Associations between Motivation to Learn, Basic Skills, and Adult Education and Training Participation among Older Adults in the USA.

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Abstract

The objective of this study is to examine the associations between the motivation to learn, basic skills (i.e., literacy and numeracy), and organized adult education and training (AET) participation among the middle-aged and older adults in the USA. Rapid technological advancement and globalization necessitate individuals to engage in lifelong learning to actively participate in society. However, little is known about the roles of motivation to learn and basic skills in the AET participation in the U.S. adult population. We obtained the data from the 2012/2014 Program for International Assessment of Adult Competencies restricted-use file and adults aged 50 years and older (n = 2,580) are included. Structural equation models are used to examine (1) any AET, (2) formal AET and (3) non-formal AET participation as a function of the motivation to learn latent construct, literacy, numeracy, and other covariates. Results showed that the motivation to learn, literacy and numeracy are all positive predictors of non-formal AET participation. Only motivation to learn is associated with formal AET participation. Findings from this study may inform future interventions as well as policy changes to promote specific types of organized AET programs among older adult population in the USA.

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Lifelong learning is considered important for numerous aging-related issues such as adjusting to the fast-changing contemporary society and declining health in later life (Tikkanen, 2017). Rapid technological advancement and the globalization process necessitates lifelong learning in order to maintain the skills necessary in a changing labor market. Rather than focusing on routine skills, Karoly (2009) stresses the importance of basic skills and attitudes toward learning to adapt to the dynamic changes in current society. By the same token, lifelong learning is key to navigating the knowledge-based society where the latest information in a wide range of topics provides economic as well as social advantages (Boeren, 2017). That is, the knowledge and skill acquired in the past may no longer be sufficient for current and future workers.

Promotion of lifelong learning over the adult life course after formal education is a reasonable approach to enhance the quality of life (Jenkins & Mostafa, 2015). Yet, lifelong learning participation rate is still unfavorable in the USA. For example, less than half of adults aged 56-65 participated in any adult education or training in the past 12 months in the USA. (Desjardins, 2015). Additionally, socioeconomic characteristics such as employment status are associated with differences in lifelong learning participation. Cummins, Kunkel and Walker (2015) report that only about 30% of unemployed adults aged 45-54 participated in lifelong learning, whereas about 65% of employed adults of the same age did. There is a need for improvement in lifelong learning participation among the U.S. adult population in general and marginalized sub-populations such as unemployed and low skilled adults in particular.

Definitions of AET and Lifelong Learning

Generally, lifelong learning or adult education and training (AET) is inclusive of any learning activities at any adult life stage. Lifelong learning is "an all purposeful learning activity, undertaken on an ongoing basis with the aim of improving knowledge, skill and competence" (Commission of the European Communities, 2000, p. 3). At the same time, researchers have distinguished between the types of AET as activities in formal AET institutions (e.g., colleges and universities), and those outside of formal institution or programs (e.g., settings such as home and community) throughout the life course (Wister, Malloy-Weir, Rootman, & Desjardins, 2010). Although no universal classification has been established, AET has generally been classified as formal AET, non-formal AET and informal AET in the international community like the Organization for Economic Cooperation and Development (Werquin, 2010). Formal AET is designed for a formalized credential or diploma at the education/training institutions. Non-formal AET does not lead to any formalized credential but takes place at education/training institutions. Informal AET or self-guided learning occurs in everyday life without specific intention to acquire new knowledge, skill or formalized credential in organized programs (Commission of the European Communities, 2000). The present study focuses on what we designate as "organized AET" (i.e., formal and non-formal AET, which both occur in organized settings)**.** Informal AET was not examined in this study because it involves a wider range of individual activities, and it is more conceptually distinct from organized AET.

Wider Benefits of AET

The benefits of AET not only include potential enhancement of specific knowledge or skills but also enhancement of a wide range of economic and psychosocial aspects of one's life. In other words, the wider benefits of AET can be acknowledged above and beyond the conventional education outcomes (e.g., degree, certificate) (Feinstein, Budge, Vorhaus, &

Duckworth, 2008; Schuller et al., 2001). Some of the economic benefits include the protective effect from unemployment (Jenkins, Vignoles, Wolf, & Galindo-Rueda, 2003), individual wage increases (Hanushek, Schwerdt, Wiederhold, & Woessmann, 2013), greater life chances (e.g., higher employability) and upward social mobility (Evans, Schoon, & Weale, 2013). With respect to the psychosocial benefits from AET, Narushima, Liu, and Diestelkamp (2018a) found that learning in general and non-formal learning in particular are positively associated with psychological well-being among older adults.

Also, participation in AET is beneficial not only for the physical, mental and social well-being of individuals but also for the overall well-being of communities (Jenkins & Mostafa, 2015; Merriam & Kee, 2014; Wister et al., 2010). AET participation is also associated with well-being among older lifelong learners (McWilliams & Barrett, 2018). That is, AET participation is directly related to life satisfaction and quality of life in older adults (e.g., perceptions of learning as positive; (Edmondson, Boyer, & Artis, 2012; Narushima, Liu, & Diestelkamp, 2018b). Finally, when individuals are continuously engaged in AET, it is likely that positive effects last for an extended period of time, and such benefits amplify over the life course (Narushima, 2008).

