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USING A MULTIDIMENSIONAL RASCH ANALYSIS TO EVALUATE THE PSYCHOMETRIC PROPERTIES OF THE MOTIVATED STRATEGIES FOR LEARNING QUESTIONNAIRE (MSLQ) AMONG HIGH SCHOOL STUDENTS

ANDREA BONANOMI
MARIA GIULIA OLIVARI
ELEONORA MASCHERONI
ELENA GATTI
EMANUELA CONFALONIERI
CATHOLIC UNIVERSITY OF MILANO

This study used the multidimensional random coefficients multinomial logit model to investigate the construct validity and detect substantial differential item functioning of the Italian version of the Motivated Strategies for Learning Questionnaire (MSLQ; Pintrich, & DeGroot, 1990) among high school students. The aim was fivefold: to evaluate and identify the better structure for the Italian sample both using the multidimensional rating scale model (MRSM) and multidimensional partial credit model (MPCM); to verify the internal consistency of the subscales of the MSLQ; to investigate the item fit of each item of the MSLQ; to detect the item bias based on three student characteristics, gender, type of school, and grade; and to explore the concurrent validity of the MSLQ with the Academic Self-Efficacy Beliefs Scale (Pastorelli & Picconi, 2001). Participants included 1,071 high school students (grades 9 to 11). The MSLQ proved to be a reliable measure in the Italian context, suitable for students of different ages, genders, and schools.

Key words: Multidimensional Rasch model; Differential item functioning; Psychometric properties; Motivated Strategies for Learning Questionnaire; Self-regulated learning.

Correspondence concerning this article should be addressed to Maria Giulia Olivari, Department of Psychology, Catholic University of Milano, Largo Gemelli 1, 20123 Milano (MI), Italy. Email: mariagiulia.olivari@unicatt.it

Self-regulated learning can be described as the process through which students manage in a dynamic and purposeful way the motivational, cognitive, and behavioral aspects of their own learning (Wolters & Hussain, 2015; Zimmerman, 2000). Pintrich (2000), a leading theorist and researcher of self-regulated learning in education, defined self-regulation as "an active, constructive process whereby learners set goals for their learning and then attempt to monitor, regulate, and control their cognition, motivation, and behavior, guided and constrained by their goals and the contextual features in the environment" (p. 453).

Self-regulated learning literature has emphasized the role of self-regulation and motivational orientation in obtaining good academic performance and high-quality learning processes, demonstrating that students who have a self-regulated approach tend to view learning tasks as intrinsically interesting. Among these students, the presence of a higher motivation for learning

leads them to engage and persist with learning behaviors maximizing the degree to which learning occurs. Moreover, these students generally display more adaptive strategies: they employ deep-processing strategies and monitor their progress through self-evaluation, being able to reflect on the effectiveness of their learning approaches, modulating them also according to the topic and school subject they are dealing with (Credé & Phillips, 2011; Puustinen & Pulkkinen, 2001; Rotgans & Schmidt, 2009; Zimmerman, 2008). Finally, they consider their mistakes as an opportunity to learn and improve (Duncan & McKeachie, 2005).

This theoretical framework advocated a social-cognitive view of learning. It describes the individual and social factors that influence learning, but it also explains why some students perform better than others (interpersonal differences) or why some students' performances are better in one academic task than in a different task (intrapersonal differences; Duncan & McKeachie, 2005; Schunk, 2005). In fact, social-cognitive theory suggests that motivation and cognitive learning strategies are not fixed traits of the student; instead, they may be seen as active and dynamic processes that are contextually bound and as strategies that can be improved and brought under the learner's control (Duncan & McKeachie, 2005; Dweck, 1999).

The need to empirically investigate self-regulated learning processes led Paul Pintrich and colleagues to develop a valid and reliable measure: the Motivated Strategies for Learning Questionnaire (MSLQ; Pintrich, Smith, Garcia, & McKeachie, 1991). The MSLQ was developed at the National Center for Research to Improve Postsecondary Teaching and Learning at the University of Michigan and has been revised several times.

The first version of the MSLQ was an 81-item self-report questionnaire (Pintrich et al., 1991) comprising 15 subscales assessing students' motivation (six subscales: intrinsic goal orientation, extrinsic goal orientation, task value, control beliefs, self-efficacy, test anxiety) and students' learning strategies (nine subscales: rehearsal, elaboration, organization, critical thinking, meta-cognitive self-regulation, time and study environment, effort regulation, peer learning, help seeking). This 81-item version proved to have a good reliability and validity (motivation scales: α_{range} .62-.93; learning strategies scales α_{range} .52-.80; Garcia & Pintrich, 1996; Pintrich, Smith, Garcia, & McKeachie, 1993).

Pintrich and DeGroot (1990) also developed a shorter version, consisting of 44 items, that was administered to junior high school students attending 7th- and 8th-grade. This version assessed both student motivation (three subscales: self-efficacy, intrinsic value, test anxiety) and student learning strategies (two subscales: cognitive strategy use, self-regulation).

