

Global motivation to learn and adult learning: A nomological network analysis and a four-year longitudinal study

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ABSTRACT

This study investigated motivation to learn (MtL), conceptualized at a global level of abstraction, and participation in adult learning and training (PAE). In Study 1 ($N = 747$, 65.1 % female; age: $M[SD] = 43.21[12.09]$ years), the nomological network of global MtL revealed strong correlations with mastery goal orientation, intrinsic task value, need for cognition, and self-concept of ability. Cross-sectional associations with (past and planned) PAE were small to moderate. Based on the representative German PIAAC longitudinal study covering four years between 2012 and 2016 ($N_{2012} = 4191$, $N_{2015} = 2502$, $N_{2016} = 2370$) and using structural equation modeling, results from Study 2 support the hypothesis that global MtL affects PAE while controlling for level of education, employment, literacy, age, and sex. The results are discussed with respect to theoretical implications for the development of motivation theory and practical implications for the promotion of lifelong learning.

Educational impact and implications statement: This study examined adults' motivation to learn (MtL) at a global level of abstraction, overcoming previous limitations of focusing on specific educational settings or learning content. Global MtL may help to explain patterns of participation in adult education and training, particularly in relation to social inequalities. In addition, MtL may be malleable and thus amenable to targeted interventions, providing a starting point for promoting lifelong learning in adult populations.

1. Introduction

Lifelong learning is a vital part of adult life in modern societies (European Commission, 2000; Field, 2000; OECD, 2005). Because adult learners decide mostly independently on the type and extent of their engagement in education and learning, motivation to learn (MtL) is of particular importance for their participation in adult education and learning, comprising formally-organized education and informal learning taking place after having completed primary, secondary and higher/vocational education (Boeren et al., 2010; Courtney, 1992; Manninen, 2005; Radovan et al., 2004). MtL is a key variable in educational research conceptualized in different ways (Hattie et al., 2020; Murphy & Alexander, 2000; Wigfield & Cambria, 2010). The focus of motivational constructs ranges from students' motivation to engage in a specific current or upcoming task to motivation to learn and achieve in certain situations (e.g., during a lecture), subjects (e.g., history), domains (e.g., mathematical, verbal), or institutions (e.g., at school, at university). Because MtL has been primarily investigated within primary and secondary school settings and higher education, its

conceptualization and operationalization typically refer to a specific institutionalized educational setting or content, and focus on younger learners, such as children and adolescents. Nevertheless, motivational theories generally claim to be universal, that is, valid across educational settings, types of learning content, and age groups.

Focusing on adult education and training, Gorges et al. (2016) have argued that global MtL—that is, MtL conceptualized and measured independently of a subject, domain, or institution—should affect participation in adult education and training (PAE) when the specific educational setting or learning content that will be the next opportunity to learn is unknown. From this perspective, MtL would signify an individual's tendency to engage in learning across various settings and situations rather than referring to a specific setting or learning content. Thus, MtL, which was initially described as a person-situation interaction, eventually meets the concept of relatively stable personality traits such as need for cognition, which is an individual's stable predisposition for effortful information processing (Cacioppo & Petty, 1982; Jebb et al., 2016), locus of control (i.e., a generalized control expectation; Rotter, 1966), openness to new experience (McCrae & Costa, 1987;

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Rammstedt, Danner, & Martin, 2016), and intellectual curiosity (Powell et al., 2016; von Stumm et al., 2011).

Against this background, the present research explored where global MtL stands in relation to conceptually linked constructs from motivational and personality research, and to what extent global MtL affects PAE, using the MtL Scale (see Table 1) implemented in the Programme for the International Assessment of Adult Competencies (PIAAC) background questionnaire (OECD, 2010). According to Cronbach and Meehl (1955), a nomological network illustrates construct validity because a “construct is defined implicitly by a network of associations or propositions in which it occurs” (pp. 299/300). Therefore, Study 1 sought to examine the nomological network of global MtL including established motivational and personality measures as well as past and planned PAE. Study 2 tested the predictive validity of MtL regarding adult learning using a four-year longitudinal study, the longitudinal extension of the 2012/13 PIAAC study in Germany (Rammstedt, Martin, et al., 2017), while controlling for established sociodemographic predictors (e.g., age, employment, and level of education). Longitudinal data analyses allow for careful causal conclusions by providing data on the chronological order of MtL and PAE. Thus, this research adds to the literature (1) by exploring the nomological network of global MtL and (2) by investigating its prospective predictive validity for educational task choice in adult education and training.

1.1. Motivation to learn—From situational to global motivation

The relevance of motivation in educational psychology has been documented in numerous publications detailing the conceptual foundation of various theoretical approaches to MtL (cf. Hattie et al., 2020; Wentzel & Miele, 2016). Motivation has generally been defined as “a process in which goal-directed activity is instigated and sustained” (Schunk et al., 2014, p. 5). Accordingly, MtL in educational psychology reflects the driving force behind activities to acquire knowledge and develop competencies, typically with a focus on academic settings (as opposed to, for example, learning how to ride a bike). MtL—beliefs regarding a task’s value (i.e., why should one engage in a task?; Eccles & Wigfield, 2020)—is deemed relevant for an individual’s task choice, task engagement, and successful task completion across all age groups (Gorges, 2015; Courtney, 1992; Wentzel & Miele, 2016; Włodkowski & Ginsberg, 2017).

Research conducted within primary and secondary school, higher education and vocational settings typically measures students’ MtL regarding their engagement at school, at university, or in terms of subject-/content-specific or situation-specific motivation (Dietrich et al., 2017; Hulleman et al., 2016; Hurtz & Williams, 2009). Thus, motivational beliefs can be conceptualized at varying levels of abstraction (King & McInerney, 2013; Marsh, 1990; Vallerand, 2000). Guay et al. (2003) suggest a distinction among a “global level” of self-determined motivation (Ryan & Deci, 2000), which qualifies as a relatively stable personality trait, a “life domain level”, and a fluctuating “situational level” (p. 992). Likewise, intrinsic motivation (Ryan & Deci, 2000) can be conceptualized as a school subject-specific or domain-specific construct, or specific to an educational institution (Gorges, 2019; Chanal & Guay, 2015; Daniels, 2008); other studies distinguish between

situational and individual task value (Dietrich et al., 2017; Parrisius et al., 2022; see Gogol et al., 2017, for similar findings regarding interest across three different school subjects). These results suggest that individuals hold motivational beliefs at levels of abstraction higher than school subjects (see Fig. 1). Moreover, within the theoretical framework of habitual achievement goal orientations (Dweck & Leggett, 1988; Maehr & Zusho, 2009; Nicholls, 1984), the concept of mastery goal orientation—the goal to expand one’s competence—may reflect an “enduring personality disposition” guiding action across situations (Kaplan & Maehr, 2007, S. 163).

Overall, global MtL can be conceptualized as task value or mastery goal orientation with respect to academic learning in general (Gorges et al., 2016). Hence, global MtL appears to be conceptually linked to mastery goal orientation, intrinsic task value, and, given the relations of these constructs with ability beliefs, to academic self-concept of ability. Therefore, the global MtL as operationalized in PIAAC should be embedded in a network of meaningful relations, referred to as nomological network (Cronbach & Meehl, 1955). Moreover, because MtL affects task choice in educational settings, global MtL should predict PAE.

1.2. Motivation to learn in adult education research

Unlike educational psychology, adult education research on predictors of PAE has focused on sociodemographic characteristics. A person’s age, sex, level of education, and integration in the labor market (i. e., employment, as well as specific attributes of their employment such as size of employer or type of contract) have been consistently documented as major contributors to PAE (Courtney, 1992; OECD, 2005; Vaculíková et al., 2024). In addition, literacy has been explored as a prerequisite of PAE and as an indicator of job-task complexity, which could reflect a person’s intellectual potential and level of qualification better than broad categories such as academic background (Boudard & Rubenson, 2003; Punksungka et al., 2022).

Only a few studies have focused on investigating adults’ motivation for PAE, and even less their global MtL. Using the 2012/13 cycle of PIAAC data, Yamashita et al. (2022) and Gorges et al. (2016) have documented significant cross-sectional relations between MtL and basic skills and PAE, respectively. However, Gorges et al. (2016) limited their analyses to employed medium-aged adults to control for employment and age, and Yamashita et al. (2022) explored predictors of MtL. Other studies using PIAAC investigated relations between MtL and adult skills, age, level of education, or skill use (Roessger et al., 2022; Sahoo et al., 2023; Smith et al., 2015).