Conceptual Framework

The present research employs the conceptual framework developed by Boeren, Nicaise, and Baert (2010). The Boeren et al. (2010) model suggests that lifelong learning participation is determined by a series of socioeconomic (e.g., employment, income), sociodemographic (e.g., gender, education) and sociocultural (e.g., cultural/social participation) characteristics in addition to psychological factors (e.g., motive, attitude, confidence). The model incorporates higher-level factors such as the characteristics of education and training organizations as well as societal-level social/economic conditions. Given the lack of national-level empirical studies among middle-

aged and older adults in the U.S. this study focuses less on testing the Boeren et al. model with the multiple level factors but on establishing baseline research at the individual level among the U.S. adults.

Previous studies link a series of sociodemographic and socioeconomic characteristics to AET participation. Older age, male gender, minority ethnicity status, increased caregiving responsibilities, lower educational attainment, lower parental educational attainment, as well as unemployed work status and lower income are associated with a lower likelihood of AET participation (Boeren et al., 2010; Broek & Hake, 2012). Specific pathways between each factor to AET participation are yet to be explored, but there are several identified links. Some individual-level characteristics (e.g., older age, men, lower education) are related to negative attitudes toward AET (Roosmaa & Saar, 2017). Also, women and men tend to respond to different motivations (intrinsic for women vs. extrinsic for men) for learning (Rothes, Lemos, & Gonçalves, 2014).

Educational attainment has been consistently linked to AET participation. Knowledge acquired in formal educational programs in the past could be the foundation for lifelong learning (Biagetti & Scicchitano, 2013). In addition, positive experiences with previous education and arguably the family's expectation toward education promote further learning activities (Boeren et al., 2010; Chang & Lin, 2011). Moreover, successful education experiences (e.g., degree attainment) are most likely associated with openness and confidence to learn (e.g., self-efficacy), which lead to subsequent learning activities (Hammond & Feinstein, 2005; Head, Van Hoeck, & Garson, 2015). Motivation to enhance one's own career and increase income are important promoters of AET participation. This notion is consistent with human capital theory, which links investment in knowledge/skills to economic gains (Knipprath & De Rick, 2015). Finally, among

the most overlooked education-related factors are basic skills such as literacy and numeracy (Boeren et al., 2010; Desjardins, 2011). Some individuals may avoid AET due to poor readiness for learning. One's basic skills (e.g., reading and writing) may be mismatched to the available AET programs. One may argue that basic skills are necessary to learn new and complex concepts (Schuller et al., 2001).

Other socioeconomic characteristics such as income and employment determine economic barriers to AET (e.g., tuition, geographic accessibility; (Jenkins & Mostafa, 2015). White (2012), however, indicates that socioeconomic factors partially explain participation in AET, although the effect is weak and pathways are still unclear. Furthermore, one may argue that increases in socioeconomic status or its constituent elements such as educational attainment are not only difficult to improve at the population level but such effort also are inefficient due to the cumulative advantage/disadvantage, particularly in later life (Willson, Shuey, & Elder, 2007). In other words, inequality by educational attainment, which often takes place in earlier stages of life increases as a function of time and becomes more salient as time goes along. Another important predictor of AET participation is health status. Poor health impacts multiple life domains (e.g., physical health, time constraint and financial security) and in turn, becomes a barrier to AET participation (Roosmaa & Saar, 2017). At the same time, as mentioned earlier, AET participation also makes positive impacts on health and well-being (Narushima, 2008).

Boeren et al. model also suggests that a set of psychological factors such as motives, attitudes and intention matter to AET participation. These factors constitute the general motivation for learning. However, the concept of motivation to learn is diverse. The researchers proposed that key components of motivation to learn are the desire to be successful learners, to feel sense of control over their learning, to learn what the learners believe to be valuable, and to

have a pleasant experience in learning (Knowles, Holton, & Swanson, 1998; Wlodkowski, 1985). Additionally, Jarvis (2007) emphasizes that the value of lifelong learning (e.g., updated knowledge) is linked to the social and economic advantages in the fast-paced knowledge society. As such, greater social participation as well as moving up the social ladder through learning is most likely related to the motivation to learn.

Taken together, Boeren et al. (2017) assert that future research should employ an interdisciplinary approach to explore the determinants of AET. Similarly, Desjardins (2011) emphasizes that an inquiry of AET participation should simultaneously examine psychological (e.g., motivation, personality), social (e.g., social support, life situation) and economic factors (e.g., fee/cost, time). This notion is in alignment with the identified determinants of AET participations in the previous research.

In order to better understand the predictors of AET participation in adult life, as well as to inform future policies in the U.S., the current literature suggests several missing pieces. First, although increasing evidence shows the importance of motivation for learning, most of the previous large-scale studies to date have been conducted in Europe and Canada. Second, the focus has been predominantly placed on the economic outcomes among younger population despite the known wider benefits of learning over the life course (Jenkins & Mostafa, 2015). Third, as Desjardins (2011) indicated, only few studies have been conducted to link basic skills and indicators of readiness to learn to AET participation. It should be noted that readiness to learn is an abstract construct, which may or may not include basic skills necessary for higher level learning. As indicated earlier, the motivation to learn has a unique theoretical proposition in the context of lifelong learning participation. Therefore, possible readiness to learn components or AET participation determinants such as motivation and basic skills should be separately

examined in the context of AET (Smith, Rose, Ross-Gordon, & Smith, 2015). Taken together, the present study addresses these gaps by exploring the roles of motivation to learn and basic skills for AET participation among older adults in the U.S.

