

PIAAC–L Data Collection 2015: Technical Report

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GESIS-Papers

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1 Introduction

The PIAAC-Longitudinal project (PIAAC-L) follows-up the German respondents of the international large-scale assessment PIAAC 2012 (*Programme for the International Assessment of Adult Competencies*)¹ with a longitudinal design encompassing three additional waves of data collection in 2014, 2015, and 2016. An overview of the PIAAC-L project can be found in Zabal, Martin, and Rammstedt (2016) and Rammstedt, Martin, Zabal, Carstensen, and Schupp (2017). Beyond the longitudinal extension, PIAAC-L also collects information at the household level, conducts interviews with household members, and gathers extensive additional information hereby enriching the breadth and depth of background information on the German PIAAC respondents.

PIAAC-L is a collaborative project carried out by GESIS – Leibniz Institute for the Social Sciences (lead), the German Institute for Economic Research (DIW Berlin), and the LfBi – Leibniz Institute for Educational Trajectories; it is funded by the Federal Ministry of Education and Research. The project brings three important German surveys closer together: PIAAC (GESIS was responsible for the national project management of PIAAC 2012 in Germany), the German Socio-Economic Panel (SOEP, run by the DIW), and the National Educational Panel Survey (NEPS, run by the LfBi). Instrument components from all three surveys were incorporated in the PIAAC-L data collections, thus creating important links.

This technical report summarizes the design and data collection for the second wave of PIAAC-L conducted in 2015. The focus of this wave was the re-assessment of the key cognitive competences literacy and numeracy which were already measured in PIAAC 2012. The assessment of these competences was undertaken using both the original instruments from PIAAC 2012 for literacy and numeracy as well as instruments implemented by the NEPS for reading and mathematics. The data will allow analysts to investigate whether and how the literacy and numeracy proficiencies of the PIAAC 2012 respondents have changed over time and how the PIAAC and NEPS instruments and the resulting proficiency scores relate to each other. This latter question is of particular importance to policy makers to see how international and national assessment results can be integrated to better inform policy.

While the first wave of PIAAC-L data collection in 2014 targeted PIAAC 2012 respondents (referred to as *anchor persons*) and members of their household aged 18 years and over, the second wave of data collection focuses on the anchor persons recruited for the PIAAC-L project in 2014 and on their partners/spouses living in the same household (henceforth called *partners*). In PIAAC-L 2015 the objective was thus to collect interviews from the anchor person and their partners (if these lived in the same household). Box 1.1 offers a summary of key facts for the collection of PIAAC-L 2015.

The design of the second wave of PIAAC-L is described in Chapter 2. Chapter 3 provides information on the measurement instruments. Fieldwork procedures and results are reported in Chapter 4. Chapter 5 summarizes the data management activities and data products.

¹ PIAAC is an initiative of the OECD (*Organisation for Economic Cooperation and Development*).

Box 1.1. Key Facts: The Data Collection 2015 (PIAAC-L Wave 2)

- Instruments:
 - Person questionnaire
 - General, vocational, and professional education
 - Current status and employment, income
 - Skills used at work
 - Computer skill use
 - Mother tongue(s) and knowledge of foreign languages
 - Self-assessment of numeracy and literacy
 - Health, leisure, friends
 - Family and relationships
 - Background information (e.g., parents, citizenship)
 - Cognitive assessment
 - PIAAC: literacy, numeracy
 - NEPS: reading speed, reading, mathematics
 - Interview administration: CAPI (computer-assisted personal interview) and cognitive assessment (either computer-based or paper-based), usually administered in the respondent's home
 - Interview language: German
 - Target persons:
 - Anchor persons (participated in PIAAC Germany 2012, could be contacted for PIAAC-L, and participated in PIAAC-L wave 1 in 2014)
 - Partners of anchor persons living in anchor person's household
 - Data collection period: March 25 to September 1 2015
 - Number of interviewers: 117
 - Interview duration (on average):
 - Anchors: 103 minutes
 - Partners: 89 minutes
 - Gross sample size (anchor persons): 3 758
 - Realized sample size:
 - Anchor persons: 3 263
 - Partners: 1 368
 - Achieved retention rate (anchor persons): 87%
 - Data: accessible for scientific purposes as scientific use files (ZA5989) from GESIS Data Archive / Research Data Centre PIAAC (FDZ PIAAC)
-
- Project partners: GESIS – Leibniz Institute for the Social Sciences [lead], Socio-Economic Panel (SOEP) at German Institute for Economic Research (DIW Berlin), and Leibniz Institute for Educational Trajectories (LIfBi)
 - Survey organization: TNS Infratest (now: Kantar Public)
 - Funded by the Federal Ministry of Education and Research

2 Design PIAAC-L 2015

The main focus of the second wave of data collection was the assessment of the key adult competences literacy and numeracy. Various central objectives were pursued with this. First, the repeated measurement of literacy and numeracy for anchor persons (these respondents had already been administered the PIAAC cognitive assessment in 2012) provides insights on how these competences may change over time in the adult population and allows to examine factors associated with the acquisition, maintenance, and loss of skills.² The information collected in the background questionnaire for this wave focused on measuring key analytical variables in exactly the same way as they had been implemented in PIAAC 2012 to enable direct comparisons with the PIAAC data. A number of additional constructs and measures potentially related to skills and their development in adulthood were also included. Second, the comparison of the international PIAAC competence measures for literacy and numeracy with the national measures for reading and mathematics studied in the German National Education Panel Survey (NEPS) enables researchers to investigate how these relate to one another and whether and how they can be linked. Third, the comparison of the literacy and numeracy competences of the anchor persons and those of their partners allows a different set of research questions to be addressed, such as how skills may influence partner selection or how skills are distributed in partnerships.

2.1 Sample

Following the PIAAC-L sample concept, the anchor persons remain the backbone of the sample: Only anchor persons that had participated in the first wave of PIAAC-L (2014) were eligible for PIAAC-L 2015 ($n = 3\,758$). In addition, this second wave of PIAAC-L addressed partners of anchor persons living in the anchor person's household. Partners were only included if their anchor person had previously given an interview in this wave of data collection. Contrary to wave 1, no other household members were interviewed in this wave of data collection.

New partners were required to consent to having their data linked with the anchor person's PIAAC 2012 data and the data of all other members of their household interviewed for PIAAC-L, including the data of the anchor person and the other household members from both the previous PIAAC-L wave in 2014 and the subsequent PIAAC-L data collection in 2016.

Table 2.1 shows how the PIAAC-L wave 2 gross sample is derived. The original PIAAC 2012 target sample consisted of non-institutionalized adults between 16 and 65 years of age, who resided in the country at the time of data collection, irrespective of their nationality, residential status, or language skills (Mohadjer, Krenzke, & Van de Kerckhove, 2013a; OECD, 2010). For PIAAC 2012, a probability-based sample was realized in Germany using a registry-based, two-stage stratified and clustered sampling design (see Zabal et al., 2014). In the first wave of PIAAC-L data collection in 2014, 5 225 German PIAAC respondents were addressed. The 3 758 anchor persons that agreed to participate in the PIAAC-L project and from which an interview was collected in 2014 form the gross sample for PIAAC-L 2015. This corresponds to 68.8% of the PIAAC-DE 2012 net sample, and 36.7% of the PIAAC-DE 2012 gross sample.

The gross sample for the partners living in the anchor persons' household cannot be determined a priori but was derived empirically during fieldwork; there were 2 103 eligible partners.

² The terms competence and skills are used interchangeably in this report.

Table 2.1. Gross Sample: From PIAAC 2012 to the PIAAC-L Wave 2 Gross Sample

Initial gross sample PIAAC Germany 2012	10 240
Completed cases (net sample) PIAAC Germany 2012	5 465
Literacy-related nonrespondents, breakoffs to cognitive assessment, no consent to re-contact	240
Initial gross sample PIAAC-L 2014 (anchor persons)	5 225
Final net sample PIAAC-L 2014 = gross sample PIAAC-L 2015 (anchor persons)	3 758

In the original German PIAAC 2012 sample, target persons were distributed over 277 communities with 320 sample points. Due to mobility and relocation of PIAAC-L respondents over the years after their participation in PIAAC 2012, there were 564 communities in PIAAC-L 2015.

2.2 Assessment Design

Different assessment designs were defined and implemented for the anchor persons versus their partners. Since the major research questions focused on the assessment of the anchor persons, an elaborate assessment design differentiated eight assessment conditions for anchor persons. These included conditions in which only NEPS instruments, only PIAAC instruments, or a mixture of both NEPS and PIAAC instruments were administered. For the partners, however, a very simple assessment design with only two conditions and using NEPS instruments exclusively sufficed.

The assessment instruments were to be administered exactly as in the original surveys. Thus, the PIAAC instruments were per default computer-based, with an optional paper-based mode (cp. OECD, 2013a; Zabala et al., 2014). The NEPS tests which are exclusively paper-based and timed were administered exactly as in the 2010/2011 data collection for the NEPS adult cohort (cp. Aust et al., 2012).

Assessment design for anchor persons

The cognitive assessment for the anchor persons in PIAAC-L 2015 encompasses the domains literacy and numeracy from PIAAC, and the domains reading (including reading speed) and mathematics from the NEPS. Please note that the PIAAC domain problem solving in technology-rich environments and the reading components module were excluded in the PIAAC-L design. An appropriate assessment design consisting of eight assessment conditions was developed with the aim to maximize the linking accuracy with the two precursor surveys PIAAC and NEPS, and optimize the longitudinal comparison with PIAAC Germany and the comparison between PIAAC and NEPS (specifically PIAAC literacy with NEPS reading and PIAAC numeracy with NEPS mathematics). The chosen assessment design for the anchor persons is shown in Table 2.2.