These two versions of the MSLQ have been widely used and employed in motivational and educational psychology research (Hilpert, Stempien, van der Hoeven Kraft, & Husman, 2013). According to a recent literature review based on the 81-item version of MLSQ (Credé & Phillips, 2011) tens of thousands of students from different countries have been evaluated using the MSLQ. Moreover, the MSLQ has been used to study different student populations such as university students (e.g., Balam & Platt, 2014; Valentín et al., 2013), secondary school students (e.g., Loy & Chai, 2014; Tsai, Lin, & Yuan, 2001), and primary students (e.g., Karadeniz, Buyukozturk, Akgun, Cakmak, & Demirel, 2008; Law, Chan, & Sachs, 2008; Ocak & Yamaç, 2013) aiming to measure common and stable dimensions of self-regulated learning among different cohorts. This instrument has also been used to evaluate students in different settings: online classes, distance learning course, telecourses (Puzziferro, 2008; Yukselturk & Bulut, 2007), and street learning stations (Dangwal & Gope, 2011), proving its flexibility.

In addition to the abovementioned studies, which use the MSLQ to measure motivation and learning strategies with different aims, in the last two decades a further field of study emerged. This latter regards the investigation of the psychometric properties of MSLQ or the assessment of its reliability and validity to permit a cross-cultural use of this instrument. Table 1 provides a taxonomic summary of the 12 studies which, to our knowledge, have dealt with this topic.

Of these 12 studies, six assessed the construct validity of the 81-item MSLQ version (or of a part of it; e.g., a motivation or cognitive section) with samples of university students, carrying out exploratory (EFA) or confirmatory factor analyses (CFA). Moreover, these studies evaluated its reliability through the computation of Cronbach's alpha, suggesting that the instrument is quite reliable with this population (Alkharusi et al., 2012; Büyüköztürk, Akgün, Özkahvecý, & Demirel, 2004; Cazan, 2011; Jakešová, 2014; Nausheen, 2016; Saks, Leijen, Edovald, & Õun, 2015). Only one study (Cazan, 2011) assessed the convergent validity of the MSLQ using the Inventory of Learning Styles (Vermunt & Vermetten, 2004).

The remaining six studies assessed the MSLQ with a population of high school students. Three focused on the 81-item MSLQ version (or on a part of it; e.g., the motivation section), carrying out EFA or CFA analyses (Feiz, Hooman, & Kooshki, 2013; Karadeniz et al., 2008; Loy & Chai, 2014). Moreover, two of these studies evaluated its reliability through the computation of alpha, suggesting that this version of the MSLQ, even if made for university students, is also reliable with high school students (Feiz et al., 2013; Loy & Chai, 2014).

The three remaining studies evaluated the 44-item MSLQ, carrying out in two cases CFA (Erturan Ilker, Arslan, & Demirhan, 2014; Rao & Sachs, 1999) and in one case a multidimensional Rasch analysis (Lee, Zhang, & Yin, 2010). In particular, Rao and Sachs (1999) found a high correlation between cognitive strategy use and self-regulation subscales, suggesting a four-factor structure of the MSLQ. Subsequently, in 2010, Lee, Zhang, and Yin tested and evaluated through a multidimensional Rasch analysis both a four-factor structure (considering cognitive strategy use and self-regulation as a single factor) and Pintrich and DeGroot's (1990) five-factor structure. In evaluating the 44-item version of the MSLQ, these three studies tested its reliability (through the computation of alpha or with a multidimensional Rasch analysis), confirming that the 44-item version of the MSLQ is also reliable with high school students (Erturan Ilker et al., 2014; Lee et al., 2010; Rao & Sachs, 1999). However, further investigations are needed in order to proceed with the investigation of the construct validity and of the factor structure of the 44-item version of MSLQ, since both a four-factor structure and a five-factor structure proved to be valid with high school students (Lee et al., 2010).

Regarding the Italian context, to our knowledge few studies have investigated students' motivation and learning strategies using the MLSQ. Two of them used the MSLQ with university or junior high school students. In the first one, Albanese and colleagues (2010) described how they ideated and implemented tools for metacognitive reflection in online environments to sustain self-regulation among university students. In the second one, Caputo (2014) investigated the association between students' bullying victimization at school, academic self-concept, learning motivation, and test anxiety. In Italy, the psychometric properties of the MSLQ have not been deeply investigated, with the exception of the test anxiety subscale. This latter was adapted to the Italian context and validated among fifth-grade primary students using the Andrich rating scale model, an extension of Rasch's simple logistic model (Poliandri, Cardone, Muzzioli, & Romiti, 2011).

TABLE 1
Taxonomic summary of MSLQ validation studies

N	Authors (year)	*N* items	Country	Student features	Validity	Structural validity (FA)	Reliability
1	Alkharusi et al. (2012)	71 (short version; s.v.) and 81 (long version; l.v.)	Oman	University students	Construct validity	CFA	Cronbach's alpha: for s.v. ranged from .40 to .82 for l.v. ranged from .32 to .82
2	Büyüköztürk et al. (2004)	81	Turkey	University students	Construct validity	EFA CFA	Cronbach's alpha: ranged from .41 to.86
3	Cazan (2011)	31 (cognitive section of MSLQ-81 version)	Romania	University students	Convergent valitidy (with Inventory of Learning Styles; Vermunt & Vermetten, 2004)	EFA	Cronbach's alpha: rehearsal = .56 elaboration = .78 organization = .68 critical thinking = .72 metacognitive self-regulation =.71
4	Erturan Ilker et al. (2014)	44	Turkey	High school students	Internal content validity	CFA	Cronbach's alpha: self-regulation = .75 cognitive strategy use = .76 self-efficacy = .75 intrinsic value = .70 test anxiety = .77 total MSLQ scale = .88
5	Feiz et al. (2013)	81	Iran	High school students	Construct validity	EFA	Cronbach's alpha: total MSLQ scale = .96
6	Jakešová (2014)	31 (motivation section of MSLQ-81 version)	Czech Republic	University students	Construct validity	EFA CFA	Cronbach's alpha: academic self-efficacy = .76 task value = .84 test anxiety = .84 total MSLQ scale = .78