Drawing on data from the European Adult Education Survey—a trend study of PAE across Europe conducted since 2007 (European Commission, 2021)—Gorges and Hollmann (2015) have found that adults’ task value regarding adult education and training predicted their PAE during the 12 months preceding the data collection. The importance of adults’ task value increased when contextual factors were less relevant (e.g., in self-initiated, private PAE compared to job-related PAE; see also Gorges, 2018), and when adults hold a lower level of education, presumably because these individuals are less likely to have favorable environmental conditions leading to PAE (e.g., employers who provide them with educational activities or financial resources to pay for education; Gorges, 2018; Gorges & Hollmann, 2015). Unfortunately, this study did not control for employment, which may also explain differences across levels of education. Moreover, none of these studies provide an analysis of prospective longitudinal data to enable careful causal interpretation of the predictive validity of MtL.

Overall, given its cross-sectional relations with predictors of PAE and, based on a limited number of studies, PAE itself, global MtL should affect subsequent PAE. Thus, a prospective predictive validity for MtL and subsequent PAE was hypothesized in this study and tested using longitudinal data spanning four years of data collection. This study design allows for a tentative causal interpretation of the effect of MtL on

Table 1
Variable names and items of the Motivation to Learn (MtL) scale implemented in PIAAC (Gorges et al., 2016).

Variable	Item
I_Q04d:	I enjoy learning new things.
I_Q04j:	I like to get to the bottom of difficult things.
I_Q04l:	I like to figure out how different ideas fit together.
I_Q04m:	If I don’t understand something, I look for additional information to make it clearer.

Note. Instructions were “Rate on a scale from 1 (Not at all) to 5 (To a very high extent)”.

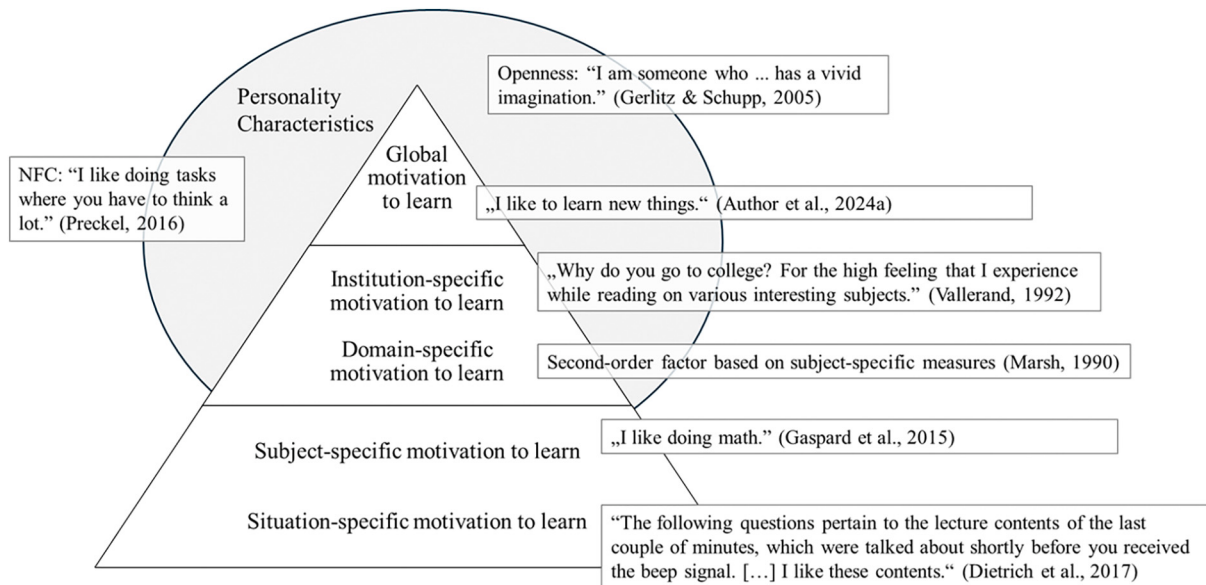


Fig. 1. Hypothesized hierarchical structure of motivation to learn.

PAE. Moreover, global MtL may be a key to increasing PAE especially for low-qualified adults given its boosted relevance when level of education is low. Therefore, the interaction between MtL and level of education was explored as well.

1.3. Predictors of academic achievement and learning in personality research

Personality research has identified several global theoretical constructs affecting learning and achievement. Need for cognition has been repeatedly found to strongly correlate with motivational constructs (Chen & Wu, 2012; Luong et al., 2017; Story et al., 2009), particularly with mastery goal orientation and intrinsic motivation (r 's > 0.58). A person's locus of control is associated with conceptualizations of expectancy of success (e.g., self-efficacy; Phillips & Gully, 1997), which, in turn, correlates strongly with value beliefs that signify MtL. Internal locus of control—the belief that life events occur because of one's own behavior—is positively (r 's from 0.18 to 0.35) correlated with mastery goal orientation (Albert & Dahling, 2016; Buluş, 2011), job-related intrinsic motivation (Ng et al., 2006), and job-related PAE ($O.R.$ = 1.68, Offerhaus, 2014). Fazey and Fazey (2001) reported a positive relationship between external locus of control—the belief that success depends on circumstances that individuals cannot influence—and low levels of motivation. Notably, the distinction between internal and external locus of control is still under debate (Jakoby & Jacob, 1999; Kovaleva et al., 2012).

From the widely accepted Big Five personality model (McCrae & Costa, 1987), conscientiousness is primarily associated with achievement (Komarraju & Karau, 2005; Song et al., 2020) but also moderately associated (r 's between 0.34 and 0.45) with MtL (Komarraju & Karau, 2005; Major et al., 2006). The relationship between conscientiousness and MtL (Colquitt & Simmering, 1998; Komarraju & Karau, 2005; Major et al., 2006) has been reported to be weak to moderate (r 's around 0.20). Openness to experience (Costa & McCrae, 1992) is associated with knowledge acquisition (Von Stumm, 2018) and significantly predicted job-related PAE in a representative sample of the working population in Western Germany ($O.R.$ = 1.64, Offerhaus, 2014). A previous study using PIAAC data reported a non-significant association between openness, assessed in 2014, and PAE during the past 12 months, assessed two years before, when age, gender, migrant status, educational attainment, and numeracy were controlled (Rammstedt, Danner, & Lechner, 2017).

Intellectual curiosity, comprising openness, need for cognition, epistemic curiosity, and typical intellectual engagement (von Stumm et al., 2011), shows a substantial conceptual overlap with MtL and has been assessed, in part, using identical items (Bluemke et al., 2023). In his theoretical framework of intellect, Mussel (2013) integrated need for cognition (Cacioppo & Petty, 1982; Jebb et al., 2016), typical intellectual engagement (Furnham et al., 2009), openness (McCrae & Costa, 1987), and curiosity (Litman, 2005) by systemizing similarities and differences between a range of personality constructs associated with intellectual achievement. The framework comprises a two(“Seek, Conquer”)–by-three(“Think, Learn, Create”) matrix emphasizing, for example, that need for cognition pertains to seeking situations that require deep thinking, whereas (interest–) curiosity and mastery goal orientation pertain to seeking situations that offer learning opportunities. Results from three validating studies show that the seek–learn dimension of intellect is most strongly associated with mastery goal orientation (r > 0.70).

Overall, MtL should show moderate to strong associations with related personality constructs such as need for cognition and openness, while maintaining a conceptual uniqueness. Global MtL may reflect the seek–learn dimension of intellect and should be an important factor for PAE because of its specific focus on learning activities. Fig. 1 summarizes the assumed hierarchy of motivational concepts.

1.4. The present research

The present research examined global MtL, which is hypothesized to be part of a network of learning-related motivational and personality constructs and to affect PAE across settings and learning content. Study 1 explored global MtL's construct validity based on Cronbach and Meehl's (1955) idea of a nomological network to answer the question how MtL relates to distinct but conceptually related theoretical constructs, conceptually unrelated theoretical constructs, and PAE. Focusing on the question “does MtL affect PAE?”, Study 2 tested MtL's prospective predictive validity drawing on longitudinal data of a representative sample of the German working population, while controlling for typical sociodemographic factors (i.e., sex, age, level of education, literacy, employment; Courtney, 1992; OECD, 2005).