Table 2.2. Assessment Design for Anchor Persons: Eight Assessment Conditions (AP1–AP8)

AP1	AP2	AP3	AP4	AP5	AP6	AP7	AP8
Reading Speed (NEPS)	Reading Speed (NEPS)	Reading Speed (NEPS)
Reading (NEPS)	Math (NEPS)	Literacy (PIAAC)	Numeracy (PIAAC)	Reading (NEPS)	Literacy (PIAAC)	Math (NEPS)	Numeracy (PIAAC)
Math (NEPS)	Reading (NEPS)	Numeracy (PIAAC)	Literacy (PIAAC)	Literacy (PIAAC)	Reading (NEPS)	Numeracy (PIAAC)	Math (NEPS)

Please note that the assessment conditions AP3 and AP4 were modified for the paper-based administration: Because it takes longer to work on the PIAAC paper-based instruments than their computer-based counterparts, it was not possible to administer both domains within a single assessment condition in the paper mode. Therefore, respondents in the paper branch were administered only the literacy booklet in assessment condition AP3 and only the numeracy booklet in assessment condition AP4.³

The allocation of anchor persons to one of the eight assessment conditions was determined prior to fieldwork using a controlled stratified allocation to ensure a homogeneous distribution of anchor persons and age groups in each condition.⁴ The allocation was determined as follows: (1) the list of anchor persons was ordered at random, (2) the list was subsequently sorted according to age (in months), and (3) the numbers one to eight were consecutively (and repeatedly) allocated to the anchor person list, whereby the first number was randomly allocated.

This procedure assigned a random number between one and eight to each anchor person so that 1/8 of the anchor person sample was assigned to each of the eight assessment conditions. The assigned assessment condition was preloaded into the CAPI program. In order to route anchor persons who were assigned to any of the PIAAC conditions correctly through the PIAAC international software, some information (e.g., assessment condition, derived variables, etc.) was accordingly generated and transmitted as input parameters to the PIAAC international software.

Assessment design for partners

Partners were administered NEPS instruments exclusively. The allocation of the partners to one of the two partner assessment conditions was determined based on their partner's (anchor person) assessment condition and is described in Figure 2.1. This design was chosen to optimize the comparability of the assessment results between anchor persons and their partners. In partner condition P1 respondents are first administered the NEPS reading and then the NEPS mathematics booklet. In partner condition P2 the order is reversed: first NEPS mathematics and then NEPS reading.

³ The core booklet was administered in both cases prior to the main literacy or numeracy booklet.

⁴ A simple random allocation to a test condition during the interview is more likely to produce less homogeneous and stable distributions.

<div>AP1→P1</div> <div>AP2→P2</div> <div>If the anchor person was exclusively administered NEPS instruments (assessment condition AP1 or AP2), their partners were administered the exact same NEPS booklets (in the same order). Note that the assessment conditions P1 and P2 for partners do not include reading speed.</div>	<div>AP3→P1</div> <div>AP4→P2</div> <div>If the anchor person was exclusively administered PIAAC instruments (assessment condition AP3 or AP4), the partners were administered the same domain order using the NEPS instruments.</div>	<div>AP5→P1</div> <div>AP6→P2</div> <div>AP7→P2</div> <div>AP8→P1</div> <div>For the mixed assessment conditions in which the anchor person was administered one domain with the NEPS and one with the PIAAC instruments (AP5-AP8), the partner was administered the corresponding NEPS domain in the same position in the two-domain sequence as their partner (anchor person).</div>
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Figure 2.1. Allocation of partners' assessment condition

2.3 Interview Workflow

The PIAAC-L 2015 interviews were designed to take between 90 and 105 minutes on average: 25-40 minutes for the questionnaire, 60 minutes for the cognitive assessment – with approximately 30 minutes per domain – and 5 minutes for the observation module that wrapped-up the interview. The interview necessarily had to be administered to the anchor person first. The partner interview was activated in the interview software only upon completion of the anchor person interview. Interviews were to be carried out if possible without interruptions – these were only allowed in exceptional cases. Interviewers were instructed to do their best to administer the interview without the presence of third persons, in particular the partners, and most especially during the cognitive assessment.

The interview was initiated with the verification or entry of respondent's key personal data. Partners who had not previously participated in PIAAC-L were required to give their consent to data linkage with data obtained from other household members and with data from PIAAC and other PIAAC-L data collection waves.

The questionnaire was carried out as a computer-assisted personal interview (CAPI) and varied slightly for anchor persons and their partners. Furthermore, respondents who were in a relationship (whether or not they lived together) were asked an additional set of questions.

After completing the questionnaire, the cognitive assessment was automatically started within the interview software. The assessment conditions were allocated automatically. For anchor persons who were administered PIAAC instruments, the PIAAC international software (virtual machine) was directly launched by the interview CAPI program. All instructions required to administer both the PIAAC and the NEPS instruments were provided for interviewers on the screen and easy to follow.

For the PIAAC assessment, respondents who had never used a computer before (this information was captured in the questionnaire) or who failed a computer-based core (CBA Core 1) that tested their skill

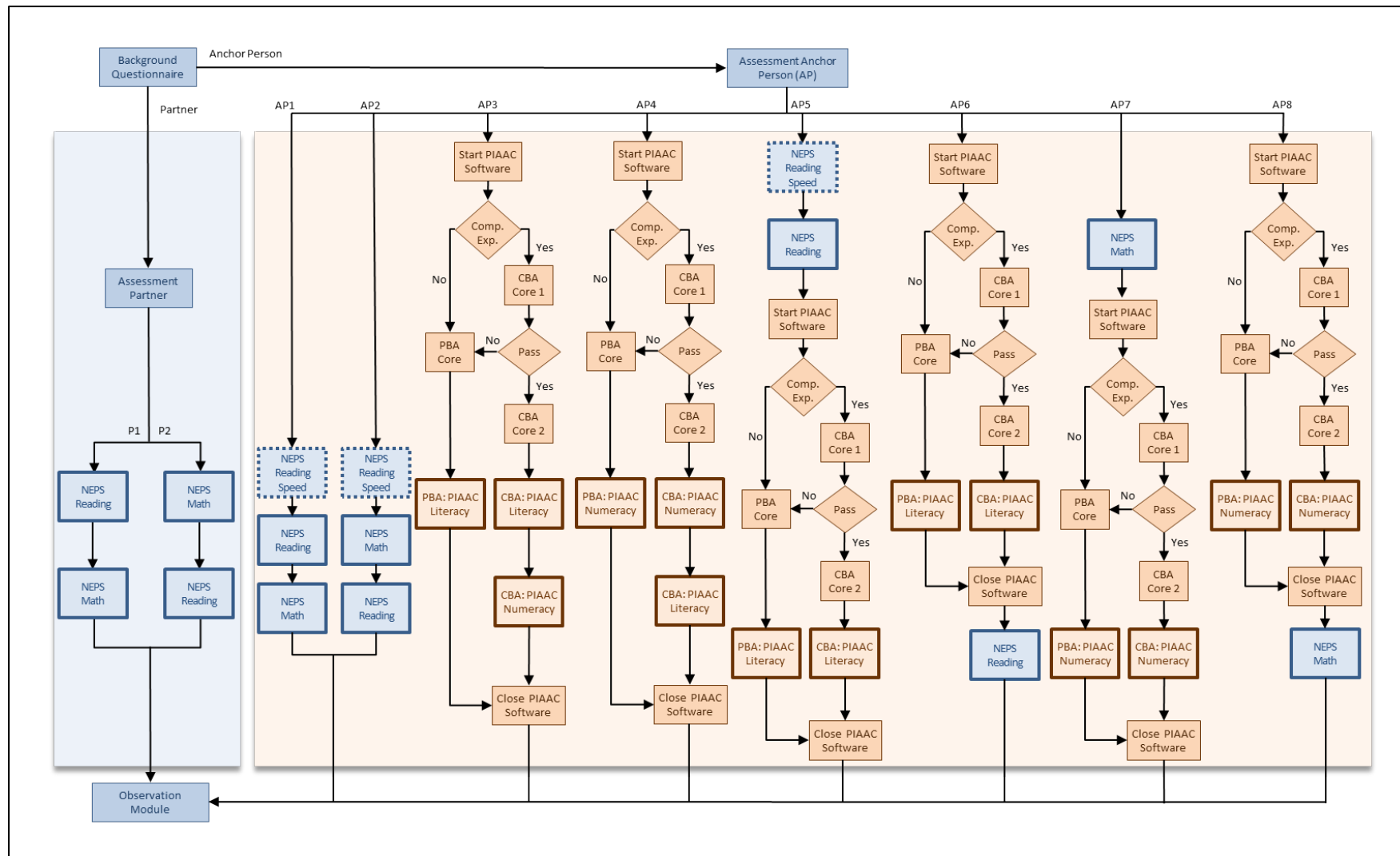
using the computer mouse were routed to the PIAAC paper branch.⁵ The PIAAC assessment then started with a core instrument consisting of very few literacy and numeracy items of low difficulty (in the computer-based branch: CBA Core 2; in the paper-based branch: PBA Core). In PIAAC 2012, the function of this core was to route persons with very low skills directly to the assessment of reading components. Because PIAAC-L does not include the reading components, this filtering function of the core was deactivated.⁶ Although the allocation to the specific assessment domains literacy or numeracy was undertaken according to the PIAAC-L assessment design (see Table 2.2), within each domain the exact same assessment design as in PIAAC 2012 was implemented, i.e. the same paper booklets for the paper branch as well as the identical testlets and selfsame multistage adaptive algorithm to select items sets for the computer branch as in PIAAC 2012 (for a description of the PIAAC 2012 assessment design see Kirsch & Yamamoto, 2013; OECD, 2013b, Zabal et al., 2014). Interviewers were guided through the NEPS test administration via the regular interview CAPI system.

After the cognitive assessment a small number of questions wrapped up the interview (observation module): These included some questions to the respondents specifically about the cognitive assessment, and some to the interviewers with respect to the interview administration and other observations.

Figure 2.2 shows the interview workflow for anchor persons and their partners and depicts the routes through the different assessment conditions.

⁵ Respondents who refused to work on the cognitive items on the computer were also administered the paper instruments.

⁶ As a consequence, the interviewer scoring implemented for the paper-based branch in PIAAC was not required and hence omitted.



Notes: Comp. Exp. = computer experience (information captured in questionnaire); CBA = computer-based assessment; PBA = paper-based assessment.

