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Literacy, Numeracy, and Digital Practices at Home Among NEET Individuals in Germany

How are they Associated with Future Work and School?

Abstract: For adults who are not in education, employment, or training (NEET), an important source of their informal learning is literacy, numeracy, and digital (LND) practices at home. By analyzing data from the Programme for the International Assessment of Adult Competencies (PIAAC) and the longitudinal follow-ups in Germany, this study provides insight into the literacy, numeracy, and problem solving in technology-rich environments skill profile of NEET individuals and examines if LND activities at home contribute to their level of skill in these areas. Additional longitudinal analysis examines the association between the probability of being NEET two and four years later and initial level of LND activities at home. Together, the results demonstrate that literacy, numeracy, and problem-solving skills are lower among NEET individuals and LND activities partially account for their difference in average skill levels compared to non-NEET people. Over time, LND activities at home have a small association with a lower probability of being NEET two years later but minimal to no association four years later.

Keywords: Germany, NEET Adults, Informal Learning, Longitudinal Research PIAAC-L, Skill

1. Introduction

The following study explores the literacy, numeracy, and problem solving in technology-rich environments (PS-TRE) skill profiles of German adults who are not in education, employment, or training (NEET) and examines an important source of activity that may contribute to their informal learning: literacy, numeracy, and digital (LND) practices at home. Skill-based activities at home are a range of activities that may promote skill maintenance and development. For example, literacy-based activities include reading books or newspapers; numeracy-based activities include calculating a budget or using simple algebra or formulas; and digital practices include looking up new information or using word processing software.

As skill-based activities at home are known to support lifelong learning (Nygren, Nissinen, Hämäläinen & De Wever, 2019) they may also change the likelihood of being NEET over time. The German component of the Programme for the International Assessment of Adult Competencies (PIAAC) study provides an opportunity to examine the nexus of literacy, numeracy, and PS-TRE skills, home-based activities, and NEET status. With the inclusion of a series of comprehensive questions surrounding LND activities at home, there is an opportunity to understand how people who are NEET en-

gage in these activities and how they contribute to their overall literacy, numeracy, and PS-TRE skill levels. In addition, later longitudinal survey follow-ups allow for insight into how LND activities at home are associated with the likelihood of becoming or remaining NEET over time.

Prior research finds that NEET and unemployed adults have lower literacy, numeracy, and PS-TRE skills, even when accounting for prior education (Lundetræ, Gabrielsen & Mykletun, 2010; OECD, 2013a). Once someone becomes NEET, there is also evidence that this status lowers their likelihood of later skill and education attainment. For example, one study demonstrates that NEET status early in adulthood is associated with lower LND skills over time (Barth, Keute, Schøne, von Simson & Steffensen, n.d.). One contributing factor is that NEET individuals are excluded from formal and informal learning within education and employment (Olsen & Tikkanen, 2018). Employment and education barriers may also contribute to a decreased motivation to learn (Liu, 2019). However, there are still opportunities for NEET people to engage in LND activities at home, an informal avenue through which learning can take place (Livingstone, 1999; Scandurra & Calero, 2017). Prior research indicates that these home-based activities are associated with higher LND skill level (Hämäläinen, De Wever, Nissinen, & Cincinnato, 2019; OECD, 2013a); although, adults with lower skills are less likely to engage in skill-based activities at home, such as writing emails or reading a newspaper (Grotlüschen, Buddeberg, Dutz, Heilmann & Stammer, 2020).

The likelihood of being NEET also connects to structural inequalities, such as labour market conditions and ascriptive factors (Bacher, Koblbauer, Leitgöb & Tamesberger, 2017; Eurofound, 2016; Zuccotti & O'Reilly, 2019). While the studies we discuss above demonstrate that educational attainment and literacy, numeracy, and PS-TRE skills are associated with the likelihood of becoming NEET, they cannot account for social barriers and historical circumstances, such as economic downturn (Bruno, Marelli, & Signorelli, 2014). The likelihood of becoming unemployed differs by various ascriptive factors, such as parental unemployment (Lindemann & Gangl, 2019), immigration status (Cohen, 2017), and gender (Mósesdóttir, 2019). Beyond individual characteristics, labour market conditions also influence how many people become or remain NEET (Tomić, 2018). Over the period we study, overall unemployment in Germany decreased (OECD, 2020a), although the NEET rate remained largely the same (OECD, 2020b). Although it is outside the scope of this study to assess, lower unemployment rates may change the relationship between skill-based factors and NEET status.

While previous PIAAC research demonstrates that lower literacy, numeracy, and PS-TRE skills are associated with education and labour-market barriers (Calero & Choi 2017), it is also important to highlight the role of the person as "an actor endowed with agentic capacities" (Buchmann & Steinhoff, 2017, p. 2083). An individual who is NEET may engage with informal learning activities that are associated with higher skill levels – practices that are a form of personal agency as they are acting on their own behalf. To understand the agentic potential of informal learning for individuals who are NEET, this study draws upon two theoretical frameworks: practice engagement theory (Reder, 1994, 2016; Reder, Gauly & Lechner, 2020) and a socio-ecological model of agency

(Schoon & Lyons-Amos, 2017). Individuals who are NEET are often framed as disengaged or excluded from learning; yet, their activities at home may contribute to informal learning for this group and shape future outcomes. Providing insight into if LND activities at home matter for people who are NEET, practice engagement theory moves beyond understanding skills as formally acquired levels and emphasizes the contribution of everyday activities in promoting skill development (Reder 1994, 2016; Reder et al., 2020).

While practice engagement theory emphasizes the importance of LND activities at home in contributing to overall skill level, a socio-ecological model of agency highlights that these activities are also reflective of one's capabilities, constraints, and self-directedness. Rather than formally test or contrast these two theories, we draw upon both perspectives in our discussion of the results to provide a more expansive understanding of the importance of LND activities at home. Along with the skill potential of home-based activities, engaging in informal learning is a projective and practical aspect of agency "grounded in habitual (often unconscious) patterns of action" (Schoon & Lyons-Amos, 2017, p. 38). As Emirbayer and Mische (1998) argue, individual habits are a form of agency, even when they are taken for granted. In this sense, LND activities at home involve effort that may transform (or reproduce) future life course transitions and the probability of being NEET over time.