Research questions

Drawn from the literature and conceptual frameworks, this study addresses the following research questions:

(1) Is educational attainment associated with AET participation among middle-aged and older adults in the U.S.?

(2) Is the motivation to learn associated with AET participation among middle-aged and older adults in the U.S.?

(3) Are the basic skills including literacy and numeracy associated with AET participation among middle-aged and older adults in the U.S.?

Based on the evidence from the previous research (e.g., Biagetti & Scicchitano, 2013), we hypothesize that educational attainment is positively associated with AET participation, regardless of the type of AET. By the same token, motivation to learn is hypothesized to associate positively with AET participation. Also, considering that the literacy and numeracy could reflect the basic skills for learning, these are hypothesized to be positively associated with the likelihood of AET participation.

Methods

Data

We obtained the data from the Program for International Assessment of Adult Competencies (PIAAC) 2012/2014 restricted-use file (RUF). Due to the sensitive information in the RUF, the U.S. Department of Education's Institute of Education Sciences revised and

approved our data security plans and data use guidelines (license number: 17080026) before providing the data (National Center for Education Statistics, 2017). The U.S. PIAAC adopted four-stage stratified probability sampling, and the respondents were interviewed in person (see Hogan et al., 2016 for more detail). The PIAAC data allow for the generation of nationally representative estimates of basic skills such as literacy and numeracy among adults aged 16 to 74-years old (AIR PIAAC Team, n.d.). The PIAAC RUF also provides a series of demographic, socioeconomic, and behavioral information, as well as sampling weights and replicate weights for statistical analysis. Our analytic sample included respondents aged 50-years and older. An age criterion of 50 years was chosen to reflect a typical starting point of the pre-retirement stage over the life course. Although no specific age range can universally define a life stage, an age criterion of 50 years is frequently used in other population-based research (e.g., Johnson & Schoeni, 2011) and is publicly recognized as representing middle-to-older age in the U.S. (e.g., AARP membership eligibility). After excluding 60 cases with AET participation status missing, the final analytic sample size was 2,580.

Measures

Outcome/Dependent variables (3 variables). AET participation is a dichotomous variable indicating participation in AET in the past 12 months. Specifically, (1) any (both formal and non-formal), (2) formal and (3) non-formal AET participation are considered. In the PIAAC, formal AET participation means engagement in organized education and training opportunities that take place in recognized education and training institutions, and lead to a formal credential and/or diploma. Non-formal AET participation also takes place in recognized education and training institutions but the objective is not for any recognized credential. For example, distance learning, job-related training and private lessons can be considered non-formal AET

(Grotlüschen, Mallows, Reder, & Sabatini, 2016). On a relevant note, informal AET participation, which is unorganized, unintentional and/or unrecognized learning in everyday life is not included due to its unlimited variability, susceptibility to personal preference, lack of potential for systematic improvement (e.g., specific policy suggestion) at the population level, and unavailability in the PIAAC data.

Key regressors/Independent variables (4 variables). (1) Educational attainment is recorded as the total years of formal education among the respondents. (2) Motivation to learn is measured as a latent construct based on four items (see Figure 1 for the four survey items) in the PIAAC. Validity evidence for this measurement approach has been provided in previous work (Gorges, Maehler, Koch, & Offerhaus, 2016). In this study, validity evidence for a motivation to learn is examined for the middle-aged and older adults by assessing a measurement model (see the methods and results section). In the PIAAC, (3) literacy skills represent the ability to understand, evaluate, use, and engage with written texts to participate in society, to achieve one's goals, and to develop one's knowledge and potential" and (4) numeracy skills represent "the ability to access, use, interpret and communicate mathematical information and ideas, in order to engage in and manage the mathematical demands of a range of situations in adult life" (OECD, 2012, pp. 20, 34). The literacy and numeracy scores are provided as a set of 10 plausible values (with score range 0 – 500), which are statistically derived from the assessment results in the PIAAC. The PIAAC participants' literacy and numeracy are measured either by computer-based or paper-based assessment tools during the in-person interview. More detailed description of the literacy and numeracy assessments in the PIAAC has been published elsewhere (e.g., Goodman, Finnegan, Mohadjer, Krenzke, & Hogan, 2013).

Covariates/Control variables (9 variables). (1) Age at the time of the survey is measured in years. (2) Gender is recorded as woman or man. (3) Race is a dichotomous variable indicating non-Hispanic White vs. non-White. Due to the limited sample sizes, more detailed categories of race/ethnicity are not analyzed. (4) Parent's educational attainment is recorded as the college or higher vs. high school or less given the data availability and distribution. (5) Income is recorded as quintiles (5 levels) of the respondent's self-reported income. Given that income is not assessed for the respondents who were not employed at the time of the interview, "not employed" is included in the lowest income quintile. As such, the income variable also indicates the employment status in this study. (6) Living with a spouse is recorded as yes vs. no (7) The number of household members is a count variable. (8) Self-rated health is a dichotomous variable (excellent, very good, or good vs. fair or poor health). (9) Native English speaker indicates whether the respondent is native or non-native. In the PIAAC, the native English speaker status was a self-reported measure based on the language that the respondent first learned in childhood.