Figure 2.2. Scheme of PIAAC-L 2015 interview workflow

3 Instruments and Instrument Administration

The PIAAC-L 2015 instrument consists of two main elements: the questionnaire and the cognitive assessment. Contrary to the PIAAC-L 2014 and 2016 interviews, no household protocols or household questionnaires were implemented. Given the design for this second wave of data collection, it was mandatory to administer the interview with the anchor person *before* the interview with the anchor person's partner (if applicable).

At the beginning of each interview, a short module introduced the respondent to the current PIAAC-L interview and checked that the key person information was correct. The respondents confirmed or corrected their own registered case information (e.g. name, year of birth, and sex). In the interview with the anchor person, this module also collected information on whether the anchor person had a partner living in the same household, and if so, their key coordinates. This information was used to initialize and activate the corresponding partner interview, if applicable. The transition to the background questionnaire was imperceptible for the respondent. The background questionnaire, the cognitive assessment and the observation module that concludes the interview are described in more detail below.

3.1 Questionnaire

Anchor persons and their partners living in the same household (who consented to an interview in PIAAC-L 2015) were administered a background questionnaire as a CAPI, using show cards for specific questions; standardized administration of the questionnaire was emphasized during interviewer training. The questions were for the most part identical for both types of respondents, but there were some questions that were only addressed to anchors and some only to partners (who, of course, had not participated in PIAAC 2012) as well as some additional questions to respondents who were in a relationship (whether they were living together or not).

A significant number of items corresponding to key analytical variables were replicated from the PIAAC background questionnaire to allow for a direct comparison with PIAAC Germany 2012. The framework for the PIAAC background questionnaire is provided in OECD (2011). Key PIAAC questions reiterated in the PIAAC-L 2015 questionnaire include questions on education, work and employment, computer experience, and native language; the PIAAC items on country of birth, parental education and occupation were also implemented, but for partners only.

Questions from other surveys and new questions were included for various purposes: (1) questionnaire items from PIAAC-L 2014 and SOEP for longitudinal continuity, (2) different operationalizations of constructs also measured in PIAAC 2012 with a view to contributing to the questionnaire development for PIAAC Cycle 2 (e.g. the NEPS skills use module which can be regarded as an alternative to the skills use module implemented in PIAAC), and (3) new constructs that extend the spectrum of relevant background information and analytical scope (e.g. a self-assessment of literacy and numeracy, German as a foreign language). Often, items taken from other survey questionnaires required a certain amount of modification.

The questionnaire covers the following topics (this order does not necessarily reflect the order in the questionnaire):

- **Educational attainment and participation:**⁷ highest qualification, country in which highest qualification was obtained, participation in formal education (current, last 12 months), years of education⁸
- **Labour-force status, work:**⁹ current labour-force status, current job – including occupation, and industry, work history (ever worked, past 12 months), size of enterprise, supervisory function, gross wages/salary (or earnings from business if self-employed)
- **Skill use at work, job characteristics:**¹⁰ reading, writing and mathematical practices at work, problem-solving versus routine tasks, work autonomy, manual tasks/physical exertion at work
- **Computer use:** use of computer at work or ever,¹¹ tasks undertaken on computer,¹² age of first computer use¹³
- **Language background:** mother tongue(s) (first/second language learnt as a child and still understood),¹⁴ knowledge of foreign languages,¹⁵ knowledge of German as a foreign language¹⁶
- **Self-assessment of numeracy and literacy:** respondent's assessment of their own literacy and numeracy skills¹⁷
- **Health, leisure, life satisfaction, friends:**¹⁸ current health, healthy nutrition, smoking, alcohol consumption; leisure activities, cultural and political participation, volunteering, life and domain satisfaction, number of close friends

⁷ Replicated from PIAAC Germany 2012;
https://www.gesis.org/fileadmin/piaac/Downloadbereich/PIAAC_BQ_Final_deutsch.pdf

⁸ New.

⁹ Replicated from PIAAC Germany 2012; see above.

¹⁰ Taken from NEPS adults (fourth panel wave);
https://www.neps-data.de/Portals/0/NEPS/Datenzentrum/Forschungsdaten/SC6/6-0-0/SC6_6-0-0_W4_5_de.pdf

¹¹ These two questions taken from PIAAC Germany 2012 were also required as input for the PIAAC international software.

¹² Taken from AES Germany 2012;
<https://dbk.gesis.org/dbksearch/SDesc2.asp?il=10¬abs=1&af=&nf=&search=&search2=&db=D&no=5354>

¹³ Translation from PISA 2015 - ICT Questionnaire by PIAAC-L group (using double translation and reconciliation procedure).

¹⁴ Replicated from PIAAC Germany 2012; see above.

¹⁵ Adapted from AES 2012 Germany; see above.

¹⁶ New.

¹⁷ The self-assessment items were developed as a part of a cooperative effort with research groups in Canada and Poland who also pursued a longitudinal follow-up of PIAAC 2012 respondents. Partly based on a self-assessment instrument developed by Human Resources and Skills Development Canada (<https://www.canada.ca/en/employment-social-development/programs/essential-skills/tools/numeracy-self-assessment.html>; <https://www.canada.ca/en/employment-social-development/programs/essential-skills/tools/reading-self-assessment.html>), we developed German numeracy and literacy self-assessments for CAPI administration. This included the development of items aligned with the PIAAC literacy and numeracy frameworks as well as the development of an appropriate response scale. The German self-assessment items were tested in the GESIS cognitive pretest laboratory and adjusted according to the pretest results.

¹⁸ Replicated from PIAAC-L 2014, SOEP Person Questionnaire (<https://www.econstor.eu/bitstream/10419/96127/1/782878962.pdf>), and NEPS adults, see above.

- **Family situation and relationship:** marital/civil status, various questions about relationship (if applicable) including division of tasks in relationship,¹⁹ activities with partner²⁰
- **Personal background information:**²¹ parental occupation and education, citizenship, immigration to Germany

A detailed documentation of the final person questionnaire for PIAAC-L 2015 can be found at the GESIS Data Archive website (ZA5989_fb_Persons_15.pdf).²²

3.2 Cognitive Assessment

As indicated above, the direct cognitive assessment measured literacy and numeracy competences as conceptualized in PIAAC, and reading and mathematical competences as conceived by the NEPS. Figure 3.1 provides the basic definitions for these competence domains in the respective surveys. Both PIAAC and NEPS developed frameworks for each of their assessment domains to elaborate the theoretical background, define the important construct dimensions and other measurement-relevant aspects, and as such provide a guideline for item development. The PIAAC frameworks explicitly focus on adult competences, while the NEPS aims at assessing and monitoring different competences across the entire lifespan. The assessment frameworks for reading and mathematical competence thus strive for a common theoretical underpinning which is overall coherent and adequate for all age groups – including adults (Artelt, Weinert, & Carstensen, 2013).

The PIAAC literacy framework (Jones et al., 2009) distinguishes between different types of texts, e.g. structural features of texts (digital, print-based), formats, different contexts, and different cognitive operations or processes. The PIAAC numeracy framework elaborates four facets of numerate behaviour: mathematical content, mathematical representations, contexts, and cognitive processes and types of mathematical responses (Gal et al., 2009). OECD (2013b) shows the distribution of test items by these characteristics or facets, and also includes some example items; German example items can be found in Zabal et al. (2013).

The NEPS reading competence framework differentiates different text functions and text types, cognitive requirements, and item formats (Gehrer, Zimmermann, Artelt, & Weinert, 2013). The item distribution over these three facets for the reading competence items for the adult cohorts can be found in Koller, Haberkorn, and Rohm (2014). In addition to reading competence, in certain assessment conditions the NEPS instrument for *reading speed* was also administered. Reading speed refers to basic and widely automatized reading processes relevant for reading comprehension especially at the lower performance level (Zimmermann, Artelt, & Weinert, 2014). These assessment tasks were administered as a speed test and consist of short sentences that require only general knowledge to generate the required response. The NEPS framework for mathematical competence differentiates mathematical content areas or ideas and process-oriented aspects, i.e. cognitive components of mathematical thinking (Ehmke et al., 2009). Sample items and item distributions with respect to content areas can be found in Neumann et al. (2013).

¹⁹ Taken from PAIRFAM;
http://www.pairfam.de/fileadmin/user_upload/redakteur/publis/Frageboegen/pairfam_anker_fragebogen_welle_1_2008_09.pdf

²⁰ Adapted from NEPS additional survey Thüringen (2009/2010/2011);
https://www.neps-data.de/Portals/0/NEPS/Datenzentrum/Forschungsdaten/TH/1-0-0/TH_1-0-0_Q_w1-2.pdf

²¹ Replicated from PIAAC Germany 2012; see above.

²² <https://dbk.gesis.org/dbksearch/SDesc2.asp?Il=10¬abs=1&af=&tnf=&tsearch=&tsearch2=&db=D&no=5989>

The wide majority of the NEPS reading and mathematics tasks are presented in a multiple choice response format; in the mathematics test some short constructed responses (open entry) are also included. The PIAAC items include open responses (both computer-based and paper-based items), items requiring highlighting of text or clicking on text (computer-based assessment), and only very few closed-format items.

The assessment instruments were to be administered exactly as in the original surveys. Thus, the PIAAC instruments were per default computer-based, with an optional paper-based mode (cp. OECD, 2013a; Zabal et al., 2014). The DIPF (German Institute for International Educational Research) was subcontracted to modify the PIAAC international software – concretely the virtual machine implemented for PIAAC Germany 2012 – to conform to the PIAAC-L assessment design.²³ For the paper-based assessment, the exact same paper booklets as in PIAAC Germany 2012 were used.