2. Study 1

The goal of a nomological network analysis is to analyze a theoretical

construct in relation to several other constructs that may support the convergent (i.e., a moderate to strong correlations) and discriminant (i.e., a weak or zero correlations) validity of the construct under investigation (Cronbach & Meehl, 1955). To this end, Study 1 explored correlations between MtL and measures from motivational and personality research. Motivational measures were adapted to refer to learning on a global level of abstraction. Given the conceptual overlap (mastery goal orientation, intrinsic task value) and theoretical association (academic self-concept) of the motivational constructs with MtL, moderate to high correlations were expected. Regarding constructs from personality research, openness, conscientiousness, need for cognition, and locus of control were considered, which have been associated with academic achievement in previous studies. These constructs were expected to be differentially related to MtL given that some have higher conceptual overlap (openness, need for cognition) with MtL than others (conscientiousness, locus of control). In addition, agreeableness was included to explore discriminant validity, as it is not expected to be associated with MtL or PAE (Major et al., 2006). Finally, regarding the predictive validity of MtL, low-to-moderate positive associations were expected with (planned) PAE, owing to various contextual factors that affect actual participation in addition to motivation (Gorges & Hollmann, 2015). Correlations were expected to be nominally higher for more self-determined forms of PAE, namely informal and non-job-related PAE, compared to formal education and job-related PAE.

2.1. Methods

2.1.1. Participants and procedure

An online questionnaire using the SoSci-Survey software was submitted to the SoSci Panel, a convenience pool of nearly 100,000 panelists (60 % female, 96 % between 20 and 76 years old). Most panelists have completed upper secondary education (33 %) or higher education (49 %; Leiner, 2016; SoSci Panel, 2025). The SoSci Panel peer reviewed the questionnaire and invited panelists to participate in the study. Data collection took place in accordance with the local legislation and guidelines on studies with human subjects adopted by the German Association for Psychology. Participants were informed about the content and duration of the study; they were told that their participation would be voluntary and that they could stop their participation at any time. Participants were informed that the data is collected anonymously and is only used for scientific purposes. In addition, participants were invited to join a lottery of shopping vouchers as an incentive. The participants completed the questionnaire in less than ten minutes on average ($N = 747$ participants; see Table 2 for sample characteristics). The proportion of missing values was below 0.3 %, with most variables having complete data.

2.1.2. Measures

Global MtL. MtL was measured using the PIAAC MtL scale (see Table 1; Gorges et al., 2016; OECD, 2010). Responses were given on a five-point Likert-type scale: (1) not at all, (2) very little, (3) to some extent, (4) to a high extent, and (5) to a very high extent (Cronbach's $\alpha = 0.78$; $M = 4.05$; $SD = 0.58$).

Motivational Measures. Participants' responses on adapted motivational measures were recorded on a five-point Likert-type scale: (1) does not apply at all, (2) does rather not apply, (3) neither/nor, (4) rather applies, and (5) applies completely. **Mastery goal orientation** was assessed using five adapted items (Spinath et al., 2002, e.g., "When I consider something more closely (e.g., by reading something or attending a course), I intend to understand complex ideas." (Cronbach's $\alpha = 0.69$; $M = 4.12$; $SD = 0.54$). The **intrinsic task value** of learning was measured using three adapted items (e.g., "I enjoy learning.") developed by Steinmayr and Spinath (2010), which were modified to refer to learning in general (Cronbach's $\alpha = 0.88$; $M = 4.24$; $SD = 0.67$). **Academic self-concept of ability** was assessed using five adapted items developed by Dickhäuser et al. (2002), using a semantic differential

Table 2
Socio-demographic characteristics of the sample in study 1.

Characteristics	Descriptive Statistics
Age	$M = 43.21$, $SD = 12.09$, range = 18–72 years
Sex	65.1 % female
Country of Birth	82.2 % Germany
Family Language	94.8 % German
Nationality	82.2 % German
Marital status	45.3 % married, living together 22.3 % living with partner 2.8 % married, living separately 20.0 % single 8.2 % divorced 1.5 % widowed
General Education	84.5 % upper secondary education
Vocational Education	45.3 % Master-level degree or higher (e.g., PhD) 16.5 % Bachelor-level degree 18.2 % vocational education 3.9 % no vocational education 16.1 % other
Employment	66 % working full time (at least 35 h/week) 22.5 % working part-time (16–24 h/week) 2.9 % working less than 16 h/week 8.6 % not employed (e.g., retired, unemployed, in education)
Participation in adult education and training	Job-related non-formal: 88 % Non-job-related non-formal: 93 % Informal: 77 %
Planned participation in adult education and training ^a	Non-formal: $M = 2.85$, $SD = 0.6$ Informal: $M = 3.22$, $SD = 0.62$

Note. ^a rated on a 5-point Likert-type scale (1 = "yes, definitely" to 5 = "no, definitely not").

scale (Cronbach's $\alpha = 0.84$; $M = 3.89$; $SD = 0.62$, e.g., "Learning new things is easy [...hard] for me.").

Personality measures. **Need for cognition** was assessed using items of the Need for Cognition–Teens (NFC–Teens; Preckel, 2016) Scale, which had better psychometric properties than existing short scales used in panel studies (Beißert et al., 2014). The five positively phrased items that displayed the strongest loadings on the need for cognition factor in the original study (Preckel, 2016) were included in the questionnaire (e.g., "I like doing tasks where you have to think a lot.", Cronbach's $\alpha = 0.86$; $M = 3.70$; $SD = 0.62$). **Locus of control** was measured using the four-item Scale for the Assessment of Locus of Control (Kovaleva, 2012). The two-item subscale measuring internal locus of control (e.g., I am in control of my own life.") and the two-item subscale measuring external locus of control ("My plans are often thwarted by fate.") were included in the model as a four-item-scale (Cronbach's $\alpha = 0.65$; $M = 4.05$; $SD = 0.58$). Responses for need for cognition and locus of control were recorded on the same 5-point Likert-type scale used for adapted motivational measures. **Openness to experience, conscientiousness, and agreeableness** were assessed using the respective three-item subscales of the Big Five Inventory-SOEP (BFI-S Gerlitz & Schupp, 2005). The response options of the seven-point Likert-type scale were (1) does not apply at all, (2) does not apply substantially, (3) rather does not apply, (4) neither/nor, (5) rather applies, (6) applies substantially, and (7) applies completely (openness: Cronbach's $\alpha = 0.72$; $M = 5.15$; $SD = 1.23$; conscientiousness: Cronbach's $\alpha = 0.61$; $M = 5.29$; $SD = 0.98$; agreeableness: Cronbach's $\alpha = 0.56$; $M = 5.21$; $SD = 0.95$). Sample items are: "I see myself as someone, who...has vivid imagination [openness]; ...works thoroughly [conscientiousness]; ...can forgive [agreeableness]").

PAE was assessed using binary single-item measures from the Adult Education Survey, which is a Europe-wide survey to monitor adult participation in education (European Commission, 2021). To assess participation in job-related or non-job-related non-formal education, respectively, participants were asked to report whether they have

participated in one or more of a range of educational activities within the last 12 months (yes/no). Job-related, non-formal PAE comprised “job-related courses lasting more than one day;” “job-related talks, trainings, seminars, or workshops lasting one day maximum;” and “on-the-job training by superiors, co-workers, or trainers or through e-learning.” Non-job-related, non-formal PAE comprised “non-job-related courses lasting more than one day;” “non-job-related talks, trainings, seminars, or workshops lasting one day maximum;” and “private lessons in the spare time.” Informal PAE referred to having “taught [oneself] or [...] currently studying something in [one’s] free time (for example, by reading textbooks).”, regardless of its relation to a job. In addition, participants rated the likelihood of their PAE (**planned PAE**) regarding the next 12 months based on the same item options as above for non-formal (private and/or job-related) and informal (private and/or job-related) education using the following response options: “yes, definitely;” “rather yes;” “don’t know;” “rather no;” and “no, definitely not.” Planned participation was included in the analyses as an interval-scaled continuous variable computed as mean across all items for non-formal and informal education, respectively.

