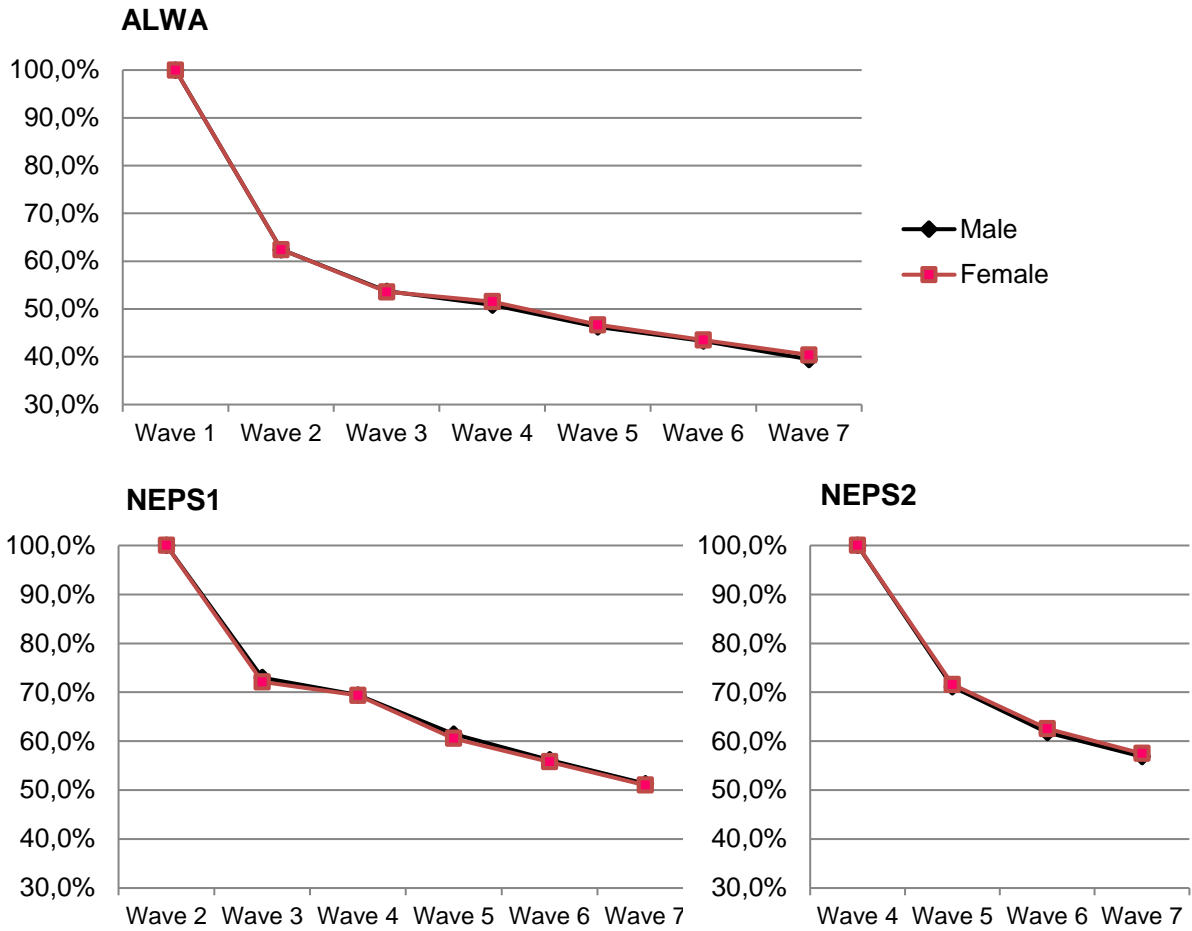|		Wave 2 2009/10	Wave 3 2010/11	Wave 4 2011/12	Wave 5 2012/13	Wave 6 2013/14	Wave 7 2014
ALWA	Male	3,185	2,742	2,594	2,360	2,209	2,014
		49.0	*49.1*	*48.7*	*48.8*	*48.9*	*48.5*
	Female	3,310	2,842	2,734	2,476	2,308	2,142
		51.0	*50.9*	*51.3*	*51.2*	*51.1*	*51.5*
	Total	6,495	5,584	5,328	4,836	4,517	4,156
		100.0	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*
NEPS1	Male	2,531	1,847	1,757	1,555	1,422	1,299
		49.1	*49.4*	*49.1*	*49.5*	*49.3*	*49.3*
	Female	2,623	1,891	1,819	1,589	1,463	1,338
		50.9	*50.6*	*50.9*	*50.5*	*50.7*	*50.7*
	Total	5,154	3,738	3,576	3,144	2,885	2,637
		100.0	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*
NEPS2	Male			2,628	1,869	1,623	1,494
				50.5	*50.3*	*50.1*	*50.2*
	Female			2,580	1,847	1,614	1,483
				49.5	*49.7*	*49.9*	*49.8*
	Total			5,208	3,716	3,237	2,977
				100.0	*100.0*	*100.0*	*100.0*

ALWA

NEPS1

NEPS2

Figure A2. Attrition by sex and subsample

a. We assume the dropout rates from wave 1 (ALWA study) to wave 2 to be the same in the two sex groups corresponding to the overall attrition from wave 1 to wave 2. This assumption is necessary because the wave 1 data are not included in the SUF. A breakdown of the overall case number of 10,404 into different sex groups is therefore not possible.