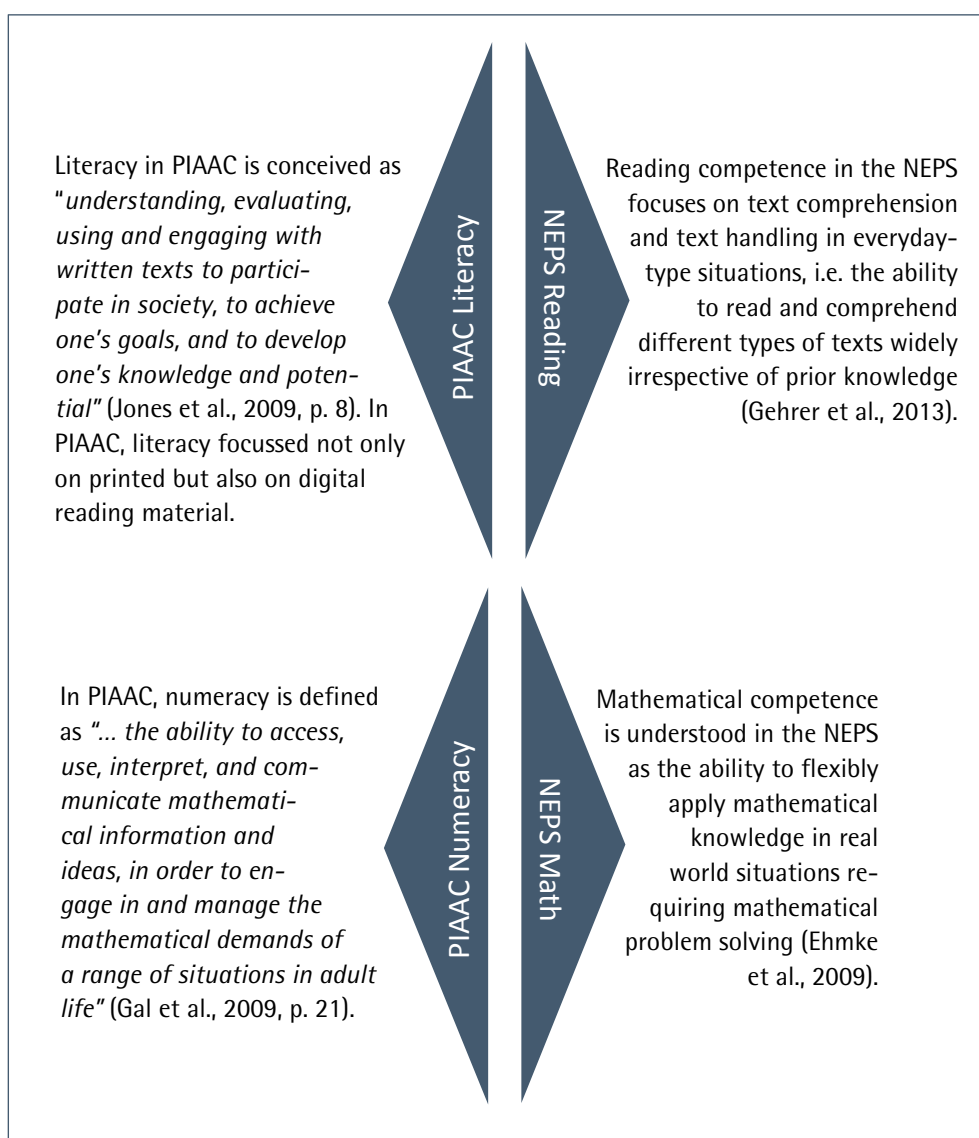


Figure 3.1. The PIAAC and NEPS concepts of literacy/reading and numeracy/mathematics

²³ As a part of the international consortium in PIAAC Cycle 1, the DIPF was responsible for assembling the national virtual machines. In addition, the DIPF was also national IT Coordinator for PIAAC Germany.

The NEPS tests, which are exclusively paper-based and timed, were administered exactly as in the 2010/2011 data collection for the NEPS starting cohort 6 of adults (cp. Aust et al., 2012). For the domain reading speed the available processing time was 2 minutes. Processing time for the reading booklet and math booklet was restricted to a maximum of 28 minutes for each. Correct time measurement, i.e. using the stopwatch, and ensuring that the time limitations of the assessment were respected was a crucial element of the interviewer training for the NEPS assessment.

Due to some key differences between the assessment approaches of the two surveys (see Figure 3.2), ensuring that the cognitive assessment was run appropriately for each assessment condition was a challenging task for the interviewers. First, whereas respondents had as much time as they wanted to complete the PIAAC assessment items, there were strict time limitations for all the NEPS tests. Second, PIAAC was administered per default computer-based, with only an optional paper-based version. In contrast, all NEPS tests were paper-based. Third, different accompanying material was to be provided in the PIAAC versus the NEPS assessments, notably different calculators for the numeracy and mathematics tasks. Finally, the PIAAC assessment was administered via the international PIAAC software, which was somewhat different from the CAPI software used in the rest of the interview (including the administration of the NEPS tests) and not as familiar to interviewers.

PIAAC	Time		NEPS
	No time restriction	Time restriction	
	Respondents could work on the PIAAC assessment at their own pace and for as long as they wished	Interviewers timed the tests with a stopwatch:* → Limitation of 2 minutes for reading speed → Limitation of 28 minutes for the reading / mathematics booklets	
PIAAC	Mode		NEPS
	Computer (and paper)	Paper	
	Per default computer-based Paper booklets optional → 3 different PIAAC booklets (core, literacy, numeracy)	Exclusively paper booklets → 3 different NEPS booklets (reading speed, reading, mathematics)	
PIAAC	Material		NEPS
	For PIAAC numeracy:	For NEPS mathematics:	
	→ Simple calculator → Ruler → Photo** (for cba branch)	→ More sophisticated calculator; Interviewers were required to explain calculator functioning to respondents	

Notes: * Timing information was also registered in the CAPI software. ** Photo size and printing conditions conformed to PIAAC specifications.

Figure 3.2. Key differences between PIAAC and NEPS assessments

All in all, there were 6 possible paper booklets which could be administered in various combinations. Colour-coding was used to help the interviewers quickly discriminate between PIAAC and NEPS materials: PIAAC was blue (PIAAC paper booklets had covers in different shades of blue, the PIAAC calculator was marked with a blue sticker), whereas the NEPS material was green (NEPS paper booklets had covers in different shades of green, the NEPS calculator was marked with a green sticker). Thus, depending on the assessment condition, respondents could work on computer-based items only, or only on paper booklets, or both on paper and on the computer. Furthermore, respondents could have unlimited time for all assessment tasks, or time restrictions for all tests, or a mixture of the two.

Interviewers were instructed to keep all assessment material in an organized manner to ensure that respondents would be given the correct material at all times, and not to leave any left-over material on the table. This was especially important for the conditions with numeracy/mathematics, as different calculators and accompanying material were foreseen for use within the different survey instruments.

Interviewers were trained to understand the special requirements of the cognitive assessment part of the interview and to be sensitive to respondents' potential fears or anxiety should they feel they are being "tested." Interviewers were asked to create seating arrangements which would allow the respondents a good, secure, and preferably secluded space to carry out the assessment on their own, but which would still allow interviewers to monitor the respondents' progress and to intervene in case of need. They were instructed to set up good working conditions for their respondents, including ensuring a good seating position, watching out for an optimal screen angle of the laptop and comfortable access to the mouse (the latter for computer-based assessment). Respondents always worked on the assessment tasks on their own; interviewers were absolutely not allowed to help respondents with any assessment items. However, they were allowed to provide technical support, for example with the mouse or with the NEPS calculator. For the PIAAC instruments, interviewers were further instructed that they could gently tell the respondents they could go on to the next item if they noticed that the respondents were "stuck" – they could for example say that some items are easier than others, or that the solution to one item was not required for the next. They were also encouraged to motivate respondents who were "clicking through" the assessment to take their time and try to solve each task. Once the cognitive assessment was initiated, it had to be completed within the same session and could not be interrupted and continued on another day.

3.3 Observation Module and Interview Wrap-Up

After the cognitive assessment, respondents answered a few questions about their motivation and amount of effort during the direct assessment. If applicable, they also received some questions comparing the PIAAC to NEPS instruments, for example whether they had found the NEPS or the PIAAC items generally easier or whether they had felt stressed by the time limitation in the NEPS. The interviewer subsequently also answered questions about the interview in general, for example where the interview had taken place and whether other persons had been present during the interview. They were also asked more specific questions about the direct assessment, for example how motivated the respondent had seemed to them during the assessment, and whether the respondent had asked for help.

Before closing the interview, anchor persons were asked for their consent to a linkage with administrative data. A linkage with administrative data from the Institute for Employment Research (IAB) of the German Federal Employment Agency (BA) was pursued as part of the cooperation between the PIAAC-L project and the PIAAC Leibniz Network (PIAAC-LN) – an interdisciplinary network of researchers working with PIAAC data with a variety of research objectives. In accordance with privacy regulations, written consent was required for linkage (name, birth date, birth name, signature). If the respondent was unsure about whether or not to consent at the time of the interview, it was possible for them to send the consent form to home office at their discretion (a return envelope was provided).

3.4 Interview Laptops

In order to ensure comparable conditions for the PIAAC assessment, it was necessary to administer the PIAAC-L 2015 interview on laptops that complied with the hardware requirements specified in the PIAAC standards and guidelines (OECD, 2010). Due to the fact that not all the interview laptops used for PIAAC 2012 (cp. Zabal et al., 2014) were still perfectly functional, it was necessary to purchase a number of new interview laptops. The laptop model that was used as interview laptop in PIAAC 2012 was no longer available for purchase and it was necessary to find an alternative which would also comply with all PIAAC standards. Various possibilities were considered, and after extensive tests by the survey organization and especially the sub-contractor DIPF, in its role as PIAAC-related IT coordinator for PIAAC-L 2015, the model Fujitsu Lifebook Modell E754 was selected. This laptop fulfilled all the PIAAC technical requirements. The technical specifications can be found in Annex A. Unlike the old laptops, new laptops had a keyboard with a numeric keypad. It was deactivated to ensure consistent response conditions for all respondents irrespective of type of laptop. Touchpads were also deactivated on all laptops. Ninety-five original PIAAC 2012 laptops and twenty-five newly purchased laptops were used in PIAAC-L 2015.²⁴

²⁴ 16% of interviews were administered on new laptops.