(Table 1 continues)

Table 1 (continued)

N	Authors (year)	*N* items	Country	Student features	Validity	Structural validity (FA)	Reliability
7	Karadeniz et al. (2008)	81	Turkey	Primary and high school students	Construct validity	CFA	Corrected item-total correlations: for motivation ranged from .16 to .58 for learning strategies ranged from .19 to .68
8	Lee et al. (2010)	44	Hong Kong	High school students	Construct validity	MRCMLM multidimensional Rasch model DIF	Multidimensional Rasch analysis: for five-factor model ranged from .67 to .86 for four-factor model ranged from .68 to .91
9	Nausheen (2016)	31 (motivation section of MSLQ-81 version)	Pakistan	University students	Internal content validity	EFA	Cronbach's alpha: task value = .80 self-efficacy =.66 test anxiety = .60 extrinsic goal orientation = .57
10	Rao & Sachs (1999)	44	Hong Kong	High school students	Construct validity	CFA	Cronbach's alpha: self-regulation = .71 cognitive strategy use = .80 self-efficacy = .77 intrinsic value= .71 test anxiety = .72
11	Saks et al. (2015)	81	Estonia	University students	Internal content validity	EFA	Cronbach's alpha: for subscales ranged from .34 to .90. total MSLQ scale = .92.
12	Loy & Chai (2014)	31(motivation section of MSLQ-81 version)	Singapore	High school students	Construct validity	CFA	Cronbach's alpha: for six-factor model is .94. for subscales ranged from .67 to .93

Note. FA = factor analysis; EFA = exploratory factor analysis; CFA = confirmatory factor analysis; MRCMLM = multidimensional random coefficients multinomial logit model; DIF = differential item functioning.

From this literature analysis, it emerged that, although some studies on the psychometric properties of MSLQ have been conducted, few modern advanced psychometric methods, such as item response theory (IRT) or Rasch analysis, were employed (Lee et al., 2010). Recently, this latter method has been widely utilized to evaluate the psychometric properties of questionnaires in the humanities or social sciences (Lee et al., 2010; Yao & Schwarz, 2006). In some recent studies the use of multidimensional Rasch modelling has proven fruitful for several reasons (Miceli, Settanni, Marengo, & Molinengo, 2015; Shih, Chen, Sheu, Lang, & Hsieh, 2013; Yan, Lum, Lui, Chu, & Lui, 2015). Compared with the traditional method, Rasch method has the advantage of being independent from item sampling and of examining samples in regard to the item and personal parameters. Rasch model puts the examinee's ability and item difficulty parameters on the same scale with a probabilistic distribution of examinee's success (endorse) on the item level. The invariance properties of item and person statistics make Rasch analysis superior to classical testing models. Moreover, the correlation between subscales is not taken into consideration by a Classical Test Theory analysis when several subscales are considered together, as in MSLQ.

In Rasch model framework, it is important to distinguish between unidimensional or multidimensional model. One of the most relevant consequences of treating a multidimensional test as a unidimensional one is that an uncontrolled bias is introduced in the ranking of examinees according to their test score (Miceli et al., 2015). For these reasons, investigating the factor structure is necessary to provide fundamental evidence of validity. Moreover, unidimensional Rasch model underestimates the correlation between subscales because of measurement errors (Lee et al., 2010). Finally, several previous studies showed a multidimensional structure of MSLQ, suggesting us to consider this approach.

Most multidimensional Rasch constructs can be considered a set of unidimensional subscales. A good item should only measure a single trait to which it belongs rather than other subfactors or subdimensions in the multidimensional structure. The multidimensional model approach also preserves the subscale structure, calibrates all subscales simultaneously, and utilizes the correlations between subscales to increase the measurement precision of each subscale. Compared to the separate calibration for each subscale within a multiple-subscale test using a unidimensional Rasch analysis, the multidimensional Rasch analysis can obtain a much higher level of precise measure and a more proper and accurate estimation for the correlations between subscales. Moreover, the multidimensional model can simultaneously calibrate all subscales and increase measurement precision by considering the correlations between subscales. The advantages of the multidimensional approach are especially salient when the subscales are short and the correlations among them are generally high.