Table A3. Number of participants by birth cohort, waves and subsamples

		Wave 2 2009/10	Wave 3 2010/11	Wave 4 2011/12	Wave 5 2012/13	Wave 6 2013/14	Wave 7 2014
ALWA	1956-1965	3,168	2,758	2,664	2,427	2,292	2,101
		48.8	*49.4*	*50.0*	*50.2*	*50.7*	*50.6*
	1966-1975	1,889	1,626	1,547	1,407	1,338	1,231
		29.1	*29.1*	*29.0*	*29.1*	*29.6*	*29.6*
	1976-1986	1,438	1,200	1,117	1,002	887	824
		22.1	*21.5*	*21.0*	*20.7*	*19.6*	*19.8*
	Total	6,495	5,584	5,328	4,836	4,517	4,156
		100.0	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*
NEPS1	1944-1955	3,096	2,289	2,197	1,934	1,775	1,620
		60.1	*61.2*	*61.4*	*61.5*	*61.5*	*61.4*
	1956-1965	812	624	596	510	478	448
		15.8	*16.7*	*16.7*	*16.2*	*16.6*	*17.0*
	1966-1975	652	454	427	392	350	325
		12.7	*12.1*	*11.9*	*12.5*	*12.1*	*12.3*
	1976-1986	594	371	356	308	282	244
		11.5	*9.9*	*10.0*	*9.8*	*9.8*	*9.3*
	Total	5,154	3,738	3,576	3,144	2,885	2,637
		100.0	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*
NEPS2	1944-1955			1,420	1,086	943	872
				27.3	*29.2*	*29.1*	*29.3*
	1956-1965			1,502	1,102	954	880
				28.8	*29.7*	*29.5*	*29.6*
	1966-1975			1,250	858	759	693
				24.0	*23.1*	*23.4*	*23.3*
	1976-1986			1,036	670	581	532
				19.9	*18.0*	*17.9*	*17.9*
	Total			5,208	3,716	3,237	2,977
				100.0	*100.0*	*100.0*	*100.0*

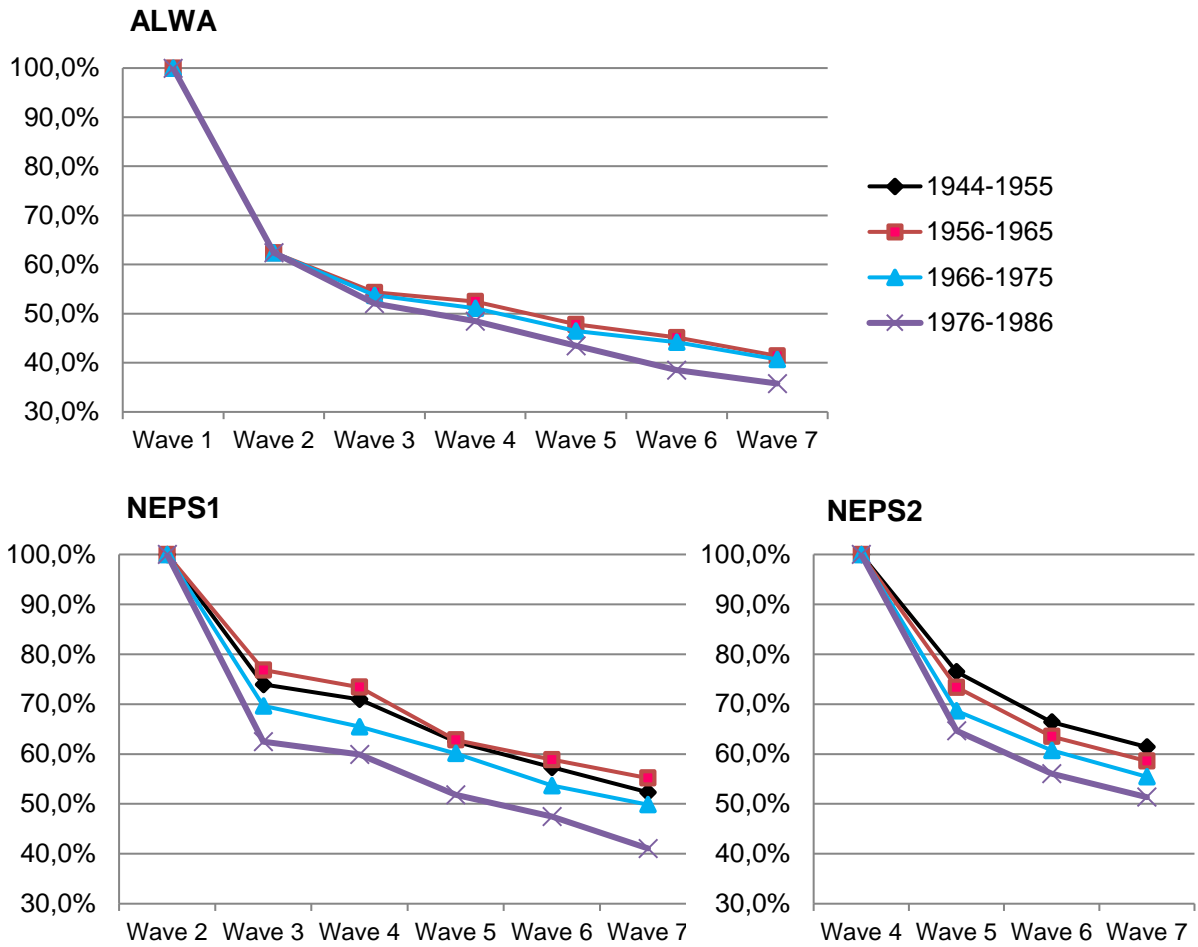**ALWA**

NEPS1

NEPS2

Figure A3. Attrition by birth cohort and subsample

a. We assume the dropout rates from wave 1 (ALWA study) to wave 2 to be the same in all three birth cohorts corresponding to the overall attrition from wave 1 to wave 2. This assumption is necessary because the wave 1 data are not included in the SUF. A breakdown of the overall case number of 10,404 into different birth cohorts is therefore not possible.