2.1.3. Statistical analyses

To test the assumed factor structure of the latent variables, confirmatory factor analyses (CFA) of the measurement models were conducted for all latent variables in MPlus 8.11 (Muthén & Muthén, 1998) using the robust MLR estimator. Loadings were considered sufficiently high when $\lambda > 0.30$ and $p < .05$; model fit was evaluated on the basis of several descriptive fit indices, the χ^2/df ratio, the comparative fit index (CFI; acceptable fit indicated by CFI > 0.90 , good fit indicated by CFI > 0.95), the root mean square error of approximation (RMSEA; acceptable fit indicated by RMSEA < 0.08 , good fit indicated by RMSEA < 0.05), and the standardized root mean squared residual (SRMR; acceptable fit indicated by SRMR < 0.08 , good fit indicated by SRMR < 0.05 ; Schermelleh-Engel et al., 2003). Since all measures were adapted from validated instruments, inspection of measurement models was limited to testing a one-factor model of all motivational indicators against a four-factor model distinguishing MtL, mastery goal orientation, intrinsic task value, and academic self-concept for motivation, and testing a one-factor model of all personality indicators against a six-factor model distinguishing need for cognition, internal and external locus of control, openness, agreeableness, and conscientiousness, and, given the debate about the dimensionality of locus of control, a five-factor model (need for cognition, locus of control, openness, agreeableness, conscientiousness). Model fit was compared based on differences in CFI and RMSEA (Cheung & Rensvold, 2002). The nomological network of global MtL was analyzed based on latent variable modeling of the motivational and personality constructs and point biserial correlations with the dummy-coded variables indicating PAE.

Table 3
Model fit of measurement models of study 1.

	χ^2	df	p	CFI	Δ CFI	RMSEA	Δ RMSEA	SRMR
Motivational Variables								
One-factor model ^a	1515.94	104	< 0.01	0.629		0.135		0.98
Four-factor model ^b	351.798	98	< 0.01	0.933	0.304	0.059	0.076	0.047
Personality Variables								
One-factor model ^c	1511.691	135	< 0.01	0.546		0.117		0.112
Six-factor model ^d	366.515	119	< 0.01	0.918	0.372	0.053	0.064	0.050
Five-factor model ^e	381.659	124	< 0.01	0.915	−0.003	0.053	< 0.01	0.051

Note: ^a including variables from Motivation to Learn, Mastery Goal Orientation, Intrinsic Task Value, and Academic Self-Concept scale; ^b distinguishing the constructs included in ^a; ^c including variables from Need for Cognition, internal / external Locus of Control, openness, agreeableness, and conscientiousness scale; ^d distinguishing the constructs included in ^c; ^e Model ^d without distinction between internal/external Locus of Control; CFI = comparative fit index, RMSEA = root mean square error of approximation, SRMR = standardized root mean square residual; according to Cheung and Rensvold (2002), changes in model fit above 0.01 (CFI) or 0.015 (RMSEA), respectively, indicate significant changes.

2.2. Results

Results from CFA confirmed the expected factor structure (see Table 3 and Fig. 2 for factor loadings). Because the two-factor solution of the locus of control measure was as good as the one-factor solution, locus of control was included as one factor in the nomological network for parsimony. Internal consistency was acceptable (Cronbach’s $\alpha > 0.61$) for all constructs except agreeableness (Cronbach’s $\alpha = 0.56$), which has previously been reported to produce lower internal consistency (Rammstedt et al., 2020; Schupp & Gerlitz, 2008).

The correlations from the nomological network of global MtL are displayed in Table 4. Indicating convergent validity, MtL was strongly correlated with mastery goal orientation, need for cognition, intrinsic task value, and academic self-concept ($r > 0.56$, $p < .05$). The correlation with intrinsic task value ($r = 0.57$, $p < .05$) was lower than its correlation with mastery goal orientation ($r = 0.70$, $p < .05$). The correlation between MtL and need for cognition was high ($r = 0.66$, $p < .05$). Consistent with our hypotheses, correlations with openness and conscientiousness were positive and significant, but not as high as with the motivational constructs, and there was only a small negative correlation with agreeableness indicating discriminant validity.

Regarding PAE, correlations were highest for MtL. MtL correlated moderately with job-related PAE and slightly stronger with informal PAE but weak with non-job-related PAE. Results were similar for planned PAE, where correlations were a little higher overall, particularly for planned informal PAE. Planned non-formal PAE correlated moderately with mastery goal orientation but only weakly with MtL. Informal PAE and planned nonformal / informal PAE showed small to moderate and significant correlations with openness as well.

3. Study 2

The primary goal of study 2 was to test the prospective predictive validity of global MtL for PAE using a representative longitudinal sample of the German working population, PIAAC/PIAAC-L (Rammstedt et al., 2013; Rammstedt, Martin, et al., 2016). The data covers four measurement points from 2012 to 2016. MtL was measured in 2012 and retrospective PAE (past 12 months) and planned PAE regarding different learning activities were assessed in 2012, 2015, and 2016. Typical sociodemographic determinants of PAE were considered as covariates, namely age, sex, level of education, employment, and literacy (Boudard & Rubenson, 2003; OECD, 2005), defined as a person’s ability to understand, use, and interpret written texts (PIAAC Literacy Expert Group, 2009). Moreover, Study 2 investigated openness (McCrae & Costa, 1987) as a competitor of MtL in predicting PAE to compare their unique contributions. Finally, Study 2 aimed to explore the potential moderating role of level of education, which has been documented using data from the Adult Education Survey (Gorges & Hollmann, 2015).

MtL was expected to predict PAE, both cross-sectionally (i.e.,

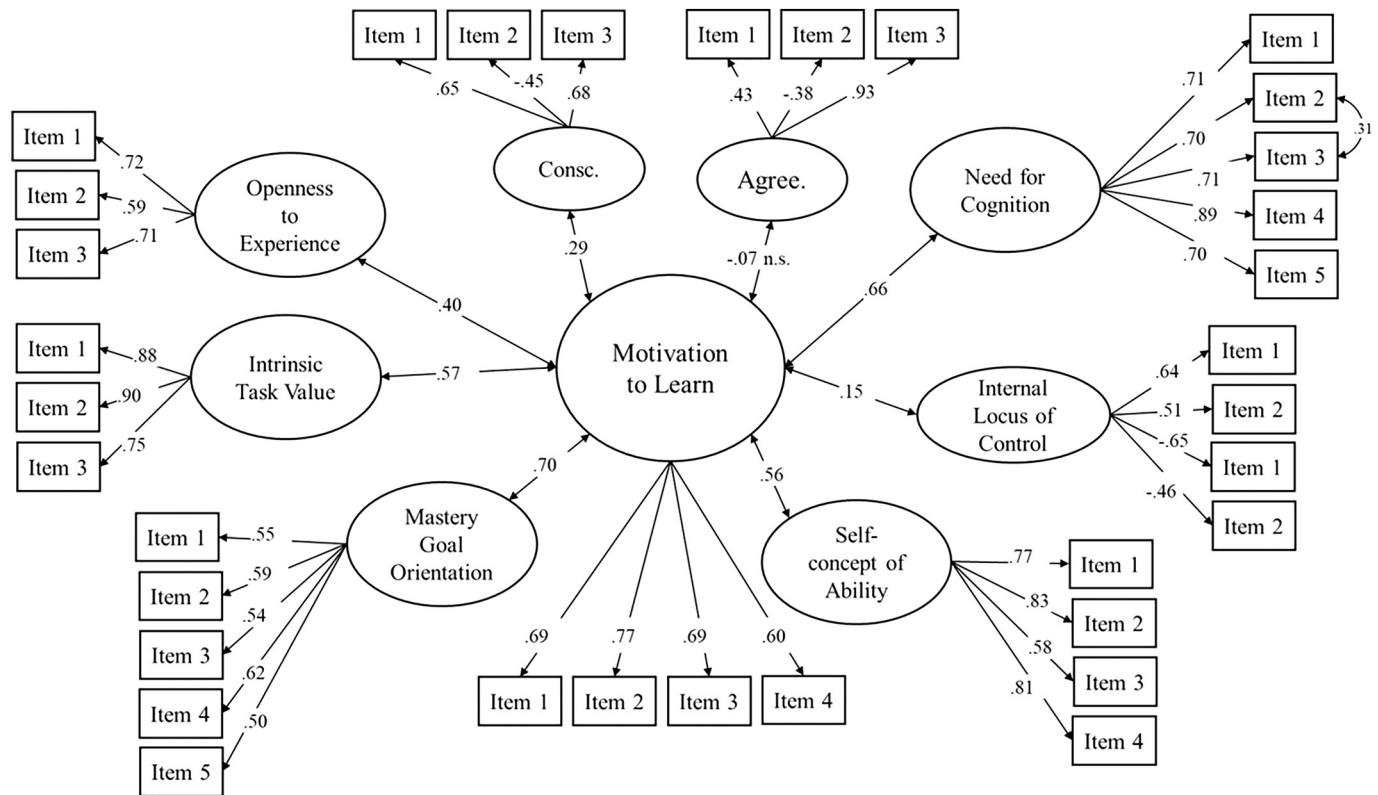


Fig. 2. Results from confirmatory factor analyses for latent variables in the nomological network.