The multidimensional Rasch model offers the advantage of exploring the dimensionality of the MSLQ structure. This model can transform ordinal scores into interval data and determine if the response categories of a scale can differentiate participants by their responses. Moreover, it can specify the structure and relationship between individuals and items in multiple underlying traits of a scale. The analysis of the multidimensional Rasch model is essentially confirmatory in nature, so items are preassigned to dimensions based on theoretically grounded hypotheses or empirical evidence in previous studies. Under the multidimensional random coefficients multinomial logit model (MRCMLM), the probability of a response in category k of item j for person i is

$$P\left(X_{ijk}=1;\xi\middle|\theta_i\right)=\frac{\exp\left(b'_{jk}\theta_i+a'_{jk}\xi\right)}{\sum_{u=1}^{K_j}\exp\left(b'_{ju}\theta_i+a'_{ju}\xi\right)} \quad (1)$$

where $\theta_i = (\theta_{i1},\ldots,\theta_{iD})$' is *i*'s levels on the *D* latent traits, ξ is a vector of the item and step difficulty parameters, K_j is the number of categories in item *j* — in the multidimensional rating scale model (MRSM), $K_j = K$ for each item, whereas in the multidimensional partial credit model (MPCM), K_j can be different for each item — b_{jk} is a score vector (known a priori) given to category *k* of item *j* across the *D* latent traits, and a_{jk} is a design vector given to category *k* of item *j* that describes the linear relationship among the elements of ξ. The most important models in the family of the multidimensional item response theory models were generalization by the partial credit model (PCM; Masters, 1982) and the rating scale model (Andrich, 1978).

To our knowledge, no study has assessed the psychometric properties of the entire 44-item MSLQ version with high school students in an Italian context, and only three studies in other cultural contexts have assessed the construct validity of this version of the instrument (Erturan Ilker et al., 2014; Lee et al., 2010; Rao & Sachs, 1999). Moreover, only one of these studies has employed the multidimensional Rasch model to evaluate the psychometric properties of the 44-item MSLQ in a Chinese sample. Therefore, the aim of this paper is to investigate the psychometric properties and construct validity of the 44-item MSLQ in an Italian high school student sample through an MRCMLM (Adams, Wilson, & Wang, 1997). In particular, the aim is fivefold: (1) to evaluate and identify a better structure for the Italian sample, choosing between the five-factor structure originally proposed (Pintrich & DeGroot, 1990) or the four-factor structure proposed by Rao and Sachs (1999) and tested by Lee and colleagues (2010), both using the MRSM and MPCM; (2) to verify the internal consistency of the subscales of the MSLQ; (3) to investigate the item fit of each item of the MSLQ; (4) to detect the item bias based on three student characteristics (gender, type of school, and grade); and (5) to explore the concurrent validity of the MSLQ with the Academic Self-Efficacy Beliefs Scale (Pastorelli & Picconi, 2001). In particular, we expected that MSLQ would positively correlate with the Academic Self-Efficacy Beliefs Scale.

Method

Participants

A total of 1,071 high school students from 9th- to 11th-grade participated in the study. Of the participants, 53.6% were males and 46.4% were females; 38.0% were in 9th-grade, 40.8% were in 10th-grade, and 21.2% were in 11th-grade. They ranged in age from 14 to 17 years (M_{age} = 14.9 years, SD_{age} = 0.80). Participants attended theoretical (64.0%) and technical (36.0%) public high schools situated in an urban area in the North of Italy.

Instruments and Procedure

Participants were recruited through a convenience sampling from 10 public high schools situated in an urban area. The headmaster, teachers, and parents of the adolescents provided per-

mission for participation. Students were given 20 minutes to complete the questionnaire, assessing sociodemographic information, motivation and learning strategies, and self-efficacy beliefs. The study was carried out according to the ethical guidelines of the Catholic University of the Sacred Heart and was approved by Catholic University of the Sacred Heart Ethical Commission (cod. 28-16).

Participants were given a sociodemographic questionnaire that ascertained information about their gender, age, class, and type of school attended.

MSLQ. Pintrich and DeGroot (1990) originally developed the 44-item MSLQ and administered it to students of 7th- and 8th-grade classrooms in a high school district in Michigan. The authors divided the questionnaire into two sections: motivational beliefs and self-regulated learning strategies (Pintrich & DeGroot, 1990; Pintrich, Roeser, & DeGroot, 1994). The first section consisted of 22 items and comprised three subscales: self-efficacy (nine items: 2, 6, 8, 9, 11, 13, 16, 18, and 19; $\alpha = .89$), intrinsic value (nine items: 1, 4, 5, 7, 10, 14, 15, 17, and 21; $\alpha = .87$), and test anxiety (four items: 3, 12, 20, and 22; $\alpha = .75$). Self-regulated learning strategies consisted of 22 items and comprised two subscales assessing cognitive strategy use (12 items: 23, 24, 28, 29, 30, 31, 34, 35, 39, 41, 42, and 44; $\alpha = .83$) and self-regulation (10 items: 25, 26, 27, 32, 33, 36, 37, 38, 40, and 43; $\alpha = .74$). The respondents were asked to indicate their degree of agreement on a 5-point Likert scale ranging from 1 (*not at all true for me*) to 5 (*very true for me*). Negatively worded item ratings must be reversed before an individual score is computed (Items 26, 27, 37, and 38). Two experienced Italian psychologists who were fluent in English translated the MSLQ. A native English-speaking expert translated the scale back into English. Researchers compared the original to the Italian translation and finalized the Italian version.