4 Fieldwork

The data collection for the second wave of PIAAC-L was carried out by the survey organization TNS Infratest (they were subcontracted for all three waves of PIAAC-L data collection after a competitive bidding process) and took place between March 25, 2015 and September 1, 2015. Fieldwork was carried out in various phases. In the main fieldwork phase, cases were released in three batches; as previously explained, partner cases were only released after successful completion of the corresponding anchor person interview. In the second phase of fieldwork, certain cases that could be re-approached according to German legislation were re-issued, again in various batches. Survey participants were sent a thank-you letter promptly after their interview, together with a short quality control questionnaire.

4.1 Staff

The staff for PIAAC-L at the survey organization consisted of one field director, seven supervisors, and 117 interviewers. The field director had been responsible for the PIAAC 2012 survey and also for the first wave of PIAAC-L at the fieldwork agency. The majority of the interviewers (101) were PIAAC 2012 and PIAAC-L 2014 interviewers, twelve interviewers had administered PIAAC-L 2014 (but not PIAAC 2012), and only four interviewers had no previous PIAAC or PIAAC-L experience; the latter were high-performing interviewers experienced in CAPI administration. The majority of interviewers were over 50 years of age (8.5% were under 50 years of age, 30% over 70 years of age) and had worked for the survey organization for long periods of time (only 10% had worked for the survey organization less than five years, 66% five to fifteen years, 24% over 15 years). Fifty-four percent of the interviewers were male. There was no interviewer attrition. As far as possible, interviewers were re-allocated the cases they had worked in the previous wave of PIAAC-L and in PIAAC 2012.

4.2 Interviewer Training and Briefing

Due to the complex design of the PIAAC-L 2015 interview and the variety of interviewer instructions and tasks for the different assessment conditions, a comprehensive face-to-face interviewer training was necessary. Four three-day interviewer trainings (corresponding to 16.5 training hours) took place in March 2015. All interviewers participated in training. The trainings were carried out jointly by the PIAAC-L team (GESIS and IflBi) and the survey organization; the sub-contractor DIPF also attended the training and provided technical support.

Interviewer training emphasized the standardized administration of the PIAAC-L 2015 interview, both for the questionnaire and the cognitive assessments. The CAPI software – including the integrated international software for the administration of the PIAAC assessment instruments – guided the interviewers through the interview, with automatic routing for all required paths through the interview (both for anchor persons as well as their partners).

The interviewer training included the following sessions:

- **Introduction to the project:** the PIAAC-L survey, design of wave 2, fieldwork organization, contacting and documenting contacts, gaining cooperation for the assessment
- **The background questionnaire:** content, following survey protocols for asking and recording survey questions, general routing and specificities of partner interview, a sample run through of the questionnaire

- **General introduction to the cognitive assessment:** introduction to the PIAAC-L assessment, interviewer role in the assessment, differences and similarities of the administration of the PIAAC and the NEPS instruments, rules for standardized administration
- **The PIAAC assessment:** administering the PIAAC computer-based assessment, administering the PIAAC paper-based assessment, materials to be used for the PIAAC assessment
- **The NEPS assessment:** administering the NEPS assessment, materials to be used for the NEPS assessment, enforcing the time limits
- **Mixed assessment conditions:** administering PIAAC and NEPS instruments in one interview
- **Practice interviews:** two practice interviews carried out as role-play, with interviewers acting once as respondents and once as interviewers
- **Quality control and sum-up**

Interviewers were also provided with an interviewer manual for PIAAC-L 2015 and an interviewer booklet. The manual included detailed information on all aspects of the design and procedures of the PIAAC-L 2015 interview, including:

- Key facts about PIAAC-L in general and the second wave of data collection in particular
- Target population
- Fieldwork organization and timeline
- Ethical principles
- General overview of interview workflow
- Overview and administration of CAPI questionnaire
- Overview and administration of cognitive assessment: Special focus on the differences in the administration of PIAAC versus NEPS instruments
- Wrapping-up the interview
- Accompanying survey material
- Quality control
- Case documentation and disposition codes
- Contacting and gaining respondent cooperation for an interviewer with a cognitive assessment component

In addition to the extensive interviewer manual, interviewers were equipped with a compact interviewer booklet containing key information for the administration of the PIAAC-L interviews. Interviewers were given the material from the interviewer training sessions, further written instructions, and briefings during fieldwork. They were required to read the manual and carry out an additional practice interview prior to commencing fieldwork. Emphasis was also placed on advance organization of survey materials: Given the complexity of the PIAAC-L 2015 interview, the interviewers had a comprehensive set of materials that was required for the data collection (see Annex B). A CAPI hotline providing technical support was available for interviewers throughout fieldwork. In addition, the project director and his team could be directly consulted regarding any questions about interview administration etc.

4.3 Interviewer Remuneration

The interviewer payment scheme for the PIAAC-L 2015 interview reflected both key aspects of the payment scheme adopted in PIAAC and the particularities of the PIAAC-L interview. The main element was an attractive rate per completed interview (higher than comparable social surveys in Germany), with a somewhat higher rate for completed interviews with anchor persons than for partner interviews. In addition, a dynamic hourly payment component for interviews longer than 95 minutes was included for anchor person interviews, to make allowance for potentially particularly long interview times due to the unrestricted time permitted for the PIAAC assessment. All travel costs were reimbursed. Day rates were paid in certain cases for interviewers working especially difficult or distant sample points.

4.4 Addressing Respondents

Due to already established prior contacts and familiarity both with the survey and in many cases with the interviewer, addressing respondents and gaining cooperation is somewhat easier in a panel survey such as PIAAC-L than in a cross-sectional survey. Nevertheless, significant efforts were maintained in PIAAC-L 2015 to stimulate continuing high cooperation. This was especially important with a view to the additional challenge of the cognitive assessment component in the PIAAC-L 2015 interview.

All eligible anchor persons were sent a Christmas card at the end of 2014. This panel maintenance measure served both the purpose of minimizing attrition by maintaining a positive contact with the PIAAC-L anchor persons on behalf of the PIAAC-L project and also of checking the contact addresses. Addresses that were found to be no longer valid were then followed-up and updated via a registry search.

A personalized advance letter was sent to all anchor persons immediately prior to the beginning of fieldwork or more specifically prior to the release of a batch. This letter announced the upcoming visit of the interviewer (mentioned by name) and indicated that in this PIAAC-L wave, anchor persons and their partners living in the same household would be asked to participate. The incentive for participation in this interview was also mentioned (see below). The voluntary nature of participation was reiterated, and a confidentiality/data privacy statement enclosed. The number of the information hotline available for respondents throughout the fieldwork period was also provided; the project director and his team could be contacted through the hotline (free of charge) to answer any questions about the PIAAC-L survey. An additional contact letter (together with the confidentiality/data privacy statement) was sent to anchor persons who were re-approached in the re-issue phase. There were two different versions: one for initial refusals²⁵ and one for non-contacts and other non-interview dispositions.

Incentives

Respondents (both anchor persons and partners) received 40 euros in cash upon completion of the interview. This conditional monetary incentive was somewhat lower than that paid in PIAAC 2012. In Germany, 50 euros were paid upon completion of the PIAAC 2012 interview (cp. Zabal et al., 2014); the PIAAC interview was comparable in terms of length and requirements to the PIAAC-L 2015 interview. The 40 euros can still be regarded as a very attractive reward for the respondents' time and cooperation. There was no additional unconditional incentive.

²⁵ Only refusals that could be legally re-contacted.

Contacting procedures

Interviewers from PIAAC-L 2014 were re-allocated the same cases as far as possible so that contacting and recruitment benefited from the existing bond between the interviewer and the respondent. The instructions to the interviewers were to start contacting promptly after the advance letters had been sent. Interviewers were asked to contact especially diligently at the beginning of the fieldwork phase and to ensure that each case was worked with the necessary intensity. In this second wave of PIAAC-L data collection, in-person contacts were no longer a requirement, but interviewers were asked to contact in-person if other contacting methods did not yield appropriate results. Four in-person contacts were required before a non-contact disposition could be allocated. All contacts and contact attempts were documented electronically within the CAPI software (date, time, type of contact, and contact result, i.e. disposition code).²⁶ Interviewers also had to answer a few questions about neighbourhood and dwelling characteristics when they made their first in-person contact. Problems with addresses and movers identified during fieldwork were either directly resolved by interviewers – they are quite successful in tracking current, valid addresses – or were reported back to home office, in which case a registry search was subsequently initiated.

4.5 Sample Releases

Cases were released in three batches in the main fieldwork phase, with separate (coordinated) waves for anchor persons and their partners. As mentioned above, cases were assigned with a view to ensuring the maximum possible overlap with PIAAC-L 2014 so that as far as possible interviewers continued working with the same respondents. Interviewers were instructed to work intensively on their cases as soon as these had been allocated to them.

In the re-issue phase (which was also realized in various batches), both anchor person as well as partner cases that could be re-approached according to German legislation were released again.²⁷ This included soft refusals, non-contacts, cases with a final disposition that indicated the anchor person had been unavailable for an interview during the main fieldwork phase, and cases for which a new address had been obtained either by an interviewer (but could not be pursued by the same interviewer) or through an address search via the registry offices. As a result of the screening at the end of the main fieldwork phase, about 63% of the non-interviews with anchor persons could be re-issued in the second fieldwork phase (cp. Steinacker & Wolfert, 2017). Refusal conversion efforts with respect to partners were carried out more cautiously so as not to jeopardize the anchor persons' continuing participation in the next wave of PIAAC-L.

More detailed information on fieldwork as well as documentation of some of the survey material used (e.g. advance letters) can be found in the report produced by the survey organization (Steinacker & Wolfert, 2017).

²⁶ A paper address/contact form was additionally available and used for administrative and invoice purposes.

²⁷ It is forbidden to re-approach so-called hard refusals by German legislation. All refusal dispositions together with information from other sources (e.g. interviewer notes, documentation from respondent hotline) were carefully screened to determine which refusals could be re-contacted for refusal conversion.