Analytic Plans

A weighted descriptive summary by AET participation is generated to describe the analytic sample in this study rather than to estimate representative figures. The measurement model using the confirmatory factor analysis with the full information maximum likelihood estimation for the motivation to learn is constructed first (Brown, 2014) where, in accordance with the validation study by Gorges et al. (2016), the four PIAAC survey items are modeled to reflect the underlying motivation to learn as a latent construct. Responses to each item is coded with 1 – 5 Likert-type response options. Specific survey items and response categories are shown in Figure 1.

A structural equation model with the latent variable (Kline, 2016) is used to examine the effects of education, motivation to learn (latent construct), and literacy and numeracy on AET participation. Given the dichotomous outcome variable, the mean and variance adjusted weighted least square (WLSMV) estimator and the probit link function are employed (B. O. Muthén, Muthén, & Asparouhov, 2016). The cases with missing values are included in the parameter estimation using the partially available information. For the correct standard error estimation with the plausible values, the sampling weight and 80 replicate weights are applied in all analyses. All observed variables and the latent variable are included in the models as the predictors of AET participation. The predictor are allowed to covary in the models.

The model building proceeds one path at a time. Specifically, the associations between each predictor variable and AET participation are first modeled separately to ensure each estimated coefficient is in alignment with the theoretical propositions. We considered the models to be identified based on the following two criteria. First, comparison of the number of off-diagonal elements of the variance/covariance matrix based on 17 observed variables (k = 153) the number freely estimated parameters in the final model (k = 101); (Wang & Wang, 2012) indicates the final model is over-identified. Second, a review of the Mplus output shows no errors suggesting possible under-identification. Additionally, for each path (i.e., individual component of structural equation models), we check the assumptions such as distributions and multicollinearity (reported in the results section). Finally, we use the sample size estimation algorithm by Preacher and Coffman (2006). The minimum required sample size to attain statistical power of 0.80 for our final models is about 208, and our sample size (n = 2,580) ensures that the models have sufficient power.

Per recommended guidelines (Kline, 2016), the models are evaluated with the chi-square statistic, comparative fit index (CFI > 0.90), root mean square error of approximation (RMSEA < 0.10) and standardized root mean square residual (SRMR < 0.10). However, with the use of plausible values, generating the model fit indices for the structural models is a complex issue, although the measurement models do not face this issue because no plausible values are included in these models. As such, we use each of the ten plausible values in separate models to generate ten sets of the model fit indices for the structural model evaluation. We evaluate the models based on the range of the observed model fit indices. Results, however, should be treated with caution due to the methodological limitations. All analyses use the sampling (SPFWT0) weight and 80 replicate weights (SPFWT1 – SPFWT80) provided in the PIAAC RUF. Mplus version 8 is used to estimate all models (L. K. Muthén & Muthén, 1998-2017). Statistical significance is determined by p-values less than 0.05.

Results

Descriptive statistics

Table 1 presents the weighted descriptive summary by the type of AET and participation status. Participation rates by the type of AET vary. Approximately 44% of PIAAC respondents aged 50 years and older participated in any AET. Only a little over 5% of respondents participated in formal AET, whereas 43% of them participated in non-formal AET. Among the non-formal AET participants, the literacy and numeracy scores were significantly greater than those of the counterpart. Yet, the scores were not different between the formal education participants and non-participants. Overall, AET participants were more likely to be younger, White (vs. non-White), more educated, and healthier than the non-participants. In the non-formal

AET, the participants also had greater income and English as their native language than the non-participants.

Structural Equation Models with Latent Variable

For the motivation to learn latent construct, the model fit indices (RMSEA = 0.076; CFI = 0.987; SRMR = 0.020) of the measurement model (Figure 1) show good fit and indicate adequate validity. All factor loadings are statistically significant. In regard to the first hypothesis, years of education is significantly positively associated with any AET ($b = 0.083$, $p < 0.05$) and non-formal AET participation ($b = 0.090$, $p < 0.05$) after adjusting for the covariates. However, education is not predictive of the formal AET participation ($b = 0.037$, $p > 0.05$) after adjusting for the covariates.

In regard to the second hypothesis, the fully conditional model showed a statistical anomaly. Namely, the non-significant bivariate associations became statistically significant when literacy and numeracy were simultaneously included in the formal AET model. A series of sensitivity analysis (e.g., only literacy in the model), step-by-step model building, and close examination of the descriptive statistics and bivariate tests (see Table 1) confirmed that formal AET was not associated with literacy or numeracy. Multicollinearity was initially suspected, but the variation inflation factors ($4.5 < 10$) indicated otherwise (DeMaris, 2005). Presumably, a combination of a relatively lower percentage of the formal AET participation (about 5%) and fairly strong correlation between literacy and numeracy (as well as other, undetermined issues) might have resulted in the statistical artifact when both literacy and numeracy are included in the formal AET models. Therefore, we exclude literacy and numeracy only from the formal AET model to avoid the methodological complication and possible misinterpretation of results. Nonetheless, motivation to learn is significantly positively associated with all types of AET

participation [any AET ($b = 0.182$, $p < 0.05$); formal AET ($b = 0.377$, $p < 0.05$); non-formal AET ($b = 0.160$, $p < 0.05$)] after adjusting for the covariates.