2. The Current Study

The purpose of this study is to first explore if there are literacy, numeracy, and PS-TRE skill differences between NEET and non-NEET individuals in Germany and if accounting for level of LND activities at home alters this difference. The research question leading this portion of the study is as follows: *How do literacy, numeracy, and PS-TRE skills differ for NEET and non-NEET individuals in Germany and to what extent do their average level of LND activities at home account for this difference?* To answer this research question, descriptive statistics first provide average literacy, numeracy, and PS-TRE proficiency scores and LND activities at home index scores among NEET and non-NEET people. Next, linear regression analyzing data from the German 2012 PIAAC study examines how the difference between the two groups changes when controlling for socio-demographic and concurrent factors, as well as LND activities at home.

Part one of the analysis is unable to determine if NEET people engage less with LND activities at home because they are NEET or if fewer of these activities at home are associated with an increased probability of being NEET. To further understand the association between activities at home and NEET status, logistic regression analyzing data from longitudinal follow-ups examines if LND activities at home are associated with a lower probability of being NEET two and four years later. Thus, part two asks: *How does the association between the probability of being NEET two and four years later and LND activities at home differ for individuals initially identified as NEET and non-*

NEET in 2012? Given the literature review and theoretical framing, while NEET individuals likely have lower literacy, numeracy, and PS-TRE skills, LND activities at home may represent an agentic practice that lowers the probability of being NEET over time.

3.   Methodology

3.1   Data and Sample

In round one of the PIAAC, Germany surveyed 5,465 residents aged 16 to 65, irrespective of legal status or nationality. Excluded groups fall under the OECD's expected non-coverage rate for the target population, set at a maximum level of 5%. As one of the few countries to extend their PIAAC study longitudinally, the same individuals were re-surveyed three additional times between 2012 and 2016. With attrition over time, the sample diminished to 2,967 respondents by 2016.[1] Along with excluded non-respondent, our analysis omits people who were retired in 2012, 2014, and 2016.

3.2   Variables

This study uses a standard definition of NEET status capturing people who were not employed or in education or training in the survey reference week. Appendix 1 provides a full description of all other indicators used in this study. Models control for selected demographic variables, including: gender; age group; immigration background; parental education; geographical region; and the number of books at home at age 16. Concurrent status indicators control for possible reasons why a person may have been NEET in 2012 (i.e., caregiving and illness status). For indicators where a large portion of respondents have missing information (i.e., parental education), we include a category representing these people.

   This study also uses two types of skill-based variables: proficiency scores in literacy, numeracy, and PS-TRE; and a series of self-reported indicators that examine reading, numeracy, and information and communication technology activities at home (i.e., LND activities). The PIAAC proficiency scores range from zero to 500, a standardized continuum representing cognitive ability level.[2] The literacy test includes com-

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1   Longitudinal sampling weights correct for attrition in all analyses. All estimates that measure skill level use the 10 plausible values produced for the 2012 PIAAC proficiency scores. All longitudinal estimates include the longitudinal sampling weights to account for survey design and attrition.

2   According to the updated Cattell-Horn-Carroll theory of intelligence (Schneider & McGrew 2018), quantitative/math ability (i.e., Gq) and reading and writing ability (i.e., Grw) are broad skill domains at Stratum II and have high factor loading on general mental ability (i.e., G). That is, both domains correlates highly with general cognitive ability. While the PS-TRE measure is not included in the Cattell-Horn-Carroll theory of intelligence, there is

prehending, decoding, interpreting, and evaluating digital or print-based written text. The numeracy test includes identifying, interpreting, evaluating, and communicating numeracy-based information through counting, estimating, or measuring. The PS-TRE test involves acquiring, evaluating, and using information available through computers.

The LND activities at home scales are based on background questionnaire items that ask respondents to self-report how often they engage in specific activities. Responses are constrained to five options: 1) never; 2) less than once a month; 3) less than once a week but at least once a month; 4) at least once a week but not every day; and 5) every day. The reading activities at home scale includes eight items, such as reading books, newspapers, manuals, and directions. The numeracy activities at home scale contains six activities, such as calculating a budget, using a calculator, or preparing a graph. The digital activities at home scale has seven items, such as writing an email, looking up in-formation, or having an online discussion. A generalized partial credit approach – an item response theory model for polytomous rating responses – forms the derived LND activities at home scales. For more information on these scales, see Chapter 20 of the PIAAC technical report (OECD, 2013b).

3.3 Analysis

After examining descriptive statistics, regression models with cross-sectional data first examine if average literacy, numeracy, and PS-TRE skills differ among people who are and are not NEET in 2012 and if including variables measuring LND activities at home reduce the overall difference between the two groups. Given that a continuous measure-ment scale represents skill, ordinary least squares (OLS) regression offers an interpre-table approach to examining group differences. In this equation, the dependent variable represents a proficiency score in either literacy, numeracy, or PS-TRE. The model re-lates each score to a set of explanatory variables, such as NEET status and other con-trol variables.

Next, logistic regression with the longitudinal data assesses how LND activities at home in 2012 are associated with the later likelihood of being NEET among those who were and were not initially NEET. Our approach is akin to a non-experimental pretest-posttest design that examines NEET status in 2014 or 2016 (i.e., time two) while con-trolling for NEET status in 2012 (i.e., time one). That is, it estimates the probability of being NEET after taking into account all variables in the first stage of analysis and an additional indicator representing NEET status in 2012. Because of the correlation among them, separate models examine each type of LND activities at home.

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a strong correlation between all three skill domains, ranging from 0.75 to 0.87 in Germany (OCED, 2013b). For these reasons, we characterize all three domains as cognitive skills. Nonetheless, other theoretical models may also characterize the PIAAC test domains as 'ac-ademic' or 'basic' skills.