Note. Figure shows standardized loadings from CFA, all loadings are significant ($p < .05$) if not stated otherwise; see Table 4 for a full overview of bivariate correlations.

Table 4

Bivariate correlations from study 1 based on latent variable modeling.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Motivation to Learn (1)	–	0.70*	0.57*	0.66*	0.15*	0.56*	0.40*	–0.07	0.29*
Mastery Goal Or. (2)		–	0.61*	0.49*	0.15*	0.34*	0.42*	–0.11*	0.33*
Intrinsic Task Value (3)			–	0.43*	0.19*	0.47*	0.27*	–0.07	0.30*
Need for Cognition (4)				–	0.17*	0.47*	0.37*	0.01	0.39*
Locus of Control (5)					–	0.29*	0.10	–0.15*	0.41*
Acad. Self-Concept (6)						–	0.39*	–0.12*	–0.34*
Openness (7)							–	–0.19*	0.18*
Agreeableness (8)								–	–0.34*
Conscientiousness (9)									–
Job-related PAE (11)	0.21*	0.08	0.13*	0.10*	–0.01	0.09*	–0.04	0.02	0.03
Non-job-related PAE (12)	0.12*	0.09	0.11*	0.11*	0.02	0.10*	0.08	0.06	–0.07
Informal PAE (13)	0.24*	0.17*	0.21*	0.14*	0.01	0.19*	0.26*	0.03	–0.03
Planned non-formal PAE (14)	0.12*	0.22*	0.16*	0.03	–0.01	0.15*	0.12*	–0.03	0.04
Planned informal PAE (15)	0.39*	0.27*	0.28*	0.27*	0.10	0.19*	0.23*	–0.03	0.04

Note. Or. = Orientation, Ac. = Academic, PAE = Participation in adult education and training.

* $p < .05$.

regarding PAE within the past 12 months) and longitudinally, and plans for future PAE while controlling for the aforementioned sociodemographic predictors. The importance of MtL as a predictor should increase when contextual factors are less relevant, for example, for educational activities that are self-initiated and unrelated to an individual's occupation. Moreover, MtL was hypothesized to be a stronger predictor of PAE for individuals with a lower level of education. Thus, Study 2 extended existing findings by drawing on a longitudinal extension of the 2012/13 PIAAC study conducted in Germany.

3.1. Methods

3.1.1. Participants and procedure

Study 2 used the German sample of the PIAAC (Rammstedt, Martin, et al., 2016) and its longitudinal extension, PIAAC-L (GESIS et al., 2017), which includes adult skills—literacy, numeracy, and problem-solving in technology-rich environments—and factors influencing skill development, including items reflecting MtL (Gorges et al., 2016; OECD, 2010). PIAAC-L covered three follow-up assessments of a subset of the original PIAAC sample in 2014, 2015, and 2016. The present study used data from 2012, 2015, and 2016 (i.e., wave 0, 2, and 3) because participants were not asked about their PAE in 2014, and openness taken from the 2014 wave.

In Germany, 5465 adults aged 16–65 years participated in the first PIAAC survey in 2012. The sample was collected using information provided by the municipalities and registry data (Zabal et al., 2014). Data collection for all survey waves was conducted in participants' homes by trained interviewers through a computer-assisted personal interview (CAPI) following ethical regulations by the German data protection laws. A detailed account of the PIAAC sampling and data collection procedure, including ethical considerations, can be found in the respective technical reports and user guides (Martin et al., 2018; Rammstedt et al., 2013; Rammstedt, Danner, & Lechner, 2017; Zabal et al., 2014, 2016, 2017).

From the participants in 2012, 3263 had also been included in 2015 (Zabal et al., 2016) and 2967 individuals participated again in 2016 (Martin et al., 2018). Participants with higher levels of education and women had a slightly higher chance of remaining in the sample (Helmschrott & Martin, 2014; Martin et al., 2021). For the analyses, participants enrolled in part-time or full-time education in the year of the PAE measure (i.e., “current” and “past 12 months”) were excluded from the analyses. Sample characteristics are displayed in Table 5. As can be seen in Table 5, the mean age and proportion of females and employed participants (based on t1 data) in the samples used for longitudinal data analyses hardly changed, whereas the proportion of participants with an academic degree was slightly higher at t2 and t3. However, Little's test revealed that missing data in 2015 was completely at random for continuous variables included in the analyses, $\chi^2(9) = 16.65, p = .055$.

3.1.2. Measurement instruments

Global Motivation to learn was measured as in Study 1. Cronbach's α was good ($\alpha > 0.79$) in all subsamples (see Table 5).

Openness was measured as in Study 1 in the 2014 wave of data collection. Cronbach's α was 0.56, which could be due to the small

number of items (Rammstedt et al., 2020; Schupp & Gerlitz, 2008).

PAE. Participants reported their job-related and non-job-related non-formal PAE in 2012, their job-related non-formal PAE in 2015, and job-related and non-job-related non-formal PAE and informal PAE in 2016, in each case based on the last 12 months before data collection (dummy-coded: 0 = not participated, 1 = participated; for details, see supplementary material 1).

Planned PAE. In 2016, participants who did not participate in adult education during the past 12 months were asked to rate the likelihood of their participation in education within the next 12 months. Responses were recorded on a Likert-type scale ranging from 1 (“not at all likely”) to 4 (“very likely”).

Covariates. Sex (dummy-coded), age, level of education based on the International standard Classification of Education (ISCED) from 2011 classification (dummy-coded as non-academic, ISCED <5, and academic background, ISCED 5 or higher), employment within the last 12 months (as derived variable, except in 2016, where only current employment—full-time, part-time, or employed to a limited extent—was assessed), and literacy were considered as covariates. Literacy is included in the PIAAC dataset using a plausible value (PV) approach (GESIS et al., 2017; Rutkowski et al., 2010; Zabal et al., 2014) with 10 PVs. Age, level of education, and employment were used from the same wave as the outcome variables to consider potential changes (e.g., a person gaining an academic degree between 2012 and 2015). Details on the variables taken from PIAAC and PIAAC-L can be found in the online supplement.

3.1.3. Statistical analyses

In the present study, PIAAC 2012 data (t1) was used as a starting point, and data from the longitudinal extension PIAAC-L was added as required, referred to as t2 (2015) and t3 (2016). Data collection in 2014 is not considered a measurement point. To be able to model MtL and openness as a latent variable while considering sampling weights, replicate weights, and literacy PVs (Rutkowski et al., 2010), Mplus 8.11 was used for data analyses (Muthén & Muthén), after data preparation was conducted using R (R Core Team, 2022).

As recommended for binary outcome and binary predictor variables, all models were fit to the data using the WLSMV (robust weighted least squares) estimator for ordered categorical data, which uses a probit regression function and pair-wise deletion (Asparouhov & Muthén, 2010) to fit the data. WLSMV does not rely on a normality distribution. Standardized regression coefficients were taken from the STD output, where the standardization is based on the latent predictor variables. Typically, only the significance and sign of the coefficients are interpreted, but a larger coefficient also indicates a greater importance of the predictor for swaying the outcome from 0 to 1 (i.e., non-participation to participation; see the supplementary material 2 for an example on how to calculate probabilities from the results). To facilitate interpretation, latent variables, age and the rating for planned PAE were z-standardized (i.e., the mean was set to 0 and the standard deviation to 1). Because replicate weights were used, only the SRMR was available to evaluate model fit (SRMR < 0.08 indicating acceptable model fit).