Finally, in regard to the third hypothesis, both literacy and numeracy are significant predictors of any AET participation as well as non-formal AET participation. Specifically, literacy is a positive predictor of any AET ($b = 0.055$, $p < 0.05$) and non-formal AET ($b = 0.054$, $p < 0.05$). Also, numeracy is a positive predictor of any AET ($b = 0.026$, $p < 0.05$) and non-formal AET participation ($b = 0.028$, $p < 0.05$). Yet, the relationships with formal AET participation are different. In short, the results from the statistical models partially supported all three hypotheses, except those involving formal AET.

Discussion

This study examines the associations between AET participation, years of education, motivation to learn, and basic skills including literacy and numeracy among adults age 50 years and older in the U.S. Here, we discuss the findings and provide possible explanations. With respect to the association between education and AET participation, years of education are predictive of any and non-formal AET, whereas not of formal AET. Positive experience with prior education and training contributes to the subsequent learning activities (Chang & Lin, 2011). Relatedly, previous education might have enhanced motivation for further learning in two ways. Individuals could have gained confidence through the completion of education programs and therefore, their self-efficacy for learning may be greater than those who have less formal educational attainment (Hammond & Feinstein, 2005). Also, it is possible that individuals with greater educational attainment may need to compete with those who have a similar educational background at work, and in turn, feel the need for continuous skill upgrading through lifelong learning (Knipprath & De Rick, 2015). Moreover, those with greater educational attainment

might be able to select the AET programs that fit their learning ability and educational need (Field, 2009). At the same time, that lack of observed education effect on formal AET could be a reflection of already sufficient qualifications and/or self-guided learning outside of work. By the same token, lower education may lead to the kinds of occupations that provide fewer opportunities of AET (Nedelkoska & Quintini, 2018).

Motivation to learn is a consistent predictor of AET participation among middle-aged and older adults. Although this study found the empirical associations between motivation to learn and AET participation, specific pathways are yet to be identified. Indeed, motivation to learn can be conceptualized and measured in multiple ways. The motivation to learn involves both intrinsic (e.g., individual value attached to education) and extrinsic (e.g., reward, promotion in career) factors (Boeren et al., 2010). Social benefit may also enhance the motivation for participation in AET (Hammond & Feinstein, 2005). Given the effect of motivation for learning on AET participation, future research needs to disentangle complex pathways between them. Such efforts may lead to the development of effective intervention or policy changes to systematically increase the motivation for learning among the adult population. Perhaps, the first step may be to create a profile of adults who are highly motivated for learning and identify sub-groups. In addition, building on the PIAAC items, the measurement of motivation for learning could be refined to reflect specific motives for lifelong learning in later life in future assessments.

Results suggest that basic skills matter to specific types of AET participation. Basic skills including literacy and numeracy may be a reflection of one's capacity for further learning (Biagetti & Scicchitano, 2013). In other words, individuals with poor basic skills may not know how to learn new complex knowledge and/or may not be confident to locate and participate in AET programs that are suitable to their capacity and learning goals. As a matter of fact, AET that

does not fit the individual (e.g., is too difficult or too easy) may result not only in distress but also in discouragement for future learning (Field, 2009). By the same token, proficient basic skills may be the product of previous successful educational activities. Furthermore, literacy skills could indicate the level of cognition in general, and among the older population in particular (Sisco et al., 2015). The aging-related lower cognitive ability or cognitive impairment can be the barrier to AET participation.

While, in the present study, both literacy and numeracy are positively associated with any AET participation and non-formal AET participation, they are not associated with formal AET participation. Previous research on this specific matter is limited. One study reports that the self-rated learning skills were positively associated with informal AET and job-related AET participation in Canada (Nilsson & Rubenson, 2014) Yet, a brief discussion of a few possible explanations is worth noting. Formal AET may be inherently different from non-formal AET in terms of participation determinants. Formal AET could have been facilitated more by requirements, for example, by the requirements of employers, rather than by individuals' intellectual curiosity. Indeed, adults with greater socioeconomic status (e.g., educational attainment) tend to be in organizations where continuous AET may be required to improve the human capital (Rubenson, 2007). As such, regardless of the basic skills, formal AET participation may be determined by a combination of the internal (e.g., motivation to learn) and external forces (e.g., required for one's job). AET participation may be influenced by the economic and social resources of the individual learner. That is, individuals with lower economic means and/or social network may miss opportunities to participate in formal AET due to, for example, costs, eligibility, transportation and time constraints (e.g., due to family obligation). This notion is supported in the bounded agency theory, which suggests that individual choices

are limited to the availability of AET programs and resources in the given environment (Roosmaa & Saar, 2017; Rubenson & Desjardins, 2009). These potential explanations are still speculative and should be revisited in future research.