Academic Self-Efficacy Beliefs Scale. Pastorelli and Picconi's (2001) 19-item scale was developed to assess adolescent beliefs about their ability to study different school topics (first section, seven items), their perceived motivation and ability to self-regulate learning activities, plan and organize study times, use cognitive strategies, and ask teachers and peers for help when needed (second section, 12 items). For the aim of this study, we administered only the 12 items of the second section ($\alpha = .85$). The participants rated items on a 5-point Likert scale ranging from 1 (*perceived incapability*) to 5 (*complete self-assurance in one's capability*).

Data Analyses

In the present study, a MRCMLM (Adams et al., 1997) was used to validate the Italian version of the MSLQ. First, a comparison between the MPCM and MRSM was conducted, considering both the five-factor structure originally proposed by Pintrich and DeGroot (1990) and the four-factor structure that Rao and Sachs (1999) proposed and Lee et al. (2010) tested. The comparison of goodness of fit indices (deviance of each model and chi-square test) suggests better models (MPCM or MRSM). Moreover, correlations between subscales were tested to decide the best and most suitable factor structure (five- or four-factor structure) for the Italian context. Secondly, a reliability analysis (Cronbach's alpha) was performed to verify the internal consistency of each subscale. Thirdly, to check whether the items fit the expected model, two item fit mean square (MNSQ) statistics (infit and outfit) were computed. MNSQ determines how well each item contributes to defining a single underlying construct. Infit is more sensitive to misfitting responses to items closest to the person's ability level, whereas outfit is more sensitive to

misfitting items that are farther away. If the data fit the Rasch model, the fit statistics should be between 0.6 and 1.4 (Wright, Linacre, Gustafson, & Martin-Lof, 1994). Analyses of difficulty and step parameters were conducted to guarantee a sufficient ranking of the different categories of response. Fourthly, a differential item functioning (DIF) analysis was used to detect item bias for examinees from different groups. In this study, DIF detection was based on three characteristics: gender (male or female), type of school (theoretical or technical school), and grade (9th, 10th, or 11th). The differences of the overall item difficulties between females and males, type of school, and grade were calculated to detect the DIF effect. The logit difference of the item- difficulty parameters from different groups was taken as an index to evaluate the effect size of DIF. The absolute values of the logit differences less than 0.40 are regarded as negligible DIF, absolute values falling between 0.40 and 0.60 are taken as moderate DIF, and absolute logit differences greater than 0.60 are seen as large DIF. The correlation between the MSLQ and Academic Self-Efficacy Beliefs Scale (Pastorelli & Picconi, 2001) was calculated to evaluate the concurrent validity. Moreover, a multiple regression model was calculated, regressing the five MSLQ subscales on the Academic Self-Efficacy Beliefs Scale. Packages TAM and eRm of R.3.2.5 were used for the MRCMLM estimates (item calibration and fit, DIF analysis), and IBM SPSS 23.0 was used for correlation and reliability analyses.

RESULTS

MRSM versus MPCM and Correlation between Subscales

Table 2 reports the comparison of goodness of fit between MPCM and MRSM for the Italian version of the MSLQ. Both for the five- and four-factor structure, the deviance of the rating scale model was greater than that of the PCM. Moreover, the chi-square test was statistically significant ($p < .01$), which indicated that the PCM fit the dataset better. The comparison between the five-factor MPCM (deviance = 127048.0, parameters = 235) and four-factor MCPM (deviance = 129597.2, parameters = 230) showed that Pintrich and DeGroot's (1990) original structure (five-factor) better fits the dataset, $\Delta\chi^2 = 2696.0$ ($df = 172$, $p < .01$).

TABLE 2
Comparison of goodness of fit between MPCM and MRSM for the Italian version of MSLQ

Number of factors	Model	Deviance	Parameters	$\Delta\chi^2$ (df, p-value)
Five-factor model	MPCM	127048.0	235	$\Delta\chi^2 = 2696.0$ ($df = 172$, $p < .01$)
	MRSM	129744.0	63	
Four-factor model	MPCM	129597.2	230	$\Delta\chi2 = 2695.1$ ($df = 172$, $p < .01$)
	MRSM	129775.6	58	

Note. MPCM = multidimensional partial credit model; MRSM = multidimensional rating scale model.

The correlations between the subscales of the MSLQ's five-factor structure are listed in Table 3. Each subscale was obtained as summed score of the corresponding items.

TABLE 3
Correlation between subscales of five-factor structure of MSLQ

	Self-efficacy	Intrinsic value	Test anxiety	Cognitive strategy	Self-regulation
Self-efficacy	–				
Intrinsic value	.48**	–			
Test anxiety	–.33**	–.06	–		
Cognitive strategy	.31**	.54**	.01	–	
Self-regulation	.35**	.60**	–.03	.64**	–

** $p < .01$.

Correlation results were consistent with Pintrich and DeGroot's (1990) five-factor structure, and they were not consistent with Rao and Sachs' (1999) and Lee and colleagues' (2010) four-factor structure. The fourth and fifth factors (cognitive strategy use and self-regulation) had a correlation equal to .64. This is a high correlation but not enough (Cohen, 1988; Lee et al., 2010) to justify the combination of the factors into one, differently from what Rao and Sachs (1999) found.