To facilitate interpretation, line graphs with confidence intervals report the average marginal effects (i. e., predicted probability). These describe the average expected difference in the probability of being NEET in 2014 or 2016 with a one-unit increase in each LND index score among individuals who were and were not NEET in 2012. While other longitudinal approaches are available, notably linear growth analysis, more measurement time points would be necessary to provide complete and fulsome insight into how LND activities are associated with a change in the likelihood of being NEET over time. Our study provides initial evidence to support future interventions that would aim to bolster LND activities among NEET individuals; nonetheless, a more robust experimental design would provide the most concrete evidence on if such an intervention would reduce the likelihood of remaining NEET.

4.   Results

4.1   Sample Description

Table 1 provides descriptive statistics for the analytical sample. The column "% NEET" describes the NEET rate for each group. For example, 9.8% of people age 34 or younger were NEET in 2012. "Proportion of NEET" describes the NEET sample. For example, 26% of all NEET individuals in 2012 were age 34 or younger. In examining the results, 12% of the sample were NEET in 2012, a percentage that grew to 18% in 2014 and 2016. The higher NEET rate in later years is sample dependent and likely due to age-specific change. By 2016, almost 50% of people age 55+ were NEET. In 2016, 22% of women were NEET, as were 20% of individuals whose parent(s) did not complete post-secondary education (PSE), and 28% of people who grew up with less than 25 books at home. In terms of the two concurrent status indicators, the majority of people on long-term disability in 2012, as well as people not working due to caregiving, were NEET in subsequent survey periods – although their NEET percentage rate diminished over time.

Table 2 provides descriptive statistics on literacy, numeracy, and PS-TRE skill and LND activity scores among NEET and non-NEET respondents across all three waves. Compared to individuals who are NEET, people who were not NEET had higher literacy, numeracy, and PS-TRE proficiency in 2012, as well as higher LND activities at home index scores. T-tests that measure the significance of this group difference are all statistically significant.

	NEET status in 2012		NEET status in 2014		NEET status in 2016	
	% NEET	Proportion of NEET	% NEET	Proportion of NEET	% NEET	Proportion of NEET
Total NEET	12.28	–	17.96	–	18.17	–
Age in 2012						
34 and younger	9.84	26.13	15.94	29.13	12.41	22.42
35 to 54	12.09	50.79	14.24	40.46	12.80	36.06
55 and older	17.95	23.08	33.83	30.41	47.30	41.52
Gender						
Male	8.29	34.15	13.21	36.87	14.48	40.17
Female	16.36	65.85	22.74	63.13	21.93	59.83
Immigration status						
3rd generation or higher	11.24	64.76	16.85	65.44	17.10	66.36
2nd generation immigrant	10.83	16.27	16.66	16.91	18.86	19.20
1st generation immigrant	21.54	18.96	26.40	17.64	23.95	14.44
Parental education						
Has PSE	8.94	25.89	13.15	25.27	13.10	25.41
No PSE	13.69	70.38	19.99	71.15	20.30	70.82
Missing information	35.27	3.73	41.48	3.58	51.08	3.77
# of books at home at age 16						
25 or under	19.10	33.45	26.68	33.88	27.97	33.51
26 to 100	11.19	30.56	16.94	31.62	16.57	30.69
101 or more	9.53	34.69	13.85	33.44	14.20	34.65
Missing information	68.83	1.30	72.71	1.06	91.41	1.15
Region in 2012						
East Germany	12.11	18.04	19.19	19.00	18.86	18.78
West Germany	12.32	81.96	17.70	81.00	18.02	81.22
Caregiving status in 2012						
Not working due to status	94.98	33.36	79.15	19.96	65.22	15.62
All others	8.56	66.64	15.06	80.04	16.03	84.38
Long-term illness/disability status in 2012						
Not working due to status	99.29	19.07	90.69	12.58	85.18	11.31
All others	10.18	80.93	16.10	87.42	16.52	88.69
N	2,791					

Note: German PIAAC and PIAAC-L microdata for all respondents, excluding those who were retired in 2012, 2014, or 2016. Following the recommended weighting strategy for the German PIAAC-L, the 2012 estimates include the PIAAC final and replicate weights, the 2014 estimates include the 2014 PIAAC-L longitudinal weight (i.e., spfwt0*bleib_14), and the 2016 estimates include the 2016 PIAAC-L longitudinal weight (i.e., spfwt0*bleib_16).

Tab. 1: Descriptive statistics of NEET individuals in 2012, 2014, and 2016

	N	2012			2014			2016		
		Non-NEET	NEET	T-test	Non-NEET	NEET	T-test	Non-NEET	NEET	T-test
Skill domains										
Literacy	2,791	281	249	***	279	249	***	282	254	***
Numeracy	2,791	285	242	***	283	245	***	285	251	***
PS-TRE	2,449	289	266	***	288	264	***	289	266	***
LND activities										
Reading	2,787	2.44	2.12	***	2.43	2.11	***	2.44	2.19	***
Numeracy	2,664	2.17	1.75	***	2.15	1.78	***	2.17	1.81	***
ICT	2,484	2.14	1.82	***	2.13	1.81	***	2.14	1.86	***

Note: German PIAAC and PIAAC-L microdata for all respondents, excluding those who were retired in 2012, 2014, or 2016. Following the recommended weighting strategy for the German PIAAC-L, the 2012 estimates include the PIAAC final and replicate weights, the 2014 estimates include the 2014 PIAAC-L longitudinal weight (i.e., spfwt0*bleib_14), and the 2016 estimates include the 2016 PIAAC-L longitudinal weight (i.e., spfwt0*bleib_16). Skill assessment means use all 10 plausible values. Significance levels: $p < 0.05$ = * $p < 0.01$ = ** $p < 0.001$ = ***

Tab. 2: Skill proficiency scores and LND activities at home assessment scores in 2012 among NEET and non-NEET individuals in 2012, 2014, and 2016