Limitations

Several limitations should be noted in this study. To begin with, omitted variable bias cannot be ruled out. Particularly, underlying psychological factors such as personality and work ethics could be linked to some of, if not all, the predictors of AET participation in this study. Also, higher-level factors (e.g., institutional barriers, economic context, industrial sectors) are not incorporated in our analysis and therefore, the findings need to be verified in the future research with multi-level analytic strategies (Boeren et al., 2010; Roosmaa & Saar, 2017). On a related note, we focused on the general middle-aged and older adults, and therefore, analysis by industrial sectors was beyond the scope of our current study. The meaningful next step in future research is to conduct a sub-group analysis of working adults by industrial sectors. Furthermore, this study focuses on the organized AET programs but the detailed classification of each program is not possible. Previous studies report that specific programs such as arts, music and exercise may be linked to the AET participation due to their psychosocial benefits (Narushima et al., 2018b).

In addition, due to the PIAAC study design with the replicate weights, the model fit indices are not estimated in a conventional manner. Moreover, although we adopted the Boeren et al.'s model (2010) and existing research to guide the model specifications, a lack of previous research on the same topic, the theoretical proposition in the model building should be refined as more relevant research becomes available. Particularly, further inquiry of directions within the relationships between motivation, basic skill and AET participation in the longitudinal data

would be valuable. Finally, use of the cross-sectional data does not allow us to make any inference in terms of the longitudinal associations. Emerging evidence suggests that continuous engagement in AET is necessary for sustained benefits, which may stimulate subsequent AET participation (Narushima et al., 2018b). Longitudinal data collection on AET participation along with the motivation to learn and basic skills is highly desirable in future research.

Implications

This study identified the associations between the specific types of AET participation, education, motivation to learn, and basic skills in middle-aged and older adults in the U.S. Although improving educational attainment at the population level is difficult (Reder & Bynner, 2009), more malleable factors including motivation to learn, literacy and numeracy should receive more attention in order to promote AET participation in the second half of adult life. Also, from a program administrator's perspective, providing AET programs at various levels that accord with participants' intellectual curiosity (which may be indicated by the motivation to learn) as well as with their learning skills (which may be indicated by basic skills) is essential, as skill-mismatch is known to result in undesirable learning experience (Field, 2009). Moreover, more research is needed to clarify specific pathways between specific types of AET participation and the known predictors such as motivation to learn, literacy, and numeracy (Narushima et al., 2018b). In addition, the impacts of institutional, community, and societal level factors on the likelihood of AET participation should be rigorously examined. Joint efforts by individuals, communities and public sectors to enhance the malleable promoters of AET participation and to prevent skill-mismatch in the AET programs may lead to a greater AET participation rate. Ongoing monitoring and research could inform more effective strategies and resource allocations. It should also be reminded that the promotion of education in earlier life stages is

still a primary strategy to promote lifelong learning. Given the wider benefits of AET (Feinstein et al., 2008), endeavors to improve formal education, motivation to learn and basic skills over the life course are a wise investment as a society.

Conclusions

The analysis of nationally representative data of U.S. adults aged 50 and older showed that motivation to learn, literacy, and numeracy are linked to participation in any AET and non-formal AET. At the same time, literacy and numeracy are not observed to be associated with formal AET in this study. Considering the wider benefits of lifelong learning, investing time and resources on motivation to learn and basic skills may lead to an increase in participation in AET programs. At the same time, removing barriers to AET participation and providing skill matched AET programs may require policy-level interventions. Further research is necessary to disentangle complex pathways between the multiple types of AET participation and the malleable predictors. The importance of formal education in the early life stages should be re-emphasized in view of the motivation to learn and basic skills to set up lifelong learning.

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Table 1: Weighted Descriptive Summary by Any AET, Formal AET, and Non-formal AET

Variables	Any AET Participation		Formal AET participation		Non-formal AET participation	
	Yes (n = 1,140)	No (n = 1,440)	Yes (n = 140)	No (n = 2,440)	Yes (n = 1,100)	No (n = 1,480)
	Mean (SE) or %	Mean (SE) or %	Mean (SE) or %	Mean (SE) or %	Mean (SE) or %	Mean (SE) or %
Motivation to learn [a]						
"I like learning new things" (1 – 5)	4.230 (0.029)	3.830 (0.031)	4.470 (0.063)	3.989 (0.022)	4.227 (0.028)	3.841 (0.032)
"I like to get to the bottom of difficult things" (1 – 5)	3.996 (0.029)	3.709 (0.034)	4.191 (0.080)	3.822 (0.023)	3.995 (0.029)	3.716 (0.034)
"I like to figure out how different ideas fit together" (1 – 5)	3.883 (0.026)	3.508 (0.035)	4.109 (0.078)	3.657 (0.025)	3.881 (0.028)	3.516 (0.035)
"If I don't understand something, I look for additional information to make it clear" (1 – 5)	4.183 (0.026)	3.862 (0.023)	4.383 (0.067)	3.989 (0.019)	4.178 (0.025)	3.873 (0.023)
Literacy (0 - 500)	278.892 (1.753)*	246.588 (1.878)	270.846 (5.698)	260.805 (1.437)	279.384 (1.779)*	246.830 (1.919)
Numeracy (0 – 500)	267.278 (1.989)*	233.378 (1.948)	246.238 (6.331)	248.931 (1.583)	267.926 (2.061)*	233.529 (1.938)
Age (years)	58.327 (0.027)*	61.503 (0.173)	57.302 (0.483)*	60.196 (0.103)	58.327* (0.211)	61.440 (0.174)
Gender (women vs. men)	53.700%	51.500%	59.100%	52.200%	53.7000%	51.600%
Race (white vs. others)	75.600%*	73.200%	51.000%*	75.500%	76.500%*	72.500%
Years of education	14.734 (0.092)*	12.511 (0.057)	14.349 (0.330)*	13.479 (0.043)	14.842 (0.094)*	12.509 (0.058)
Parents' education (college or higher vs. less than college)	32.200%*	17.200%	26.400%	23.900%	32.800%*	17.400%
(college vs. less than college)						
Income groups (quintile: 1 – 5)	2.718 (0.042)*	1.514 (0.029)	2.189 (0.137)	2.056 (0.029)	2.738 (0.043)*	1.522 (0.032)
Living with spouse (yes vs. no)	87.000%*	83.200%	84.800%	84.900%	87.300%*	83.100%
Number of household members	2.450 (0.034)	2.365 (0.039)	2.558 (0.116)	2.396 (0.009)	2.450 (0.034)	2.367 (0.040)
Self-rated health (good vs. fair/poor)	85.700%*	68.100%	85.300%*	75.700%	86.200%*	68.100%
Native English speaker (yes vs. no)	90.200%*	84.800%	88.600%	87.300%	90.600%*	84.600%