Reliability Analysis

Among the questionnaire subscales, self-efficacy and intrinsic value yielded an internal consistency of .87 and .82, respectively, showing good internal consistency. Test anxiety and cognitive strategy reached an internal consistency of .79 and .75, respectively, showing moderate internal consistency. Self-regulation had an internal consistency of .68, showing acceptable internal consistency.

Moreover, the goodness of fit analysis previously shown (deviance) suggested that it was more appropriate to apply a five-factor structure to the construct validity analysis. For all these reasons, in this study, psychometric properties of the five-factor structure of the MSLQ will be henceforth investigated.

Model Data Fit

Two items fit mean square (MNSQ) statistics (infit and outfit) were computed. MNSQ determines how well each item contributes to defining a single underlying construct. Infit and outfit statistics and item and step difficulty parameters estimates are reported in Table 4.

The item statistics ranged from 0.93 to 1.20 for the infit MNSQ and from 0.94 to 1.19 for the outfit MNSQ. These values indicate a very good fit of the MPCM. The step difficulty parameters for all the items within the five-factor structure had a sufficiently large range and were different for the items within or between the five subscales, meaning that the students had different criteria for the five response categories for different items. The results also indicated that the order of the step difficulty estimates across the items had great relevance. For most of the items, the difficulties of the steps were ordered so that later steps were more difficult than earlier steps. However, for some items (e.g., 4, 5, 13, 15, 19), the order of the difficulty estimates for Steps 2 and 3 was reversed.

TABLE 4
Infit and outfit statistics, item and step difficulty parameter estimates

Item	Outfit MNSQ	Infit MNSQ	Difficulty	Step 1	Step 2	Step 3	Step 4
Item 1	1.00	1.00	–1.45	–6.25	0.25	0.59	2.42
Item 2	1.00	1.00	–1.53	–4.28	–0.05	0.33	1.76
Item 3	1.00	1.00	–1.39	–6.96	0.75	1.46	2.12
Item 4	0.96	0.95	–2.02	–4.00	-0.80	–0.64	1.21
Item 5	1.00	1.00	–1.53	–4.79	0.71	–0.08	1.40
Item 6	1.00	1.00	–1.59	–2.31	–0.69	–0.40	1.94
Item 7	1.00	1.00	–1.54	–3.18	–0.42	–0.35	1.26
Item 8	0.93	0.94	–1.92	–4.62	–0.01	0.24	1.75
Item 9	1.00	1.00	–1.77	–5.70	–0.15	0.31	2.16
Item 10	1.00	1.00	–1.50	–6.05	0.31	0.65	2.17
Item 11	1.00	1.00	–1.49	–4.36	–0.49	–0.20	1.74
Item 12	1.00	1.00	–1.48	–6.59	0.05	1.53	1.93
Item 13	1.00	1.00	–1.49	–5.17	0.31	0.16	1.54
Item 14	1.00	1.00	–1.56	–4.27	0.07	0.66	1.15
Item 15	1.00	1.00	–1.57	–3.66	0.89	0.74	1.91
Item 16	1.00	1.00	–1.43	–6.50	0.58	0.91	2.43
Item 17	1.00	1.00	–1.54	–4.56	–0.52	–0.33	1.76
Item 18	1.00	1.00	–1.48	–5.20	–0.10	0.25	2.05
Item 19	1.00	1.00	–1.55	–3.37	–0.29	–0.46	1.25
Item 20	1.00	1.00	–1.53	–5.61	0.85	1.26	1.94
Item 21	1.00	1.00	–1.54	–4.09	–0.34	0.44	1.59
Item 22	1.00	1.00	–1.46	–6.83	1.24	1.42	2.16
Item 23	1.00	1.00	–1.56	–3.78	–0.78	0.22	0.98
Item 24	0.99	0.98	–1.92	–4.58	0.09	0.60	1.28
Item 25	1.00	1.00	–1.55	–4.97	0.57	0.76	1.46
Item 26	1.00	1.00	–1.54	–4.30	0.49	0.60	1.07
Item 27	1.00	1.00	–1.59	–4.64	0.25	0.55	1.24
Item 28	1.00	1.00	–1.54	–3.74	0.13	0.35	1.37
Item 29	1.00	1.00	–1.54	–5.10	–0.92	0.35	1.54
Item 30	1.00	1.00	–1.59	–2.72	0.38	0.57	1.25
Item 31	1.00	1.00	–1.52	–6.07	1.29	1.45	1.65
Item 32	1.00	1.00	–1.39	–7.36	0.37	1.29	2.57
Item 33	0.97	0.97	–1.77	–5.59	–0.05	0.79	2.17
Item 34	1.00	1.00	–1.57	–3.53	0.27	0.42	1.02
Item 35	1.00	1.00	–1.50	–5.74	0.60	0.89	1.70
Item 36	1.00	1.00	–1.51	–5.83	0.62	1.32	1.96
Item 37	1.00	1.00	–1.56	–4.38	0.74	0.88	1.99
Item 38	1.00	1.00	–1.49	–5.67	0.05	1.05	2.32
Item 39	0.99	0.99	–1.82	–5.14	–0.33	0.42	1.86
Item 40	1.20	1.19	–1.55	–7.43	0.43	1.20	2.34
Item 41	1.00	1.00	–1.54	–4.76	0.40	0.59	1.30
Item 42	1.00	1.00	–1.58	–4.86	0.61	1.03	1.96
Item 43	1.00	1.00	–1.55	–3.78	–0.05	0.47	1.52
Item 44	1.00	1.00	–1.54	–4.29	–0.25	0.48	1.45

Note. MNSQ = mean square.