4.2 OLS Regression Results

Tables 3, 4, and 5 examine how literacy, numeracy, and PS-TRE skills differed among NEET and non-NEET individuals in 2012 once a model controls for socio-demographic factors (Model 2), concurrent status factors (Model 3), and the corresponding LND activities at home index score (Model 4). As mentioned in section 3.3, the dependent variable across all models are the PIAAC skill proficiency scores, each modelled separately. Table 3 demonstrates that, in Model 1 with no control variables, people who were NEET had average proficiency scores that were 31 points lower compared to those that were non-NEET in 2012. As shown in Model 2, socio-demographic indicators account for approximately one-third of the difference in literacy scores between people who are NEET and non-NEET, while the gap increases slightly once Model 3 includes the concurrent status control variables. The difference in proficiency scores reduces only slightly In Model 4, which includes the indicator measuring the intensity of reading activities at home in 2012.

Table 4 illustrates the corresponding approach to measure the difference in numeracy skills between individuals who were and were not NEET in 2012. Compared to literacy, Model 1 demonstrates a larger difference in numeracy scores compared to literacy scores, with average proficiency among NEET people over 42 points lower than non-NEET people. Again, Model 2 accounts for approximately one-third of the difference in

	Model 1	Model 2	Model 3	Model 4
NEET status in 2012 (non-NEET)				
NEET	−31.10***	−20.16***	−23.54***	−20.32***
	(3.17)	(2.85)	(3.91)	(3.83)
Socio-demographic controls		included	included	included
Concurrent status controls			included	included
Index of reading activities at home				10.55***
				(1.34)
Constant	281.00***	271.02***	271.88***	249.12***
	(1.20)	(3.86)	(3.87)	(4.35)
Observations	2787	2787	2787	2787

Notes: Significance levels: $p < 0.05$ = * $p < 0.01$ = ** $p < 0.001$ = *** Analysis undertaken with the German PIAAC and PIAAC-L microdata. The sample includes all survey respondents, excluding those who were retired in 2012, 2014, or 2016. The dependent variable is skill proficiency score in 2012. Estimates include final and replicate weights for 2012 and all 10 plausible values. Reference group in parentheses.

Tab. 3: Regression results for literacy proficiency in 2012

	Model 1	Model 2	Model 3	Model 4
NEET status in 2012 (non-NEET)				
NEET	−42.13***	−29.82***	−32.58***	−29.63***
	(3.42)	(3.22)	(4.04)	(4.14)
Socio-demographic controls		included	included	included
Concurrent status controls			included	included
Index of numeracy activities at home				10.95***
				(1.08)
Constant	287.02***	275.36***	276.43***	252.80***
	(1.28)	(4.40)	(4.45)	(4.88)
Observations	2664	2664	2664	2664

Notes: Significance levels: $p < 0.05$ = * $p < 0.01$ = ** $p < 0.001$ = *** Analysis undertaken with the German PIAAC and PIAAC-L microdata. The sample includes all survey respondents, excluding those who were retired in 2012, 2014, or 2016. The dependent variable is skill proficiency score in 2012. Estimates include final and replicate weights for 2012 and all 10 plausible values. Reference group in parentheses.

Tab. 4: Regression results for numeracy proficiency in 2012

	Model 1	Model 2	Model 3	Model 4
NEET status in 2012 (non-NEET)				
NEET	−21.99***	−14.10***	−10.94*	−9.04*
	(3.30)	(3.23)	(4.27)	(4.12)
Socio-demographic controls		*included*	*included*	*included*
Concurrent status controls			*included*	*included*
Index of digital activities at home				11.46***
				(1.38)
Constant	290.55***	291.71***	291.79***	266.77***
	(1.28)	(3.74)	(3.77)	(4.50)
Observations	2358	2358	2358	2358

Notes: Significance levels: $p < 0.05$ = * $p < 0.01$ = ** $p < 0.001$ = *** Analysis undertaken with the German PIAAC and PIAAC-L microdata. The sample includes all survey respondents, excluding those who were retired in 2012, 2014, or 2016. The dependent variable is skill proficiency score in 2012. Estimates include final and replicate weights for 2012 and all 10 plausible values. Reference group in parentheses.

Tab. 5: Regression results for PS-TRE proficiency in 2012

scores between NEET and non-NEET people, with concurrent status controls (Model 3) and the index of numeracy activities at home (Model 4) having a negligible effect.

Table 5 demonstrates that the average difference in PS-TRE proficiency scores between people who were and were not NEET in 2012 is smaller compared to the difference in literacy and numeracy skills. Furthermore, once Models 2 and 3 control for socio-demographic and concurrent indicators, as well as the indicator measuring digital activities at home in Model 4, the difference in scores between NEET and non-NEET people diminishes by one half.

4.3 Regression Results with Longitudinal Data

Along with demonstrating the difference in literacy, numeracy, and PS-TRE skills among people who were and were not NEET in 2012, Tables 3 to 5 also indicate that LND activities at home are positively associated with all three domains. To understand the relationship between LND activities and the probability of being NEET, we graphically present logistic regression results with longitudinal data that measure the relationship between these activities and the probability of being NEET in 2014 (Fig. 1, 2, and 3) and 2016 (Fig. 4, 5, and 6) among people who were (red line) and were not (blue line) NEET in 2012.