*p < 0.05 (Yes vs. No)
AET = Adult education and training; SE = Standard error
Sampling weight and replicate weights are applied

Table 2: Estimated Coefficients from the Probit Regression Models on Any Adult Education and Training (AET) Participation

Variables	Model 2 N = 2,580	Model 3 N = 2,580
Motivation to learn [a]	0.370 (0.041)*	0.182 (0.039)*
Literacy (0 - 500)	0.055 (0.014)*	0.055 (0.014)*
Numeracy (0 – 500)	0.026 (0.012)*	0.026 (0.012)*
Age (years)		-0.020 (0.005)*
Gender (women vs. men)		0.235 (0.053)*
Race (white vs. others)		-0.278 (0.078)*
Years of education		0.083 (0.011)*
Parents' education (College or higher vs. less than college)		0.071 (0.066)
Income groups (quintile: 1 – 5)		0.226 (0.015)*
Living with spouse (yes vs. no)		0.103 (0.076)
Number of household members		0.023 (0.024)
Self-rated health (good vs. fair/poor)		0.179 (0.069)*
Native English speaker (yes vs. no)		0.226 (0.094)*
Model fit indices		
Chi-square (degrees of freedom)	3,183.744 – 3,294.733 (20)	3,936.096 – 3,992.561 (70)
RMSEA	0.049 – 0.054	0.031 – 0.033
CFI	0.974 – 0.979	0.969 – 0.974
SRMR	0.022 – 0.025	0.015 – 0.16

Note: The models were estimated using the probit link function and the mean and variance adjusted weighted least square (WLSMV) in Mplus version 8.0. Fit indices show the range of observed values over ten fitted models.
a. Motivation to learn is a latent variable (see the methods section and Figure 1)

Table 3: Estimated Coefficients from the Probit Regression Models on Formal Adult Education and Training (AET) Participation

Variables	Model 2 N = 2,580	Model 3 N = 2,580
Motivation to learn [a]	0.471 (0.083)*	0.377 (0.080)*
Literacy (0 - 500)	- [b]	- [b]
Numeracy (0 – 500)	- [b]	- [b]
Age (years)		-0.033 (0.006)*
Gender (women vs. men)		0.016 (0.118)
Race (white vs. others)		-0.588 (0.131)*
Years of education		0.037 (0.019)
Parents' education (College or higher vs. less than college)		-0.104 (0.117)
Income groups (quintile: 1 – 5)		-0.071 (0.040)
Living with spouse (yes vs. no)		0.105 (0.140)*
Number of household members		0.033 (0.040)*
Self-rated health (good vs. fair/poor)		0.199 (0.103)
Native English speaker (yes vs. no)		0.302 (0.190)
Model fit indices		
Chi-square (degrees of freedom)	3,097.356 – 3,223.827	3,527.895 – 3,591.387
RMSEA	0.071 – 0.077	0.030 – 0.032
CFI	0.936 – 0.947	0.966 -0.971
SRMR	0.101 – 0.109	0.015

Note: The models were estimated using the probit link function and the mean and variance adjusted weighted least square (WLSMV) in Mplus version 8.0. Fit indices show the range of observed values over ten fitted models.

a. Motivation to learn is a latent variable (see the methods section and Figure 1)

b. excluded due to the methodological complication (see the methods section)