4.6 Monitoring and Quality Control of Fieldwork

The interviewers' performance was closely monitored by the survey organization throughout fieldwork. The survey organization produced regular fieldwork progress reports and also delivered preliminary data from the field to the PIAAC-L consortium at various times during fieldwork. Fieldwork progress was also overseen by GESIS and where necessary the evaluation and possible interventions were discussed bilaterally.

One key component of the interview validation in PIAAC-L consisted in automatic checks of basic interview data. As a part of the quality control, consistency checks between the PIAAC-L 2015 interview data and data from PIAAC-L 2014 were automatically carried out (gender, year of birth, first name). Interview durations were monitored throughout fieldwork. Specifically, the time duration for the administration of the background questionnaire (focussing on very short durations) and for the administration of the NEPS cognitive assessment (which had a defined length, given the timed nature of the test) were checked. Any discrepancies were flagged.

The second key component was a 100% validation of all complete interviews via a short questionnaire that was sent by postal mail to all anchor persons. The questionnaires were sent out on a weekly basis so that the interview would still be fresh in the respondents' mind; a return envelope was enclosed. If there was a partner that had also participated in PIAAC-L 2015, two validation questionnaires were enclosed and the partners were also asked to fill out a questionnaire. The validation questionnaire asked whether the respondent had been recently interviewed for the PIAAC-L project, how long the interview had taken, and for the respondent's year of birth and gender.²⁸ The other questions focussed on specifics of the administration: whether the interview had been administered face-to-face or by phone (interview mode was face-to-face only), whether they had been asked to work on tasks (either on paper, on the laptop, or both), whether there had been a time limit for these tasks, or whether they had received any kind of help from the interviewer when working on these tasks (and if so, what kind of help). Over 60% of both anchor person and partner validation questionnaires were completed and returned to home office (64% for anchor persons, 62% for partners). The data from the validation questionnaires were screened and discrepancies and abnormalities flagged.

These quality controls were carried out as an ongoing, continuous process during fieldwork. All interviews flagged during the validation process were subsequently individually checked. The individual validation follow-ups were carried out at the household level, i.e. both the anchor person interview and the partner interview (if applicable) were further examined. A total of 294 households (9%) were flagged and more intensive validation steps undertaken. Information from all sources was pooled and further analysed, and often many issues were successfully clarified at this stage (45% of flagged cases were clarified at this stage). If not, respondents were contacted by phone by the survey organization's validation department (27% of flagged cases were clarified at this stage). If this did not yield clear results (usually because attempts to reach the respondent by phone remained unsuccessful), the interviewer was consulted for clarification and their overall work reviewed (15% of flagged cases were clarified at this stage). The validation results were reviewed by the survey organization together with GESIS, with a most careful scrutiny of the few not fully resolved flagged cases. No interview falsifications were identified.

²⁸ Birth year and gender were also compared with the interview data and PIAAC-L 2014 data to check for possible inconsistencies.

4.7 Fieldwork Results

The fieldwork results refer to the final data after validation and data cleaning, including determining final disposition codes at the end of fieldwork. For cases which had been worked in various phases, the different disposition codes were reconciled.²⁹ Any other remaining temporary disposition codes were finalized.

The net sample for PIAAC-L 2015 consists of 3 263 completed interviews with the anchor persons (primary net sample) and 1 368 completed interviews with the partners of the anchor persons living in the same household, resulting in a total of 4 631 interviews.³⁰ The final disposition codes for the anchor persons, based on the primary gross sample of 3 758 persons, are shown in Table 4.1.

Table 4.1. Final Disposition Codes for Anchor Persons

	Final disposition code	<i>n</i>	%
1	Anchor person unavailable during fieldwork period	63	1.68
2	Anchor person permanently ill or incapable	8	0.21
4	Language problem, German proficiency insufficient	3	0.08
5a	Refusal anchor person	224	5.96
5b	Refusal via other person	22	0.59
6	Anchor person moved outside of country	6	0.16
7	Anchor person moved, new address unknown	28	0.75
8	Anchor person moved, new address known	2	0.05
9	Anchor person unknown at given address	1	0.03
10	Invalid address	3	0.08
12	Death	6	0.16
13	Other reasons or unusual circumstances	83	2.21
14a	Non-contact with household	37	0.98
14b	Non-contact with anchor person	7	0.19
16	No final disposition	2	0.05
21	Completed case: anchor person interview	3 263	86.83
Total		3 758	100.00

²⁹ As in PIAAC 2012 and PIAAC-L 2014, the final disposition was only coded as a non-contact if no contact was made whatsoever with the household during the entire fieldwork (and not, for example, if non-contact was coded only for the last fieldwork phase).

³⁰ There were no breakoffs to the background questionnaire (these would not have been regarded as completed cases). However, there were a few (partial) breakoffs in the assessment which were counted as interviews according to the PIAAC definition of a completed case (cf. OECD, 2010; Zabal et al., 2014).

The simple fieldwork retention rate based on the primary gross sample of 3 758 anchor persons is 87%.^{31,32} Rates for address-related problems and non-contacts are very low (both around 1%), showing that the efforts made in survey operations to reduce these dispositions were successful.

For the transition from PIAAC-L 2015 to 2016, a non-monotonic design was implemented. Thus, some of the anchor persons who did not participate in PIAAC-L 2015 were re-contacted for PIAAC-L wave 3. This is only the case for anchor persons with clearly temporary non-interview dispositions, e.g. "anchor person unavailable during fieldwork period" or "temporary sickness". In wave 2, 247 persons can be classified as temporary drop-outs; these were re-contacted in 2016 (for more information see Martin, Zabal, & Rammstedt, 2017).

Table 4.2. Final Disposition Codes for Partners

	Final disposition code	<i>n</i>	%
1	Partner unavailable during fieldwork period	32	1.52
2	Partner permanently ill or incapable	14	0.67
3	Partner institutionalized	1	0.05
4	Language problem, German proficiency insufficient	23	1.09
5a	Refusal partner	420	19.97
5b	Refusal via other person	143	6.80
7	Partner moved, new address unknown	4	0.19
8	Partner moved, new address known	1	0.05
10	Invalid address	4	0.19
13	Other reasons or unusual circumstances	58	2.76
14a	Non-contact with household	3	0.14
14b	Non-contact with partner	2	0.10
16	No final disposition	30	1.43
21	Completed case: partner interview	1 368	65.05
Total		2 103	100.00

³¹ 3 262/3 758; given the very specific and unique calculation of PIAAC response rates (cf. Mohadjer, Krenzke, & Van de Kerckhove, 2013b; Zabal et al., 2014), which is no longer directly applicable to the PIAAC-L design, and the fact that there is no standard and straightforward application of the AAPOR response rates to registry-based samples, we report the simple fieldwork response rate here; given the longitudinal design, it is now called retention rate.

³² Relative to the net PIAAC 2012 interviews, the retention rate is 60% (3 262/5 465).

Table 4.2 provides the final disposition codes for the partners, based on the (empirically determined) primary gross sample of 2 103 persons. The participation rate for the partners is 65%.³³ As in the first wave of PIAAC-L, the main focus lay on obtaining anchor person participation. Interviewers were instructed to ensure that attempts to recruit partners were not to jeopardize anchor person cooperation. While respecting this concern, interviewer pursued obtaining partner cooperation with determination and sensitivity – since, unlike the anchor persons, partners did not have previous experience with the assessment situation in the interview, interviewers took special care to address any possible concerns in this context.

The average interview length consisting of questionnaire, cognitive assessment, and wrap-up was 99 minutes. Interviews took on average 103 minutes for anchor persons, and 89 minutes for partners. This reflects the more comprehensive anchor person interviews, including extra questions at the beginning of the interview and in the questionnaire (the questionnaire took on average 33 minutes for the anchor persons, and 27 minutes for the partners), a more complex assessment design (anchor persons spent on average 63 minutes on the assessment, the partners 58 minutes), and more elements in the interview wrap-up. Overall, the actual and the intended interview durations concurred extremely well: Approximately half an hour for the background questionnaire (31 minutes on average), and approximately one hour for the cognitive assessment (62 minutes on average).

The empirically realized distributions over the different assessment conditions are shown in Table 4.3 for the anchor persons and Table 4.4 for the partners. The allocation procedures worked as intended, both anchor persons and partners are very equally distributed across the assessment conditions.

Table 4.3. Realized Assessment Conditions for Anchor Persons

Assessment Condition	<i>n</i>	%
AP1	415	12.7
AP2	406	12.4
AP3	406	12.4
AP4	410	12.6
AP5	408	12.5
AP6	405	12.4
AP7	403	12.4
AP8	410	12.6
Total	3 263	100.0

Table 4.4. Realized Assessment Conditions for Partners

Assessment Condition	<i>n</i>	%
P1	693	50.7
P2	675	49.3
Total	1 368	100.0

Table 4.5 shows how respondents were routed to the paper branch in the PIAAC assessment. Eighty-eight percent of the PIAAC assessments were administered computer-based; this is somewhat more than the 81% in PIAAC Germany 2012 (cp. Martin et al., 2013). Approximately 5% of the anchor persons in PIAAC conditions had no computer experience (recorded in the background questionnaire), 2% refused to do the assessment on the computer, and 4% failed the CBA Core 1 which tested whether the respondents had sufficient skills using the computer mouse to do the assessment on the computer.

³³ 1 368/2 103

Table 4.5. Realized Assessment Conditions for Anchor Persons, Assessment Conditions With PIAAC Instruments (AP3-AP8)

Assessment Condition	<i>n</i>	%
1 PIAAC CBA	2 159	88.4
2 PIAAC PBA – no computer experience	129	5.3
3 PIAAC PBA – cba refusal	59	2.4
4 PIAAC PBA – cba core 1 fail	95	3.9
Total	2 442	100.0

Notes: CBA=computer-based assessment; PBA=paper-based assessment

As previously mentioned, at the end of the interview anchor persons were asked for their consent – in written form, with a signature – to link their PIAAC and PIAAC-L data with administrative data from the Institute for Employment Research (IAB) of the German Federal Employment Agency (BA). The obtained consent forms were carefully scrutinized by the survey organization, with a complete double check by GESIS. After this quality control, valid consent forms were available from 72% of the anchor persons.³⁴

³⁴ PIAAC/PIAAC-L data linked with administrative labour market data from the Institute for Employment Research (IAB) of the German Federal Employment Agency (BA) are available via the IAB Secure Data Center. A comprehensive application and a contract are prerequisites for access.