Figure 1, 2, and 3 all demonstrate that people who engaged in higher rates of LND activities at home in 2012 had a lower probability of being NEET in 2014 compared
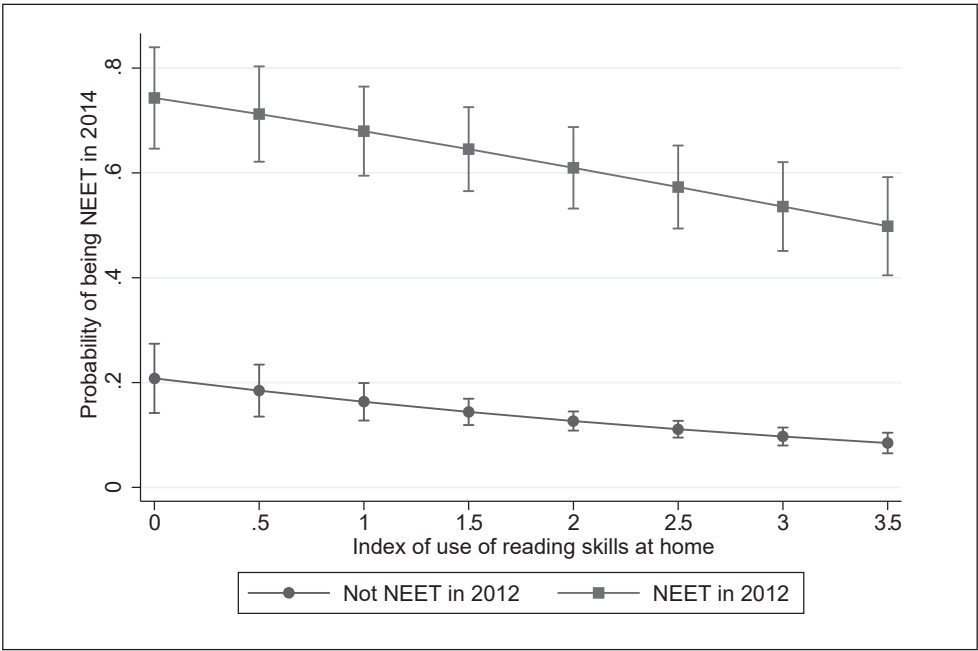
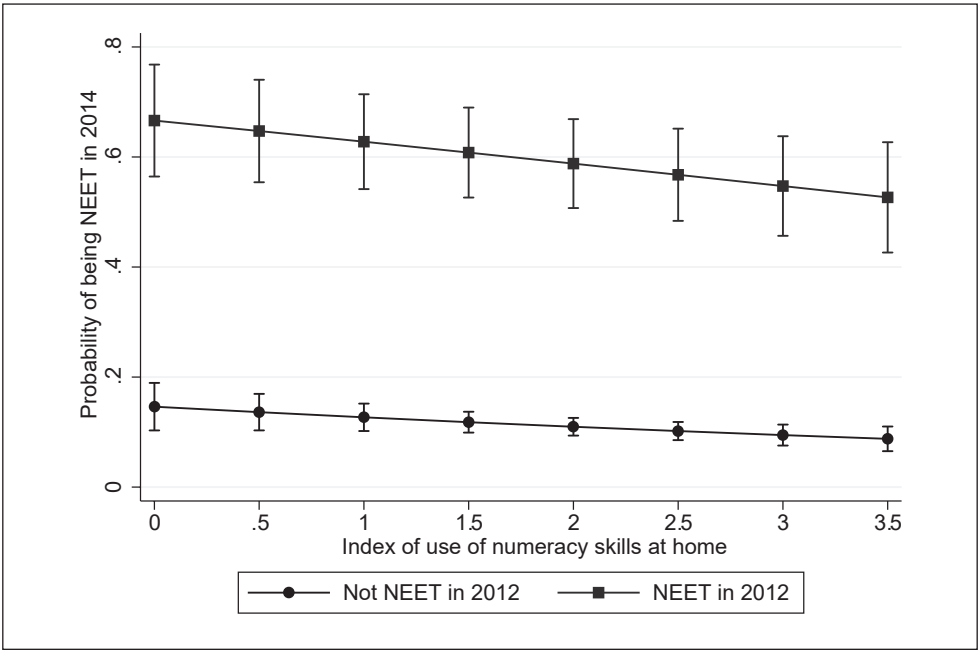Fig. 1: Probability of 2014 NEET status by reading-based activities at home in 2012

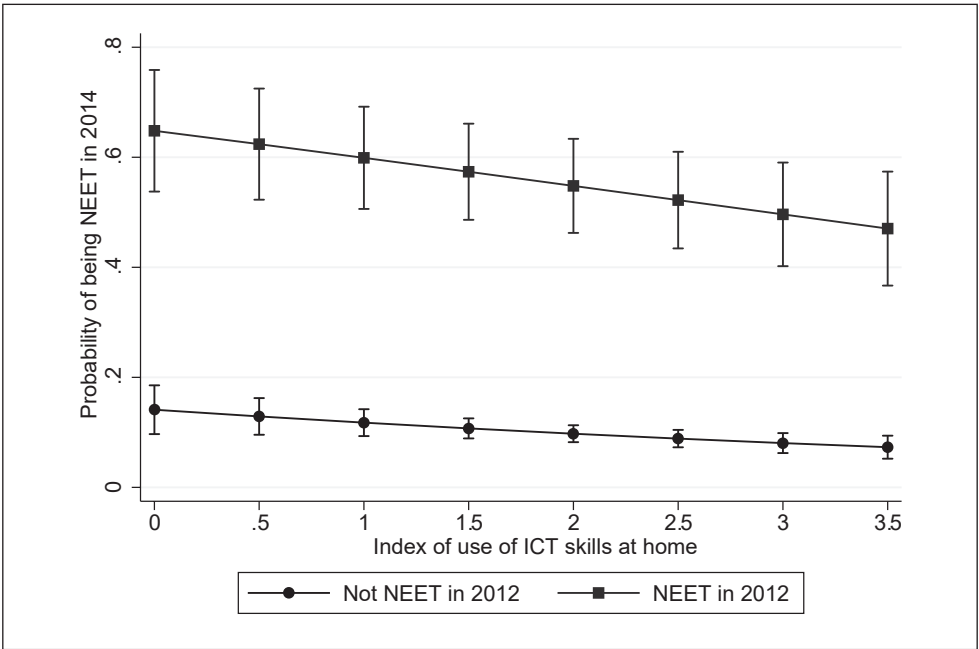Fig. 2: Probability of 2014 NEET status by numeracy-based activities at home in 2012

Fig. 3: Probability of 2014 NEET status by ICT-based activities at home in 2012

to people who engaged in lower rates of LND activities. This relationship is most pro-nounced and with less overlap in the 95% confidence intervals in Figure 1, which mea-sures reading activities at home. Not only are higher reading activities at home associated with a lower probability of being NEET two years later among people who were NEET in 2012, individuals who were not NEET in 2012 also had a lower probability.