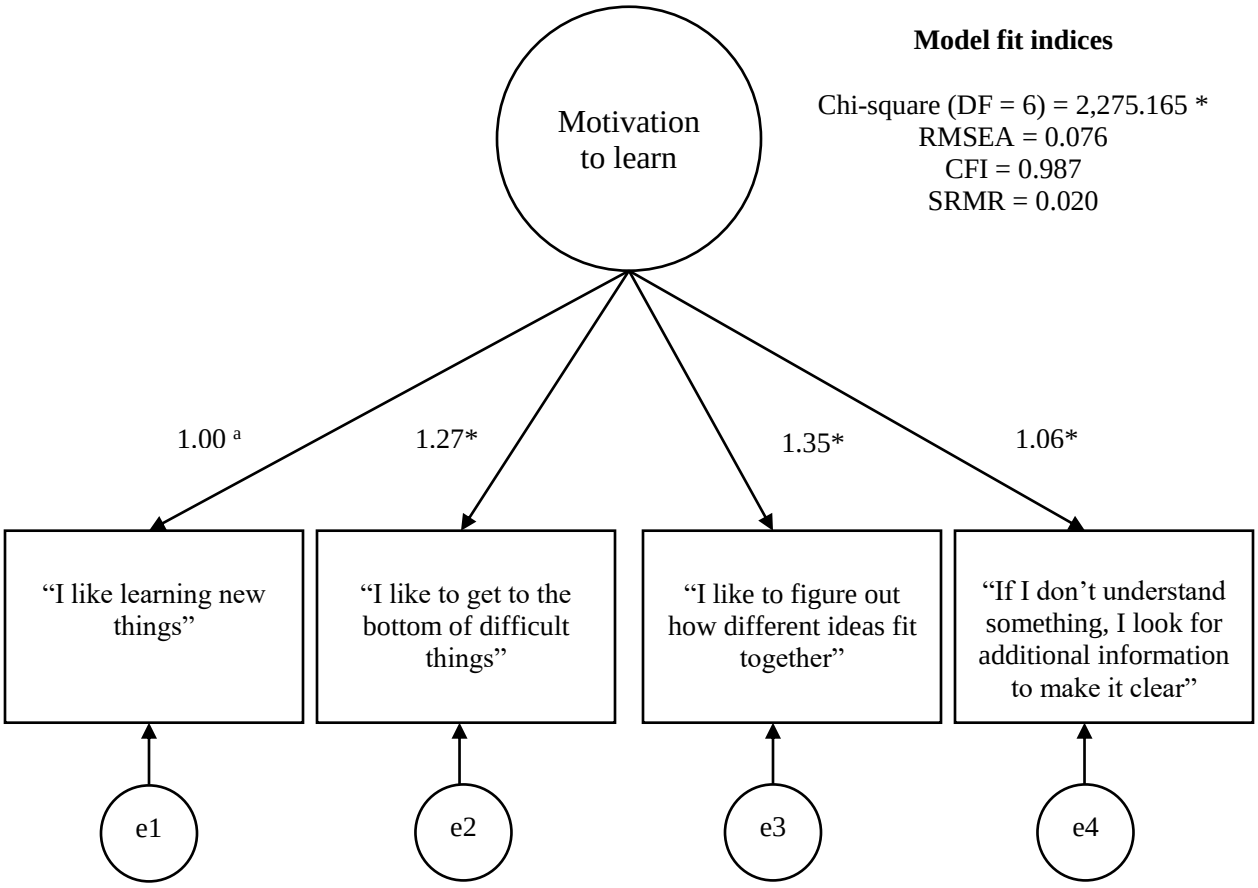
Table 4: Estimated Coefficients from the Probit Regression Models on Non-Formal Adult Education and Training (AET) Participation

Variables	Model 2 N = 2,580	Model 3 N = 2,580
Motivation to learn [a]	0.350 (0.043)*	0.160 (0.040)*
Literacy (0 - 500)	0.054 (0.015)*	0.054 (0.015)*
Numeracy (0 – 500)	0.028 (0.013)*	0.028 (0.013)*
Age (years)		-0.050 (0.005)*
Gender (women vs. men)		0.232 (0.055)*
Race (white vs. others)		-0.211 (0.075)*
Years of education		0.090 (0.012)*
Parents' education (College or higher vs. less than college)		0.068 (0.061)
Income groups (quintile: 1 – 5)		0.225 (0.017)*
Living with spouse (yes vs. no)		0.121 (0.076)
Number of household members		0.027 (0.024)
Self-rated health (good vs. fair/poor)		0.199 (0.069)*
Native English speaker (yes vs. no)		0.244 (0.097)*
Model fit indices		
Chi-square (degrees of freedom)	3,184.276 – 3,292.281	3,937.933 – 3,992.192
RMSEA	0.069 – 0.076	0.030 – 0.033
CFI	0.941 – 0.950	0.969 – 0.974
SRMR	0.103 – 0.112	0.015 – 0.016

Note: The models were estimated using the probit link function and the mean and variance adjusted weighted least square (WLSMV) in Mplus version 8.0. Fit indices show the range of observed values over ten fitted models.

a. Motivation to learn is a latent variable (see the methods section and Figure 1)

Figure 1: Motivation to Learn Measurement Model with the Estimated Factor Loadings and Model Fit Indices



*$p < 0.05$
Note: Maximum likelihood estimator was employed
a. the factor loading is fixed to 1 to provide a unit to the latent variable.
Response categories for the items are 1-5 = not at all – to a high extent
In the PIAAC data, six items were used for the readiness to learn (six-item) construct, but per Gorges et al. (2016), four items were selected for the motivation to learn construct in this study.
e1 – e4 indicates the error variances