5 Data Management, Data Products, and Documentation

Due to the diverse components of the PIAAC-L 2015 interview, data management activities were quite varied and complex. The different sources of data that were integrated into the PIAAC-L 2015 database are illustrated in Figure 5.1.

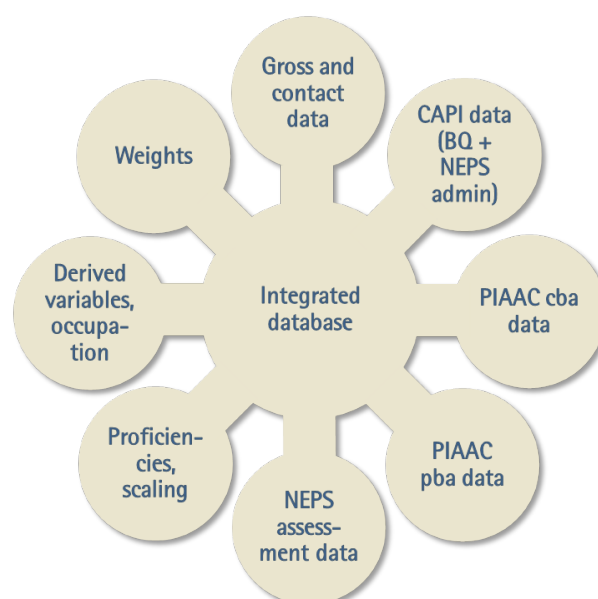


Figure 5.1. Different data sources in PIAAC-L 2015

Data from the CAPI software primarily contained the questionnaire data and data from the administrative part of the NEPS assessment. Data cleaning for this, the gross data, and the contact data was carried out by both by the survey organization and GESIS, in various iterations. This included checking the integrity and uniqueness of the sample (gross and net) and identification numbers, as well as ensuring that the latter were correct and consistent. Key sociodemographic longitudinal information was checked. For the background questionnaire data, checks and data cleaning was undertaken by GESIS. This included range and a few plausibility checks, the application of the PIAAC-L missing scheme,³⁵ and editing open entry responses. Data management activities for the cognitive data (e.g., setting "not reached / not attempted") were taken care of by the LIfBi. Open responses for occupation and industry were coded by the coding department at the Research Data Center at the LIfBi. At a more general level, GESIS checked all interview documentation. In certain cases in which the interviewer notes indicated the cognitive assessment had not been administered correctly (e.g., because the partner had translated the items), the assessment data was removed.³⁶

For the PIAAC assessment, the outputs of the international PIAAC software were various logfiles with very complex data which needed to be extracted and transformed using special software, the Data Management Expert (DME). This software, developed by the International Association for the Evaluation of Educational Achievement – Data Processing and Research Center (IEA DPC), is used to extract, manage, and integrate the PIAAC output data into a readable, standardized database format.

³⁵ The PIAAC-L missing scheme was slightly modified for PIAAC-L 2015.

³⁶ Such cases were coded as assessment breakoffs.

Because the international PIAAC software had to be adapted for the PIAAC-L assessment, IEA DPC was subcontracted to adjust the DME accordingly.³⁷ The assessment paper booklets were scored and coded by the IEA DPC³⁸ and the data were subsequently checked and cleaned by GESIS and the LfBi. The cognitive data were further processed and scaled by the LfBi.

A number of derived variables were produced by GESIS. To increase the usefulness of the PIAAC-L data and its comparability with the international PIAAC data sets, some of the PIAAC derived variables were replicated for PIAAC-L. Weighting activities in PIAAC-L are the responsibility of the DIW. They produced two weighting factors for the second wave of data collection: non-response weights (inverse staying probability) and cross-sectional weights (poststratification weighting factor).

In the PIAAC-L database, there are two new data sets pertaining to the 2015 data collection: the person data and the weights. In addition, the registry data set – which is of incremental nature and contains information on participation in the different waves of PIAAC-L – was updated.

5.1 Coding and Scoring

The responses to the questions on occupation and industry (replicated from the PIAAC-2012 questionnaire) were coded by the coding department at the Research Data Center at the LfBi. The LfBi RDC did not carry out the coding of occupation and industry for PIAAC 2012 Germany. However, they were responsible for the occupation and industry coding of all three waves of PIAAC-L data collection, hereby achieving high consistency of occupational coding within PIAAC-L. Other open responses (for example open language and country responses) were captured by the survey organization³⁹ as a part of their data processing. The IEA DPC was sub-contracted both for the coding of the results of the NEPS cognitive assessment (they carry out this task for the NEPS), as well as the scoring for the PIAAC paper booklets (IEA DPC was also in charge of this task for PIAAC Germany 2012); thus, maximal comparability of coding and scoring processes with the original studies was ensured. Scoring of the computer-based PIAAC items was automatically implemented in the international software.⁴⁰

Coding of occupation and industry

The PIAAC questions on occupation were designed with a view to capture the amount of detail required for coding into the *International Classification of Occupations* (ISCO-08; International Labour Office, 2012). Thus, in PIAAC-L 2015, occupation was directly coded into ISCO-08. In this way, occupation coding in PIAAC-L 2015 can be directly compared to the occupation coding obtained for PIAAC Germany 2012, although some limitations due to coding by different institutions are to be expected. Coding was manually carried out by 10 coders from the coding department at the Research Data Center at the LfBi, of which 9 had extensive coding experience. All coders attended a training of at least one day and were required to successfully complete numerous coding tasks prior to commencing the coding work. The coders were closely monitored, and their coding results were revised by a supervisor who provided continuous individual feedback. The open responses to the occupation questions were supplemented with additional information (e.g., occupational position,

³⁷ The required license was also purchased.

³⁸ This was done under another subcontract.

³⁹ Some of these variables were coarsened according to a scheme developed for PIAAC Germany 2012 as a part of data confidentiality edits.

⁴⁰ Please note that the LCS algorithm (longest common subsequence) used by the PIAAC international consortium to adjust the scoring of the computer-based highlighting items (cp. Yamamoto, Khorramdel, & Von Davier, 2013a) was not applied for the PIAAC-L data.

supervisory status, self-employment).⁴¹ No codes for the German National Classification of Occupations (Klassifikation der Berufe: KldB 2010; Bundesagentur für Arbeit, 2011) were derived since there is no appropriate crosswalk; thus, there is no direct comparison with the KldB codes from PIAAC-L 2014. A number of additional classifications often used in research such as ISEI-08, MPS, and SIOPS-08 were derived.

As in PIAAC 2012, industry information was coded into the *International Standard Industrial Classification of All Economic Activities* (ISIC, Rev. 4; United Nations Statistics Division, 2013). NACE⁴² codes were subsequently generated from these. Approximately 15% of the responses were coded automatically, the rest were coded manually by trained coders.

Scoring of PIAAC-L paper booklets (PIAAC booklets and NEPS booklets)

All PIAAC-L paper booklets used in the direct assessment were scanned by IEA DPC and made available to the PIAAC-L team in digital form.

For the paper-based PIAAC assessment, respondents answered the items by writing their responses by hand in the booklets. Professional human scorers are required to determine whether these handwritten responses are correct or incorrect based on very detailed item-by-item scoring guides. Scoring of the PIAAC paper-based items (open responses) was undertaken by the IEA DPC in accordance with the scoring guides and the modified scoring design implemented by PIAAC Germany 2012 (cp. Zabal et al., 2014); thus, scoring adhered to the PIAAC international standards. Scoring was done by two IEA DPC staff members who had been the lead scorers for PIAAC Germany 2012 and had personally attended the scoring training provided by the international PIAAC consortium. There was therefore no need for a special scoring training for PIAAC-L, but scorers carefully prepared themselves for this work and re-familiarized themselves with all the relevant scoring guides and accompanying materials, including the materials from the scoring training and the list of coding queries from PIAAC 2012 and the corresponding adjudications by the PIAAC consortium.

All PIAAC items were double scored (both scorers coded all responses) and disagreements between the scorers were resolved in a subsequent review and reconciliation process. Scoring was conducted strictly item-wise and the responses randomized per item. The interrater reliability was over 95% for all items. The resolution of scoring disagreements was carried out in a resolution meeting also attended by GESIS. Furthermore, additional quality control of the IEA DPC scoring was carried out by GESIS.

The NEPS assessment consists of closed-format items (single choice items and multiple choice items) or simple open responses basically only requiring transcription of a digit or a letter. Thus, only simple coding was carried out by the IEA DPC for the NEPS booklets (and not scoring as for PIAAC). This coding complied with the NEPS coding scheme and specifications. Quality control was carried out by the IEA DPC and further spot-checks were undertaken by the LfBi.

5.2 Scaling and Computation of Plausible Values for PIAAC-L

The required scaling activities for the cognitive assessment data from PIAAC-L 2015 as well as the computation of extended plausible values for the PIAAC 2012 proficiencies were carried out by the LfBi. PIAAC-L scaling activities for PIAAC 2012 data and data collected with PIAAC instruments in

⁴¹ Furthermore, apart from the official final ISCO-08 Draft-Definitions (International Labour Office, 2015), coders also had access to BERUFNET which provides information on professions in Germany. This is useful to clarify tasks, duties, and educational requirements for specific occupational titles in the German context.