DIF Analysis

DIF analysis was used for detection purposes and was based on gender, type of school, and grade. The absolute values of differences of the overall item difficulties between different groups were calculated to detect the DIF effect and are reported in Table 5. In the analysis of DIF, all differences are smaller than 0.20 logits. Therefore, no items have substantial DIF for gender, school, or grade.

TABLE 5
Gender, school, and grade DIF analysis of MSLQ

Item	Gender	School	Grade
Item 1	0.021	0.005	0.006
Item 2	0.084	0.021	0.015
Item 3	0.007	0.034	0.001
Item 4	0.027	0.017	0.063
Item 5	0.007	0.012	0.001
Item 6	0.049	0.003	0.030
Item 7	0.030	0.027	0.026
Item 8	0.043	0.007	0.012
Item 9	0.070	0.031	0.008
Item 10	0.024	0.018	0.010
Item 11	0.042	0.009	0.014
Item 12	0.021	0.003	0.001
Item 13	0.041	0.006	0.014
Item 14	0.017	0.020	0.057
Item 15	0.027	0.035	0.010
Item 16	0.085	0.028	0.019
Item 17	0.011	0.006	0.036
Item 18	0.084	0.018	0.011
Item 19	0.044	0.031	0.033
Item 20	0.046	0.023	0.006
Item 21	0.003	0.036	0.008
Item 22	0.021	0.040	0.003
Item 23	0.053	0.017	0.069
Item 24	0.056	0.040	0.004
Item 25	0.055	0.013	0.081
Item 26	0.032	0.016	0.049
Item 27	0.016	0.030	0.012
Item 28	0.024	0.022	0.054
Item 29	0.012	0.004	0.007
Item 30	0.009	0.027	0.057
Item 31	0.095	0.025	0.006
Item 32	0.025	0.024	0.052
Item 33	0.044	0.022	0.033

(Table 5 continues)

Table 5 (continued)

Item	Gender	School	Grade
Item 34	0.118	0.037	0.043
Item 35	0.010	0.003	0.010
Item 36	0.059	0.060	0.044
Item 37	0.037	0.009	0.009
Item 38	0.062	0.055	0.040
Item 39	0.015	0.010	0.045
Item 40	0.028	0.014	0.017
Item 41	0.066	0.024	0.002
Item 42	0.190	0.009	0.013
Item 43	0.053	0.012	0.043
Item 44	0.007	0.005	0.147

Concurrent Validity

Evidence for concurrent validity was provided by correlations between the MSLQ subscales and the Academic Self-Efficacy Beliefs Scale. Moreover, a multiple regression analysis was conducted, regressing the five MSLQ subscales on the Academic Self-Efficacy Beliefs Scale. Correlations and standardized regression coefficients β_j are reported in Table 6.

TABLE 6
Correlation between the subscales of five-factor structure of MSLQ and Academic Self-Efficacy Beliefs Scale and β_j of the multiple regression model ($R^2 = .61$)

		Self-efficacy	Intrinsic value	Test anxiety	Cognitive strategy	Self-regulation
Academic Self-Efficacy Beliefs Scale	Correlation	.576**	.581**	–.247**	.567**	.657**
	β_j coefficient	.293	.120	–.132	.183	.362

** $p < .01$.

The relationship between the MSLQ subscales and the Academic Self-Efficacy Beliefs Scale was always significant ($p < .01$), absolute values β_j were always superior to .10, and the coefficient of determination R^2 was significant ($p < .01$) and equal to .61. Self-efficacy and Self-regulation subscales resulted more predictive of the concurrent measure.

DISCUSSION AND CONCLUSIONS

Researchers worldwide have demonstrated an increased interest in the use of the MSLQ to investigate the motivation and use of learning strategies among students (Hilpert et al., 2013).

The MSLQ has been translated into more than 20 different languages (Duncan & McKeachie, 2005) and tens of thousands of students from different countries and different grades have been evaluated using it (Credé & Phillips, 2011). However, it is surprising that few psychometric assessment papers exist that study the MSLQ. Moreover, the majority of them focused on the 81-item version of this instrument.

In the present study, we specifically focused on the investigation of the psychometric properties of the 44-item version of the MSLQ, since few studies have deepened this aspect (Erturan Ilker et al., 2014; Lee et al., 2010; Rao & Sachs, 1999). We believed it was important to proceed with the investigation of the construct validity and the factor structure of the 44-item version of MSLQ, since both a four-factor structure and a five-factor structure proved to be valid among high school students. Moreover, in the psychometric studies of this instrument, few modern advanced psychometric methods, such as item response theory (IRT) or Rasch analysis have been employed (Lee et al., 2010). Finally, in the Italian context, the psychometric properties of this instrument have never been explored.