For planned PAE, which was measured using a Likert-type rating scale, ML estimation with Full Information Maximum Likelihood (FIML) was used to fit the model; the normality distribution of the continuous variables was confirmed based on visual inspections of Q-Q-Plots. For comparison, the same standardized coefficients and the SRMR are reported. The proportion of missing data was below 12 % and mainly applied to the dependent variable at t2 and t3, except for planned PAE, which had missing data by design.

Using a hierarchical regression modeling approach, Model 1 tested the effect of MtL on PAE while controlling for age and sex. Additional covariates were entered in Model 2 (level of education, employment) and Model 3 (literacy). Based on Model 1, the effect of openness was tested using data from t2. The interaction effect of MtL and level of education was explored based on Model 2 using multiple-group

Table 5
Sample characteristics of study 2.

	t1 (2012)	t2 (2015)	t3 (2016)
N	4191	2502	2370
MtL: Cronbach's α ; M (SD)	0.80; 3.65 (0.72)	0.79; 3.67 (0.69)	0.80; 3.67 (0.69)
Sex ^a (% female)	51.3	52.3	52.3
Age: M (SD) t1	44.83 (11.48)	45.33 (10.93)	44.95 (11.20)
Age: M (SD) t2		48.88 (10.94)	
Age: M (SD) t3			49.43 (11.21)
Level of Education (% academic) t1	35.5	38.2	38.3
Level of Education (% academic) t2		36.4	
Level of Education (% academic) t3			38.2
Employment (% employed) t1	84.7	85.0	85.2
Employment (% employed) t2		80.9	
Employment (% employed) t3			74.4 ^b
PAE (% participated) t1	51.2	52.6	52.9
Job-related PAE (% participated) t1	44.4	45.4	45.5
Job-related PAE (% participated) t2		35.5	
Job-related PAE (% participated) t3			43.6
Non-job-related PAE (% participated) t1	6.8	7.1	7.4
Non-job-related PAE (% participated) t3			16.5
Informal PAE (% participated)			73.4
Planned PAE ^c : M (SD)			2.12 (0.97)

Note. PAE = Participation in adult education and training, ^a variable from t1 used in all analyses, ^b in 2016 only employment within the last week was considered, ^c this items was only presented to participants who did not report PAE during the last 12 months ($N = 1007$; response option between 1 = “not at all likely” and 4 = “very likely”); M = mean, SD = standard deviation.

comparison.

3.2. Results

3.2.1. Cross-sectional results

Cross-sectional results depicted in Tables 6 and 7 show that MtL was a significant positive contributor to participation in all models. Thus, with higher levels of MtL, PAE was more likely. However, level of education, employment, and literacy had stronger effects than MtL: participants with an academic background, employed participants, and a higher level of literacy, were more likely to participate in non-formal education (Model 2 and 3).

Regarding job-related PAE, the pattern of results for MtL (see Table 7) mirrored the results in Table 6. Unsurprisingly, the level of education was found to be important for job-related PAE but not non-job-related PAE. In contrast, employment showed a significant but negative effect on non-job-related PAE; being employed decreased the likelihood of participation.

3.2.2. Longitudinal results

Longitudinal analyses first focused on job-related PAE in the past 12 months measured in 2015 (t2), three years after the assessment of MtL (see Table 8). Results show that MtL remained a significant predictor of PAE while controlling for age, sex, level of education, and employment (Models 1 and 2). The effect of MtL is no longer significant when literacy is included as an additional covariate ($p = .059$). Openness did not predict PAE significantly (see Model 1^{Open}).

Lastly, the predictive validity of MtL measured in 2012 was examined for job-related, non-job-related, and informal PAE measured in 2016, again regarding the 12 months before data collection (see Tables 9 and 10). MtL was a significant predictor in seven out of nine models, controlling for literacy led to non-significant effects of MtL. Again, level of education and employment were particularly strong predictors of job-related PAE, literacy was important for non-job-related and informal PAE. Regarding planned PAE, MtL was a significant predictor in all models, but level of education and literacy had the strongest effects.

3.2.3. Interaction between level of education and MtL

Based on Model 2, the interaction between level of education and MtL was explored using multiple-group comparison. Table 11 summarizes the coefficients for MtL and, to account for multiple comparisons, their adjusted confidence intervals. The pattern of results shows that the effect of MtL is generally stronger and statistically significant for the non-academic group (except for job-related PAE in 2016). In contrast, the effect of MtL is significant in only two out of eight models for the academic group. However, the confidence intervals overlap in all cases, thus, the differences in coefficients between the non-academic and academic group are not statistically significant.

Table 6
Results from t1 (2012) for participation in non-formal education.

	Model 1		Model 2		Model 3	
MtL	0.268*	0.029	0.188*	0.03	0.145*	0.030
Academic (yes)			0.590*	0.047	0.430*	0.050
Employed (yes)			0.915*	0.69	0.834*	0.075
Literacy					0.547*	0.062
Age	-0.010*	0.001	-0.008*	0.002	-0.006*	0.002
Sex (female)	-0.132*	0.037	-0.010	0.040	-0.013	0.041
SRMR	0.034		0.029		0.029	
Threshold	-0.036		0.978		2.313	
R ²	0.092		0.243		0.280	

Note. Table shows standardized probit regression coefficients; dependent variable = Participation in non-formal education within last 12 months (1 = yes), MtL = Motivation to Learn, Employed = Paid work in last 12 months, SRMR = standardized root mean square residual.

* $p < .05$.

4. Discussion

The goal of the present research was to investigate the role of global MtL for adult learning. In Study 1, the nomological network of the PIAAC MtL scale was explored to clarify how global MtL (i.e., conceptualized independently from specific educational settings and learning content) relates to established theoretical constructs. As expected, MtL showed strong associations with conceptually similar constructs, such as mastery goal orientation and adapted measures of intrinsic task value, and with self-concept of ability, as well as moderate correlations with openness and conscientiousness. Associations with (planned) PAE were small to moderate. Study 2 tested whether MtL affects adult learning using longitudinal data from a German extension of the PIAAC. Consistent with the hypotheses, global MtL was a significant predictor of PAE in most models and spanning up to four years, while controlling for major sociodemographic factors of PAE, namely age, sex, level of education, employment, and literacy. Notably, openness did not predict subsequent PAE significantly. Testing the interaction between MtL and level of education did not reveal significant moderation effects, although in most cases MtL was a significant predictor only in the non-academic group.

4.1. Motivation to learn as a predictor of participation in adult education and training

Analyses of the prospective predictive validity of MtL for PAE within the previous 12 months—a behavioral measure—using longitudinal data spanning up to four years showed that MtL is a significant contributor to PAE while controlling for well-established sociodemographic predictors of PAE. This is a remarkable finding considering the long period between the assessment of MtL in 2012 and the assessment of PAE in 2015 and 2016, and given the constraints that may limit actual PAE—which was reported here—as opposed to intention to participate (Ajzen, 2001; Greve, 2001). In addition, MtL was conceptualized as an abstract construct, whereas PAE was assessed in a very specific manner using a list of potential educational activities (Martin et al., 2018; Zabal et al., 2014, 2017). As Steinmayr and Spinath (2009) have pointed out, predictive validity is higher when predictor and outcome are conceptualized on analogous levels of abstraction. Thus, the rather small effect of MtL, for example, in comparison with the effects of level of education and employment, points to its capability to affect PAE. Measuring MtL specific to adult education courses relevant to the participant would likely increase its predictive validity, however, this would tap a more specific construct instead of the global MtL discussed in this paper. While MtL correlated moderately to strongly with job-related PAE and informal PAE, its correlation with non-job-related PAE was surprisingly low. This finding may be explained by the high proportion of participation in non-job-related PAE, making predictions statistically more difficult.

Besides MtL, adults' level of education and employment are major contributors to PAE, especially regarding job-related PAE, confirming well-known findings from adult education research. Employers' role in diminishing social disparities have also been documented by Desjardins and Kim (2023). Thus, while an academic background may be difficult to obtain in adulthood, supporting employers' role in PAE could help low-qualified adults to increase their PAE and, subsequently, their skills, economic and social participation.