Figure 4, 5, and 6, demonstrate that the relationship between LND activities at home in 2012 and the probability of being NEET in 2016 is small, with more overlap in the confidence intervals. While the relationship for individuals who were NEET in 2012 is inconclusive given their smaller sample size and the large margin of error it produces, those who were not NEET in 2012 and who did engage in high levels of reading activi-ties at home in 2012 are less likely to be NEET four years later compared to non-NEET individuals with the lowest index scores.

5. Discussion and Conclusions

With the overall aim of providing insight into the skill profile of NEET individuals in Germany and how activities at home are associated with their outcomes over time, this study first examines how literacy, numeracy, and PS-TRE proficiency scores differ among NEET and non-NEET people. The study draws upon practice engagement theory (Reder, 1994, 2016; Reder at al., 2020) to characterize home-based LND ac-
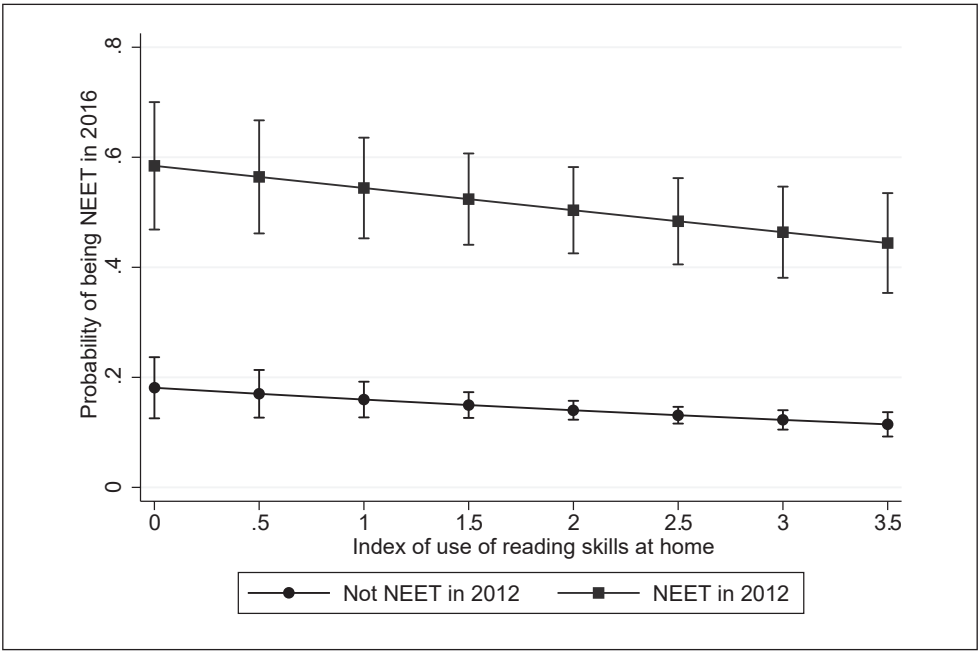
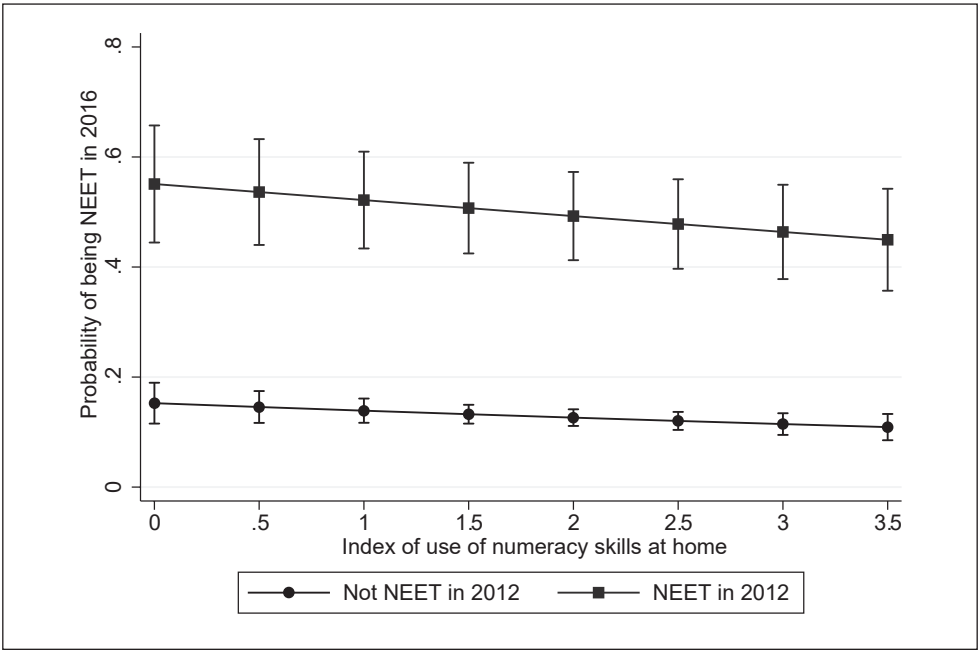Fig. 4: Probability of 2016 NEET status by reading-based activities at home in 2012