To our knowledge, indeed this is the first study in Italy aiming to investigate, through an MRCMLM (Adams et al., 1997), the psychometric properties and the construct validity of the 44-item version of the MSLQ in a high school student sample. The results of this study can be summarized in the following four key points.

From our analyses, it emerged that the 44-item version of the MSLQ is a reliable and valid instrument to assess high school students' motivational beliefs and learning strategies in the Italian context. Reliability values of the subscales were, in fact, from good to optimal. Moreover, this instrument can be administered to different groups of students because the DIF analysis showed that no items had substantial DIF for gender, school, or grade.

Through our work we confirmed the presence of all five subscales of MSLQ: self-efficacy, intrinsic value, test anxiety, cognitive strategy use, and self-regulation, as emerged for the Turkish (Erturan Ilker et al., 2014) and the American sample in the original study by Pintrich and DeGroot (1990). Indeed, analyses showed that the original five-factor structure proposed by Pintrich and DeGroot fits better to the Italian sample than the four-factor structure (Rao & Sachs, 1999) tested by Lee and colleagues (2010) in a sample of Chinese high school students. No differences between our findings and those of Pintrich and DeGroot were found with regard to the correlations between the scales of the MSLQ. The most important differences between our findings and those of Rao and Sachs and Lee and colleagues regard the correlation between test anxiety and self-efficacy and between cognitive strategy use and self-regulation. As regards the first correlation, in Chinese samples a lack of correlation emerged between test anxiety and self-efficacy, whereas in our sample and in the American sample a significant negative correlation was found. This could be due to the fact that Chinese students had lots of experiences with examinations and tests starting from the elementary school and they were used to dealing and coping with test anxiety (Lee et al., 2010). As regards the second correlation, our findings showed that cognitive strategy use and self-regulation are correlated, but this correlation is not high enough to justify the combination of these two factors into a single one (Cohen, 1988). In particular, Pintrich and DeGroot (1990) suggested that cognitive strategy use and self-regulation should be distinguished conceptually, even though a correlation of .83 (higher than the one found in this sample) was found in their research with the American sample. Indeed, the authors suggested that the presence of these two different constructs indicates that students should be capable of two differ-

ent processes in order to obtain a good achievement in school: to identify the best and most suitable strategy to use and to apply it in the right moment. We believe that this result confirms that among students from Western cultures, cognitive strategy use and self-regulation are two different constructs and they should be conceptually distinguished, unlike what happens in the Asian context, where cognitive strategy use and self-regulation seem to be more intrinsically related (Rao & Sachs, 1999).

From our results of item calibration, for the estimates of difficulty and step parameters, it emerged that the five-category of response structure did not function well for each item of the scale. In particular, Steps 2 and 3 did not always respect the monotonic order. Although PCM does not require that steps are ordered by difficulty (this means that later steps should not necessarily be more difficult than earlier steps; Dodd & Koch, 1987), the five categories of response represent a monotonic increasing measurement of score on the scale of the latent traits that these items measure. A possible solution to improve the response set could be the unification of categories for responses 3 and 4. Future studies could explore the possibility of employing a four-category response structure.

Finally, the concurrent validity of the MSLQ with the Academic Self-Efficacy Beliefs Scale (Pastorelli & Picconi, 2001) was tested, and good evidence for concurrent validity was found. The Academic Self-Efficacy Beliefs Scale presented significant and positive correlations with self-efficacy, intrinsic value, cognitive strategy use, and self-regulation and a significant and negative correlation with test anxiety.

Some limitations of this study should be taken into account as a starting point for future research. First, this study does not permit the generalization of findings due to the nonrandom sampling method used. Secondly, this study concerns a cross-sectional design. Future research will benefit from the use of longitudinal design that would allow a clearer understanding of change over time of motivation and self-regulating strategies. Thirdly, in this study we consider only concurrent validity with the Academic Self-Efficacy Beliefs Scale (Pastorelli & Picconi, 2001), whereas future research could provide evidence of criterion or predictive validity by examining the relationship of MSLQ and students' current or longitudinal academic performance, to perform a more complete validation of this measure. Finally, we did not consider the investigation of test targeting of MSLQ to the study population.

In conclusion, the current study contributes to the literature by testing the psychometric properties of the 44-item version of the MSLQ, providing evidence of a five-factor structure of this instrument. The MSLQ has proven to be a reliable measure in the Italian context and a valuable tool in both research and practice settings, suitable for students of different gender, age, and school.

We believe that this instrument can be very useful for teachers and educators in terms of educational implications. An important application could be the early identification of diseases in students, leading to intervention to prevent students from dropping out, a phenomenon that has been increasing in Italy in recent years, especially among students in their first and second year of high school. MSLQ highlights that motivational beliefs are not stable traits and that it is possible and important to increase them among students. Teachers should consider this aspect, enhancing motivational beliefs with cooperative and active teaching methods and encouraging students' desire to learn.

MSLQ could also be useful for school counselors in understanding students' learning strategies and thus planning interventions to dysfunctional learning approaches (e.g., an over reli-

ance on rote memorization). Moreover, this instrument could be used not only in individual counseling work, but also with the whole class group to increase students' awareness of their general learning approach and to engage them in a discussion about the effectiveness of different learning strategies.

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