In contrast to analyses of the adult education survey (Gorges, 2018; Gorges & Hollmann, 2015), the interaction between MtL and level of education was not significant in this study. However, MtL was a significant predictor of PAE in almost all models only for the non-academic group, but not in the academic group. Thus, the results still suggest that MtL may be particularly relevant for people with lower levels of education, although the estimation of the effect was not precise enough to detect a statically significant difference between groups.

Table 7

Results from t1 (2012) for participation in job-related and non-job-related non-formal education.

	Model 1				Model 2				Model 3			
	Job-related		Non-job-related		Job-related		Non-job-related		Job-related		Non-job-related	
MtL	0.238*	0.029	0.117*	0.041	0.148*	0.030	0.132*	0.043	0.107*	0.031	0.116*	0.044
Academic (yes)					0.572*	0.053	0.061	0.082	0.424*	0.056	−0.001	0.093
Employed (yes)					1.366*	0.078	−0.369*	0.079	1.300*	0.079	−0.407*	0.082
Literacy									0.499*	0.061	0.191	0.109
Age	−0.012*	0.002	0.047	0.039	−0.008*	0.002	0.023	0.038	−0.067*	0.022	0.034	0.041
Sex (female)	−0.237*	0.042	0.314*	0.072	−0.093*	0.047	0.282*	0.074	−0.098*	0.047	0.282*	0.075
SRMR	0.033		0.034		0.028		0.029		0.028		0.029	
Threshold	0.082		1.699		1.509		1.409		2.735		1.869	
R ²	0.092		0.035		0.320		0.052		0.349		0.058	

Note. Table shows standardized probit regression coefficients; dependent variable = Participation in non-formal education within last 12 months in 2012 (1 = yes), MtL = Motivation to Learn, Employed = Paid work in last 12 months, SRMR = standardized root mean square residual.

* $p < .05$.

Table 8

Results from t2 (2015) for participation in job-related non-formal education.

	Model 1		Model 1 ^{Open}		Model 2		Model 3	
MtL	0.147*	0.036	0.182*	0.051	0.089*	0.038	0.074 ⁺	0.039
Academic (yes)					0.518*	0.072	0.456*	0.070
Employed (yes)					1.209*	0.132	1.176*	0.133
Literacy							0.196*	0.085
Openness			−0.066	0.053				
Age	−0.080*	0.031	−0.079*	0.031	0.031	0.039	0.041	0.039
Sex (female)	−0.059	0.061	−0.049	0.061	0.095	0.069	0.091	0.068
SRMR	0.037		0.042		0.032		0.032	
Threshold	0.381		0.386		1.652		2.135	
R ²	0.031		0.034		0.251		0.255	

Note. Table shows standardized probit regression coefficients; dependent variable = Participation in job-related non-formal education within last 12 months in 2015 (1 = yes), MtL = Motivation to Learn, Academic = ISCED level 5 or 6, Employed = Paid work in last 12 months, SRMR = standardized root mean square residual, ^{Open} testing openness.

* $p < .05$.

⁺ $p = .059$.

Table 9

Results from t3 (2016) for participation in job-related and non-job-related non-formal education.

	Model 1				Model 2				Model 3			
	Job-related		Non-job-related		Job-related		Non-job-related		Job-related		Non-job-related	
MtL	0.141*	0.033	0.137*	0.042	0.062 ⁺	0.036	0.091*	0.043	0.034*	0.037	0.059	0.044
Academic (yes)					0.583*	0.075	0.508*	0.066	0.463*	0.076	0.370*	0.071
Employed (yes)					0.933*	0.090	0.054	0.081	0.881*	0.089	−0.016	0.081
Literacy									0.383*	0.085	0.437*	0.099
Age	−0.062*	0.025	0.028	0.026	0.035	0.031	−0.103*	0.027	0.056	0.032	0.042	0.027
Sex (female)	−0.056	0.062	0.101	0.071	0.053	0.064	−0.032	0.012	0.052	0.065	0.145	0.074
SRMR	0.035		0.034		0.031		0.030		0.030		0.030	
Threshold	0.186		1.056		1.115		1.326		2.119		2.431	
R ²	0.026		0.020		0.223		0.074		0.241		0.101	

Note. Table shows standardized probit regression coefficients; dependent variable = Participation in non-formal education within last 12 months in 2016 (1 = yes), MtL = Motivation to Learn, Academic = ISCED level 5 or 6, Employed = Paid work in last 12 months, SRMR = standardized root mean square residual.

* $p < .05$.

⁺ $p = .080$.

4.2. Theoretical implications

While recent research on MtL has moved to a situational approach (Eccles & Wigfield, 2020), this study took the opposite direction to conceptualize MtL on a global level of abstraction. Referring to Study 1, the analyses showed moderate relations with PAE despite the mostly highly educated sample, which would suggest an attenuated effect of MtL (Gorges & Hollmann, 2015). Moreover, most models tested in Study 2 confirm that global MtL has a significant effect on PAE.

One might say that personality research has identified appropriate constructs to predict adult learning, such as need for cognition or openness and that it is not useful to investigate MtL as a global construct

as well. However, results from this research show that MtL is distinct, specific to learning activities, and can predict PAE over a long time. The relations documented in the nomological network analysis for MtL revealed a strong association with mastery goal orientation, pointing to a conceptual overlap, which was expected considering the theoretical foundations of these two constructs (Gorges, 2015; Maehr & Zusho, 2009). The correlation with intrinsic task value was lower than the correlation with mastery goal orientation, indicating the different conceptual cores of mastery goal orientation, a habitual motivational construct, and intrinsic task value, a task-specific construct. The strong correlation between MtL and need for cognition could be explained by the selection of items from the PIAAC background questionnaire, which

Table 10

Results from t3 (2016) for participation in informal education and planned non-formal education.

	Model 1				Model 2				Model 3			
	Informal PAE		Planned PAE		Informal PAE		Planned PAE		Informal PAE		Planned PAE	
MtL	0.246*	0.047	0.164*	0.037	0.216*	0.048	0.138*	0.038	0.197*	0.047	0.107*	0.039
Academic (yes)					0.320*	0.067	0.315*	0.083	0.230*	0.072	0.194*	0.091
Employed (yes)					0.076	0.076	0.134	0.073	0.030	0.075	0.082	0.073
Literacy									0.278*	0.089	0.373*	0.094
Age	−0.039	0.032	−0.121*	0.032	−0.040	0.033	−0.131*	0.033	−0.025	0.033	−0.122*	0.032
Sex (female)	−0.095	0.066	−0.041	0.072	−0.068	0.065	0.001	0.073	−0.069	0.066	−0.016	0.071
SRMR	0.035		0.037		0.031		0.033		0.030		0.032	
Threshold	−0.634				−0.458				0.229			
R ²	0.064		0.046		0.086		0.080		0.098		0.106	

Note. Table shows standardized probit regression coefficients (for INF) and standardized linear regression coefficients (Planned NFE); dependent variable = Participation in informal education within last 12 months in 2016 (1 = yes), Planned PAE = intention to participate in non-formal education within the next 12 months (response scale 1–4), MtL = Motivation to Learn, Academic = ISCED level 5 or 6, Employed = currently employed, SRMR = standardized root mean square residual
* $p < .05$.

Table 11

Overview of moderating effect of educational level (non-academic / academic).

	Non-Academic		Academic	
		CI		CI
2012				
PAE	0.238**	0.151; 0.325	0.105**	0.022; 0.188
Job-related PAE	0.200**	0.108; 0.292	0.067	−0.012; 0.146
Non-job-related PAE	0.151**	0.027; 0.275	0.094	−0.038; 0.226
2015				
Job-related PAE	0.139*	0.027; 0.252	0.030	−0.090; 0.149
2016				
Job-related PAE	0.074	−0.02545; 0.193	0.052	−0.073; 0.177
Non-job-related PAE	0.174***	0.010; 0.338	−0.019	−0.149; 0.111
Informal PAE	0.241***	0.113; 0.369	0.168***	0.011; 0.325
Planned PAE	0.175***	0.085; 0.265	0.056	−0.137; 0.249

Note. PAE = participation in adult education and training; the CI was estimated using Bonferroni correction per dataset.