Fig. 5: Probability of 2016 NEET status by numeracy-based activities at home in 2012
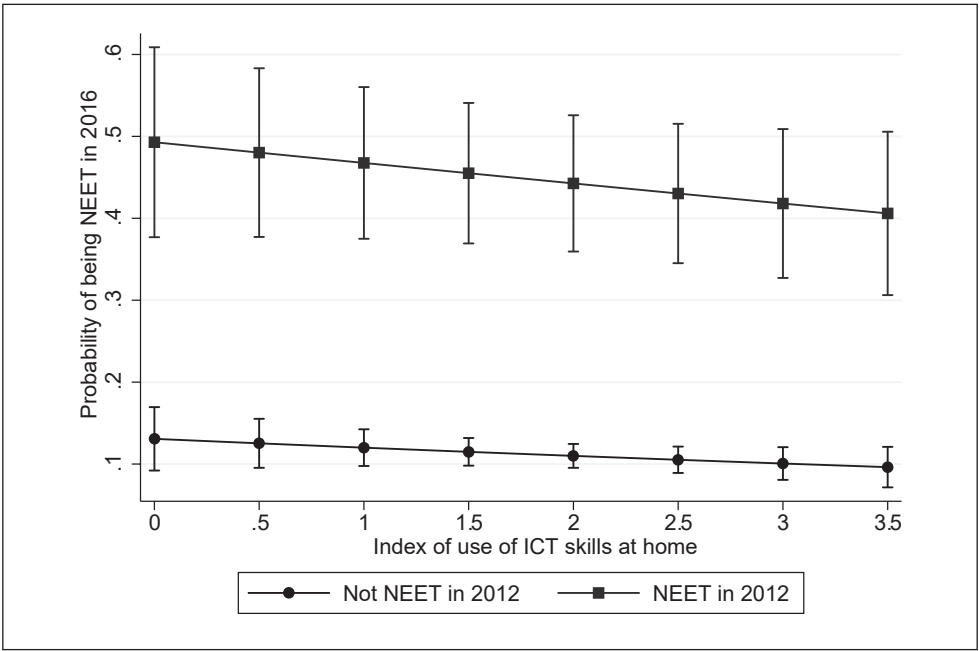
Fig. 6: Probability of 2016 NEET status by ICT-based activities at home in 2012

tivities as key in the development and maintenance of skill. From a socio-ecological model of agency (Schoon & Lyons-Amos, 2017), these activities are also viewed as holding the potential to alter later employment, education, and training engagement. Aligning with this perspective, part two uses longitudinal data to generate insight into if LND activities at home are associated with the probability of being NEET two and four years later among people who were and were not initially NEET during the baseline survey.

Both the descriptive and linear regression results illustrate that literacy and numeracy skills are significantly lower among NEET individuals compared to their non-NEET peers, while there is a smaller but still significant difference in PS-TRE skills. The finding that the difference in numeracy skills is largest converges with prior research examining how the range in proficiency scores differs across PIAAC domains; that is, numeracy skills tend to be the most unequal (OECD, 2013a), even when accounting for educational level (Ford, 2018). While this study is unable to fully account for why there is a difference in skill levels between people who are and are not NEET, practice engagement theory emphasizes that people who are excluded from opportunities to learn and use skills within employment and work have lower proficiency, as observed by labour force, employment, and training measures (Desjardins, 2003).

Adding further evidence to support practice engagement theory, prior research finds that education level and LND activities at home and work are among the strongest predictors of skill proficiency scores compared to all other characteristics observed in

the PIAAC study (OECD, 2013a). Confirming and extending this research, our study demonstrates that LND activities at home are not only associated with skill level but also partially account for the difference in proficiency scores between NEET and non-NEET people. That is, when accounting for the discrepancy in the level at which NEET and non-NEET people engage in LND activities at home, the difference in skill proficiency scores between the two groups narrows. This evidence supports the perspective that even informal practice engagement is important for understanding skill proficiency levels and how they differ between social groups. In addition, as explored in part two of our analysis, these home-based activities are reflective of agency in their association with future outcomes.

To further understand the association between LND activities at home and NEET status, the final part of the analysis examines if these activities at home are associated with a lower probability of being NEET two and four years later. We find that LND activities at home – and, in particular, reading activities – are partially associated with a lower probability of being NEET two years later. The extent to which individuals engage in reading-based activities at home relate to background and environmental factors, such as socioeconomic status (Jefferson et al., 2011); however, these background factors do not determine the extent of engagement in informal learning – a potential marker of personal agency. While the results two years later are noteworthy, measures of LND activities at home have a smaller association and a greater margin of error with NEET status four years later.

Aligning with the call to more deeply consider the importance of informal practices (Hamilton, 2006), this study demonstrates that LND activities at home are of cross-sectional and longitudinal importance. These activities have an association with literacy, numeracy, and PS-TRE skills and, when included in a model examining the difference in skill assessment scores between people who are and are not NEET, reduce the magnitude of the difference between the two groups. Two years later, however, LND activities at home have a small association in reducing the likelihood of becoming or remaining NEET. Aligning with the theoretical framework of this study, LND activities at home highlight the importance of individual agency as measured through everyday activities. This research conceptualizes an individual's skill profile as far more than a skill level but also as something that encompasses everyday activities. In this sense, practice engagement in the social context of the private life at home is influential as conscious or unconscious expressions of agency.

There are several avenues for further research to better understand the relationship among NEET people and skill. First, it is important to follow-up with further research that generates insight into both individual and structural accounts of skill differences. As Thompson argues, NEET outcomes "cannot be accounted for purely in terms of the dispositions of the individuals and the choices they make. Subjective factors are important, but they are embedded in and arise from objective conditions" (2011, p. 798). Further research must consider how the structure of opportunities at school and work are associated with both the probability of becoming NEET and skill differences and levels of LND activities at home.

To address additional limitations of this study, an area for future research is to further assess the causal relationships among skill, LND activities, and NEET status. The study of skill among NEET individuals is susceptible to simultaneous causality, especially as data collected at a single time point is unable to disentangle temporal ordering (Cox, 1992). It remains unknown if lower skill proficiency scores among NEET people are due to not being in school or work – two possible locations for education and training – or if the skill level of NEET people is a barrier to education and work engagement.