⁴² NACE="Nomenclature statistiques des activités économiques dans la Communauté européenne (Statistical Classification of Economic Activities in the European Community)

PIAAC-L 2015 were based on the scaling procedures established by the international PIAAC consortium. In PIAAC, ten plausible variables were produced for each of the proficiency scales for literacy, numeracy, and problem-solving in technology-rich environments using Item Response Theory (IRT) scaling procedures and latent regression models (for a detailed description of the PIAAC scaling procedures see Yamamoto, Khorramdel, & Von Davier, 2013a, 2013b, 2013c). Following analogous scaling procedures, the LifBi produced ten plausible values for the PIAAC-L 2015 literacy and numeracy cognitive data collected with PIAAC instruments. For the PIAAC-L 2015 cognitive data collected with NEPS instruments, weighted maximum likelihood estimates (WLEs) and standard errors for the WLEs were computed for reading and mathematics following the standard NEPS procedures (cp. Pohl & Carstensen, 2012; Pohl & Carstensen, 2013).^{43,44}

In order to be able to analyse the original PIAAC 2012 proficiencies together with the new background information collected in PIAAC-L, a new set of plausible values was computed based on an extended population model including the original PIAAC population model and the substantial number of additional PIAAC-L variables from both 2015 and 2014.⁴⁵

For details, the reader is referred to a separate technical report by Carstensen et al. (2017) that documents the scaling of the cognitive data in PIAAC-L.

5.3 Weighting

Weighting of the PIAAC-L 2015 data followed the weighting procedures established for PIAAC-L 2014 which combined weighting approaches from PIAAC Germany 2012 and the SOEP. Responsibility for weighting lies with the DIW, and they carried out the following weighting activities with the PIAAC-L 2015 data: (1) modeling nonresponse in two steps, (2) generating nonresponse weights, and (3) calibration (using a combination of raking and poststratification). Two weighting factors were produced for anchor persons only: (1) the inverse staying probabilities, and (2) the poststratification weighting factors.⁴⁶ A detailed description of the weighting procedures for PIAAC-L 2015 is provided in a separate weighting report, see Burkhardt and Bartsch (2017).

⁴³ In PIAAC, respondents work on only a subset of items from a domain, whereas in the NEPS the respondents are always administered the full item set. Please note that while plausible values yield unbiased estimates of population or subpopulation competence distributions, this is *not* the case for individual scores. The WLEs are unbiased point estimates of individual scores, which however still include measurement error components; the variance of the WLEs also includes error variance (Pohl & Carstensen, 2012).

⁴⁴ The PIAAC-L consortium decided to additionally compute and provide weighted maximum likelihood estimates and standard errors for the WLEs for the PIAAC-L 2015 literacy and numeracy cognitive data collected with PIAAC instruments for preliminary analyses. These estimates are only available for certain cases. The WLEs will be included in the PIAAC-L scientific use database to be released in December 2017 (ZA5989: 3.0.0, doi: 10.4232/1.12925). For more information on the computation and utilization of these PIAAC WLEs see Carstensen, Gaasch, and Rothaug (2017).

⁴⁵ The person data file for PIAAC-L 2015 thus offers two sets of plausible values: The plausible values for the cognitive data collected in PIAAC-L 2015 (literacy and numeracy), and the re-scaled plausible values for the cognitive data collected in PIAAC 2011/2012.

⁴⁶ Note that no replicate weights are produced in PIAAC-L (whereas in PIAAC a replication approach was followed to account for the complex sampling design and thus enable the accurate calculation of standard errors).

5.4 Data Confidentiality

As described in the technical report for PIAAC-L 2014 (Zabal et al., 2016), an elaborate data confidentiality strategy was developed for PIAAC-L. This strategy was initially based on that developed for the German PIAAC 2012 Scientific Use Files, and extended to take PIAAC-L specific characteristics into consideration, such as: (a) the vast amount of information collected due to the longitudinal design, (b) the extension to the household pursued in PIAAC-L, and (c) the different approaches to issues of data confidentiality in the three institutes responsible for the cooperative project PIAAC-L (each institute was entitled to veto the release of specific data if this seriously conflicted with their policy for disclosing information). The data collected for PIAAC-L 2015 was reviewed in detail and the associated privacy risks evaluated. Decisions taken for PIAAC-L 2014 were continued, and the disclosure risk and information loss were carefully considered for the new issues that arose. The data confidentiality decisions (i.e. release of detailed information, release of coarsened information, suppression of variables) reflect the best possible balance found. The final set of confidentiality measures were approved by the data protection officers from all three institutes as well as the three principal investigators. The final data confidentiality edits undertaken to protect the identity of the PIAAC-L respondents were implemented by GESIS and verified by the other project partners.

The data user contract is an additional important measure in the PIAAC-L data confidentiality strategy. This contract only allows individuals who have provided a convincing specific research objective and have personally signed the contract to access and use the PIAAC-L data. It generally forbids merging with other individual-level data (with the exception of the PIAAC 2012 data) and restricts the data usage length. The deletion of the PIAAC-L data set at the end of data usage is mandatory.

5.5 Data Products

The PIAAC-L project data are made available as quickly as possible for national and international academic research. The data for PIAAC-L 2015 were released (together with an update of the PIAAC-L 2014 data and the PIAAC-DE 2012 Scientific Use File⁴⁷) in December 2016 through the Research Data Centre PIAAC (RDC PIAAC/FDZ PIAAC)⁴⁸ together with the GESIS Data Catalogue. To access the PIAAC-L data it is necessary to sign the PIAAC-L user contract. The terms of this contract permits PIAAC-L data files to be merged with the PIAAC Germany 2012 Scientific Use File and thus allows for longitudinal analyses (cp. Zabal et al., 2016).⁴⁹ The most recent released PIAAC-L scientific use database with PIAAC-L 2014 and 2015 data consists of the following data sets (GESIS – Leibniz Institute for the Social Sciences, German Socio-Economic Panel (SOEP) at DIW Berlin, & LIfBi – Leibniz Institute for Educational Trajectories, 2017) available from the PIAAC Research Center / GESIS Data Archive (Data File ZA5989, version accessible since 22.02.2017: 2.1.0, [doi:10.4232/1.12734](https://doi.org/10.4232/1.12734)):

- **ZA5989_Persons_14**
 - Units: all PIAAC-L 2014 respondents (anchor persons and household members 18+, with participation in data collection 2014)
 - Content: data from person questionnaire, including derived variables
- **ZA5989_Household_14**
 - Units: all PIAAC-L 2014 households
 - Content: data from household questionnaire, including derived variables

⁴⁷ Under a separate study number and doi.

⁴⁸ <http://www.gesis.org/en/piaac/rdc/>

⁴⁹ Merging with other personal data is otherwise forbidden.

- **ZA5989_Calendar**
 - Units: all PIAAC-L 2014 respondents (anchor persons and household members 18+, with participation in data collection 2014)
 - Content: data from biographical calendar, spell data
- **ZA5989_Weights_14**
 - Units: anchor persons 2014
 - Content: weighting factors
- **ZA5989_Persons_15**
 - Units: all PIAAC-L 2015 respondents (anchor persons and partners living in the same household, with participation in data collection 2015)
 - Content: questionnaire data, derived variables, cognitive assessment data, proficiency measures (plausible values for PIAAC literacy and PIAAC numeracy; weighted likelihood estimates (WLE) for NEPS reading and NEPS mathematics)
- **ZA5989_Registry**
 - Units: All persons ever registered in PIAAC-L
 - Content: basic information on participation in the different waves of data collection; this data set is incremental and consists of an updated and extended version of the registry data set that was originally released with the 2014 PIAAC-L data
- **ZA5989_Weights_15**
 - Units: Anchor persons 2015
 - Contents: Weighting factors

Various pieces of documentation are also available (these are accessible without restrictions): A documentation of the questionnaire (in German, as administered in the field, but with English labels), an extensive codebook for each data set (in English), and notes to the users.⁵⁰ In addition, there are technical reports as well as the survey organization's fieldwork report (in German only).

⁵⁰ The "notes to the users" is a *growing documentation* that is elaborated on by the PIAAC-L group with time.

Annex A: Technical Specifications of Interview Laptops

Original PIAAC laptops were used by 95 interviewers, newly purchased laptops by 25 interviewers. Please note that contrary to the original PIAAC 2012 laptops, the new laptops also had a numeric keypad. This keypad was deactivated so that the response conditions for all respondents were identical, regardless of the interview laptop. Laptop settings were adjusted to optimize screen brightness and contrast and keep both types of laptops comparable. Interviewers were instructed to watch out for the angle of the laptop screen as this is a crucial factor for visibility, especially of highlighted text (a crucial factor for the PIAAC computer-based assessment).

Technical specifications of the original PIAAC 2012 laptops:

- Fujitso ESPRIMO Mobile D9510
- 15.4 inch WXGA Notebook (resolution: 1280x800)
- Intel Core2 Duo P8700, 2.53 GHz, SMB 1066MH
- RAM: 2 GB DDR3 SO-DIMM PC8500
- HDD SATA 160GB 5.4k
- DVD Super multi (reader/writer)
- Keyboard D w\o TS black
- Modem
- Operating system: Windows XP professional

Technical specifications of the new laptops purchased for PIAAC-L 2015:

- Fujitsu Lifebook Modell E754
- 15.6 inch (1366x768)
- Intel i5-4200M 2.5 - 3.1GHz 2 Kerne SMT
- RAM: 4 GB DDR3 1.600 MHz, PC3-12800, SO DIMM
- HDD SATA 500GB 7.2k
- DVD Super multi (reader/writer)
- Keyboard D w\o TS black
- Modem, mobile connection
- Operating system: Windows 7 32 bit

Annex B: Survey Materials for PIAAC-L 2015 Interview

General:

- PIAAC-L laptop and accessories (computer mouse, mousepad, cable, charged battery)
- Paper address/contact form
- Interviewer ID badge
- PIAAC-L callback cards
- Copies of advance letter
- Copies of confidentiality statement
- Information about consent to data linkage within household, PIAAC-L, and PIAAC (for new partners)
- Interviewer booklet
- Interviewer manual
- Written consent form for data linkage with administrative data and return envelope (for anchor persons)
- 40 € per person in cash (incentive)

For administration of questionnaire and cognitive assessment:

- Show card booklet
- PIAAC paper booklets (blue)
 - Core
 - Literacy
 - Numeracy
- PIAAC calculator (blue sticker)
- PIAAC ruler
- 2 PIAAC photos
- NEPS paper booklets (green)
 - Reading Speed
 - Reading
 - Mathematics
- NEPS calculator (green sticker)
- NEPS stop watch
- Note pad
- Pens (black)

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