* $p < .05$.** $p < 0.016$.*** $p < 0.0125$.

tapped deep-level learning strategies as well (Gorges et al., 2016). The correlation with openness was moderate to strong, reflecting that openness comprises more than just the tendency to pursue intellectual engagement (e.g., openness includes preferences for aesthetic experiences as well).

Overall, the results from the nomological network analyses shed light onto the construct of global MtL, placing it closer to motivational than to personality constructs but still supporting the distinction between global and more specialized conceptualizations of motivation to learn. Regarding the theoretical underpinnings of MtL, it would be interesting to explore the relations between MtL and the seek-learn dimension of intellect (Mussel, 2013). The specific alignment of MtL to education and learning opportunities could make it a better predictor of PAE than seek-learn. However, given the large overlap in item formulation (e.g., “I would like to learn new ways of doing things.” in Mussel, 2013, compared to “I like learning new things” in the PIAAC scale), these two constructs may be hard to separate in empirical analyses. Thus, the seek-learn dimension could also be the personality equivalent of global MtL. Nevertheless, personality research has paid little attention to exploring this dimension further, thus offering an exciting new path for motivational and personality researchers to explore in the future. In addition, it will be interesting to see how generalizable the predictive validity of

global MtL may be. More specifically, while this study focused on intentional learning in non-formal and informal settings, MtL may also promote incidental learning or learning in informal settings not considered in this research, for example, as part of organizational development or multiprofessional cooperation (Callanan et al., 2011; Rogoff et al., 2016).

When MtL is supposed to be a starting point to promote PAE, the question of its stability over time and potential influencing factors comes to the fore. Most likely, adults’ MtL results from long-term socialization processes and a life of educational experience. Thus, the question of how much of it is still malleable, and whether targeted interventions can be successful, arises. Studies looking into unexpected PAE (i.e., PAE in groups who are predicted not to participate) may shed light on factors affecting global MtL.

4.3. Practical implications

Given the malleability of many MtL constructs (Lazowski & Hulleman, 2016) and assuming that global MtL is susceptible to interventions as well, global MtL could be a lever to increase PAE, especially with disadvantaged groups, who need more support for PAE, and considering job-related PAE (i.e., adults with low formal qualifications). To promote PAE and lifelong learning, educational institutions and employers may consider measures that enhance the MtL of potential participants. For example, writing about the value of a task has been found to increase students’ motivation (Gaspard et al., 2015). Counselors or human resource developers could ask adults to write about the advantages of PAE and use techniques from motivational interviewing (Miller & Rose, 2009) to nurture interest in adult education and training and, eventually, PAE. Moreover, disadvantaged groups may perceive less opportunity for PAE because they may be uncertain how to identify viable, affordable educational activities. Providing better information about opportunities could help strengthening their MtL and putting their MtL into action, that is, PAE. In the light of the stronger effects for informal PAE compared to non-formal PAE, informal learning opportunities could be provided to a wider target group free of charge, serving as steppingstone towards more formalized learning.

To support practitioners, researchers could examine the usefulness of established motivational interventions in the context of adult learning (Lazowski & Hulleman, 2016). Regarding job-related PAE, supporting employers in their effort to promote PAE may be particularly helpful (Desjardins & Kim, 2023). Finally, assuming that adults’ global MtL is the result of their learning experience during childhood and adolescence (Gorges & Kandler, 2012; Wigfield, 1994), educational institutions could make an effort to promote long-term motivation, in addition to building basic competence such as literacy, which is another important prerequisite for adult learning.

4.4. Limitations and outlook

The present research provides support for the important role of global MtL for adult learning using longitudinal data from a representative sample from the German working population. However, when interpreting the results presented here, certain limitations need to be considered. Notably, the operationalization of global MtL in the PIAAC background questionnaire does not rely on a coherent theoretical framework but stems from a process of developing items for a large-scale study (see Gorges, 2015, for details on the origin of the MtL-scale).

Future studies on the role of global MtL for adult learning should be built on a scale to assess global MtL based on motivational theories. Researchers should investigate whether such a construct would be different from the seek–learn dimension of intellect (Mussel, 2013) or whether the seek–learn dimension sufficiently reflects what motivational theorists consider as MtL. Moreover, the relation between global MtL and more specific forms of MtL, and factors influencing MtL on different levels of abstraction should be explored to find starting points for interventions that affect adults' MtL and, subsequently, PAE. If global MtL builds on a lifetime of educational experience, the question of how much of it still varies from learning opportunity to learning opportunity, and to what extent even global MtL is susceptible to targeted interventions, comes to the fore. In addition, global MtL should be explored in younger learners as well to understand its development, influencing factors, and its interplay with more specific forms of MtL.

Another limitation in this study was the low reliability of some short scales to assess dimensions from the Big Five personality framework. While this may be attributed to using only three items to assess broad theoretical constructs (Rammstedt et al., 2020), the results should be replicated using more reliable measures.

Regarding Study 1, the sample had an above-average proportion of women and individuals with an academic background, which limits the generalizability of results. In Study 2, the attrition from the initial 2012 PIAAC sample may have biased the results due to a slight overrepresentation of participants with an academic background. However, since MtL should have weaker effects on PAE in samples with higher levels of education (Gorges & Hollmann, 2015), the significant correlations found in this sample point to the relevance of MtL. In addition, both studies used German samples, hence replication of the results in different countries and cultural contexts seem warranted.

Predicting PAE from MtL disregards that adults may participate in education for various reasons (Boshier & Collins, 1985; Gorges, 2015). Therefore, studies that aim to predict PAE should use MtL alongside other predictors such as the usefulness of adult education and training or of specific educational activities (i.e., utility value, Wigfield & Eccles, 2000) as well as other personal and contextual characteristics (Boeren et al., 2010).

Overall, investigating global MtL seems to be a promising approach to improving our understanding of why adults engage in lifelong learning and participate in education. Moreover, MtL should be considered when trying to promote adult learning and, thereby, support individual and societal development, economic success, and well-being.

CRedit authorship contribution statement

Julia Gorges: Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Conceptualization.

Transparency and openness

We report all data exclusions (if any), all manipulations, and all measures in the study, and the study follows JARS (Appelbaum et al., 2018). All data (only Study 1), analysis code, and research materials will be made available at GESIS Archives (<https://doi.org/10.7802/2890>). The data of Study 1 are publicly available via the PIAAC research center at GESIS. Data were first analyzed using R (R Core Team, 2022) and the

package lavaan (Rosseel, 2012). The analysis plan for the preliminary study was preregistered prospectively before the data were analyzed by the author; however, previously, the data were analyzed by a post-graduate student for her master's thesis (https://aspredicted.org/PBX_613). For Study 2, data were first analyzed using R (R Core Team, 2022), the package lavaan (Rosseel, 2012), SPSS 28, and the IEA IDB Analyzer (IEA, 2022). The analysis plan for the main study was preregistered prospectively before the data were analyzed by the author; however, previously, a different subset of variables in the data were analyzed using a different statistical approach (https://aspredicted.org/Q6D_LPJ). Based on reviewer comments, the analytic strategy was changed for this manuscript; the analyses presented in this manuscript have been conducted as latent variable analyses and multiple-group analyses in Mplus 8.11.

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This paper reports results from two pre-registered studies available at www.aspredicted.org: The preliminary study is titled 'A nomological network analysis of the PIAAC Motivation-to-Learn scale' (#99406); the main study is titled 'Testing the Predictive Validity of the PIAAC Motivation-to-Learn scale (updated)' (#109163). The dataset of the preliminary study has already been analyzed for an unpublished master thesis building on this dataset addressing a part of this research question. I would like to thank Jasmin Moning for data collection for the preliminary study. A previous analysis of the predictive validity of motivation to learn using PIAAC-L data was presented at the International PIAAC Research Conference in Mannheim, 2014, by the author and her collaborators. However, the main study in this paper uses more waves of data, a different set of variables and a different analytic approach. The first draft of this paper has been prepared while Julia Gorges was affiliated with the Philipps-University Marburg, Marburg, Germany. I would like to thank the anonymous reviewers for their helpful comments for the revision of this manuscript. This publication was produced at the University of Cologne and was financed by the Open Access Publication Fund of the University of Cologne.

Appendix A. Supplementary data

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