Finally, this study cannot assess why certain NEET individuals engage in higher rates of LND activities at home and if these unobserved confounding and mediating factors (e.g., taking time to prepare for an exam for future schooling) influence the association between LND activities and NEET status over time. Although this study was able to assess how skill-based activities at home are associated with the later probability of being NEET, its observational nature is unable to determine the success of intervention strategies that would promote these activities. While it provides evidence to support the rationale for an intervention-based study that would promote LND activities among NEET individuals to increase their skill levels and decrease their later likelihood of remaining NEET, it cannot assess the success of such an intervention without an experimental design.

In conclusion, it is important to emphasize the need to provide evidence to inform and strengthen education theory and practice (Evans, Yasukawa, Mallows, & Creese, 2017). The present study demonstrates that different rates of LND practices at home explain a small portion of the difference in skill proficiency levels between NEET and non-NEET individuals and are influential on later outcomes. This study aligns with concurrent German research showing that even adults with low literacy skills apply them in many ways, both at home and at work (Grotlüschen, Buddeberg, Dutz, Heilmann & Stammer, 2019, 2020). A key intent of research in this area is to demonstrate the importance of informal activities among an often overlooked group of adult learners.

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Appendix 1. Description of variables

Variable	Description	Coding	Original variable Name	Sample size
Socio-demographic controls				
Gender	Dummy variable: Comparing men and women.	0 = men 1 = women	gender_r (gender of respondent)	2,791
Age	Categorical variable: Age of respondents in 2012.	1 = 34 and under 2 = 35–54 3 = 54 and above	age_r (derived indicator of age in 2012)	2,791
Immigration status	Categorical variable: Immigration background of respondents.	1 = 3rd gen. or higher 2 = 2nd gen. (mother/father born outside Germany) 3 = 1st gen. (born outside Germany)	j_q07a_t (father or male guardian born in country) j_q06a_t (mother or female guardian born in country) j_q04a (born in country)	2,791
Parental education	Categorical variable: Either mother/father (or female/male guardian) has PSE diploma at ISCED level 5 and above.	1 = yes 2 = no 3 = missing	j_q07b (father/male guardian highest level of education) j_q06bca (mother/female guardian highest level of education)	2,791
Geographical region in 2012	Dummy variable: Respondent lived in East or West Germany in 2012	0 = East Germany 1 = West Germany	federal_state (16 states of Germany)	2,791
Books at home at age 16	Categorical variable: Self-reported number of books at home at age 16.	1 = 25 or less 2 = 26 to 100 3 = 101 or more 4 = missing	j_q08 (background – books at home)	2,791
Concurrent status controls				
Caregiving status in 2012	Dummy variable: Not looking for work due to looking after the family in 2012	0 = no 1 = yes	c_q03_03 (reason not looking for work – looking after the family)	2,791
Illness status in 2012	Dummy variable: Not looking for work due to long term illness in 2012	0 = no 1 = yes	c_q03_05 (reason not looking for work – long term illness)	2,791
Indices of LND activities at home				
Reading activities at home scale	Continuous variable: derived indictor of reading use at home	Range: −1.30 to 7.43	readhome (index of reading activities at home)	2,787
Numeracy activities at home scale	Continuous variable: derived indictor of numeracy use at home	Range: −0.51 to 5.60	numhome (index of numeracy activities at home)	2,664
Digital activities at home scale	Continuous variable: derived indictor of information and communication technology (ICT) use at home	Range: −0.77 to 4.84	icthome (index of digital activities at home)	2,484

Variable	Description	Coding	Original variable Name	Sample size
PIAAC skills domains				
Literacy	Continuous variable: derived indictor of literacy skills	Range: 80.11 to 443.36	pvlit1 to pvlit10 (literacy scale score – plausible values)	2,791
Numeracy	Continuous variable: derived indictor of numeracy skills	Range: 40.32 to 448.83	pvnum1 to pvnum10 (numeracy scale score – plausible values)	2,791
PS-TRE	Continuous variable: derived indictor of PS-TRE skills	Range: 137.50 to 461.62	pvpse1 to pvpse10 (problem-solving scale score – plausible values)	2,449

Zusammenfassung: Für Erwachsene mit NEET-Status („not in employment, education, or training") sind literale, numerale und digitale (LND) Praktiken zu Hause wichtige Formen des informellen Lernens. Diese Studie bietet – basierend auf Daten des Programme for the International Assessment of Adult Competencies (PIAAC) und der weiterführenden Langzeitstudie PIAAC-Longitudinal (PIAAC-L) – Einblicke in das Kompetenzprofil von NEET-Personen in Deutschland und analysiert, ob LND-Aktivitäten zu Hause ihre Testergebnisse in standardisierten Kompetenztests beeinflussen. Eine zusätzliche Längsschnittanalyse untersucht den Zusammenhang zwischen dem vorangegangenen LND-Aktivitätsniveau und der Wahrscheinlichkeit zwei und vier Jahre später NEET zu sein. Insgesamt zeigen die Ergebnisse niedrigere Kompetenztestergebnisse für NEET-Erwachsene, was zum Teil durch unterschiedliche LND-Aktivitätsniveaus zu Hause zwischen NEET- und Nicht-NEET-Erwachsenen erklärt wird. Insgesamt zeigen die Ergebnisse, dass die Kompetenzen im Bereich Numeralität, Literalität und Problemlösung bei NEET-Personen im Vergleich zu Nicht-NEET-Personen geringer sind. Der Unterschied im durchschnittlichen Kompetenzniveau liegt partiell in den LND-Aktivitäten begründet. Im Zeitverlauf zeigt sich, ein (geringer) Zusammenhang zwischen LND-Aktivitäten zu Hause und einer niedrigeren Wahrscheinlichkeit, zwei Jahre später NEET zu sein; vier Jahre später lässt sich ein minimaler bis kein Zusammenhang feststellen.

Schlagworte: Deutschland, NEET-Erwachsene, informelles Lernen, Langzeitstudie PIAAC-L, Kompetenz

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