Psychometric Properties of Meta-cognitive Awareness of Reading Strategy Inventory

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Abstract

The construct validity of the Meta-cognitive Awareness of Reading Strategy Inventory (MARSI; Mokhtari & Reichard, 2002) was tested with 189 college students, and its convergent validity with reading comprehension ability was investigated. Reading ability was assessed using self-report and standardized measures. Results demonstrate weak construct validity of the MARSI, suggesting that the current form of the MARSI is not appropriate for use with students who are very proficient in reading (i.e., grade level equivalents beyond 12th grade). More theoretically-based quantitative and qualitative studies using the MARSI are warranted.

Keywords: Meta-cognitive knowledge, College students, Reading comprehension, Test validity

1. Introduction

There is an urgent need for meta-cognition research related to reading in the college population. In the field of education, it is a well-acknowledged fact that college students rarely have deep comprehension of their required textbooks (Graesser, Person, & Hu, 2002). Research has demonstrated that poor readers differ from good readers in their use of meta-cognitive strategies (Baker & Brown, 1984a, 1984b; Gambrell & Heathington, 1981; Wong & Jones, 1982). Professors of remedial reading and mainstream courses could be provided richer information to guide their instruction given the following: a) an understanding of how meta-cognitive knowledge and reading comprehension skill are related in college students, and b) an assessment of meta-cognitive reading strategies that is convenient to administer, which also demonstrates good psychometric qualities.

While knowledge of reading strategies may not be sufficient for the successful application of those strategies, it

is a necessary component of skilled reading. It has been suggested that older and more sophisticated readers use meta-cognitive strategies more often and more effectively than younger and poor readers–monitoring their reading behavior and adjusting their reading purposes to facilitate understanding or remedy comprehension (for a comprehensive review of such strategies, see Duke & Pearson, 2002; see also Pressley & Afflerbach, 1995). Skilled readers know how to monitor and regulate the strategies that they know (Forrest-Pressley & Waller, 1984). Self-reported reading strategy inventories provide a means of tapping into readers' awareness of the strategies that make their reading experiences successful.

Self-reported reading strategy inventories are just one of a variety of methods for assessing strategy use. Self-reported reading strategies are regarded as prospective meta-cognitive reports. Prospective reports refer to measurements that are neither concurrent (i.e., think aloud) nor retrospective (i.e., recall; Cromley & Azevedo, 2006; Veenman, 2005). Prospective reports are a convenient way to assess readers' awareness of strategies, but they may be susceptible to confounding general knowledge of strategies with the perception of which strategies are actually used. It has been suggested that think aloud protocols provide a valid means to disentangle the knowledge of strategies from one's actual use of strategies; however, thinking aloud during reading disrupts the natural process of reading. The next best alternative method of disentangling the knowledge of strategies from their actual usage is to test whether self-perceptions of strategy use vary in a systematic fashion with reading skill.

In this study we evaluated the validity and reliability of the meta-cognitive Awareness Reading Strategy Inventory (MARSI; Mokhtari & Reichard, 2002). To achieve this research goal, we assessed the self-perceptions of reading strategies within adult readers of varying skill levels. We also examined the relation between self-reported reading ability, reading ability as assessed by a standardized measure, and college students' awareness of their reading strategies. Below we review several of the measures that have been designed to assess college students. Based on this review, we selected MARSI for use in this study because it had a comprehensive sampling of strategy types and preliminary construct validity. The goal of our study was to provide evidence for the psychometric properties of the MARSI when used with the adult college population (Mokhtari & Reichard, 2002).

1.1 Current Meta-cognitive Assessments

Measurement of meta-cognitive knowledge is challenging. The majority of current meta-cognitive knowledge measures are self-reports. Even though many measures have been developed, only a few exist which are appropriate to use with adults. The documentation of psychometric properties (e.g., validity and reliability for inventories that assess the self-perceptions of reading strategies among college students) is scant within the literature. The challenge has been the construction of an instrument that captures, along the same dimensions or constructs, the differences between the many reading skill level groups of interest to researchers and practitioners (e.g., young beginning readers, adult English language learners, more and less proficient secondary student readers, college student readers, etc.). To date, only a few assessment instruments have been reported as appropriate to use with college students (Mokhtari & Reichard, 2002; Mokhtari & Sheorey, 2002; Schraw & Dennison, 1994; Taraban, Rynearson, & Kerr, 2004). Current inventories either have weak construct validity when related with reading comprehension ability (Taraban et al., 2004) or are only cautiously advocated as supplementary tools for reading instruction instead of as sufficient benchmarks of meta-cognitive strategy use during reading (McLain, Gridley, & McIntosh, 1991; Miholic, 1994).

Our review of meta-cognitive measures begins with the measure that has the most extensive coverage of strategies related to reading. We then cover measures that have made the assessment of meta-cognitive strategies more parsimonious. Schraw and Dennison (1994) constructed the most comprehensive instrument, a 52-item inventory to measure adults' meta-cognitive awareness. Items were classified into eight subcomponents subsumed under two broader categories, knowledge of cognition (i.e., declarative knowledge, procedural knowledge, conditional knowledge) and regulation of cognition (i.e., planning, information management, monitoring, debugging, evaluation). The internal consistency of these eight subscales ranges from .93 to .88. Although there is a statistically significant correlation between the knowledge and regulation of cognition, only the knowledge of cognition factor was related to higher performance on reading tests ($r = .20$, $p<.05$).

The *Meta-cognitive Awareness Reading Strategy Inventory* (MARSI; Mokhtari & Reichard, 2002) was developed to assess the type and frequency of reading strategies that students perceive that they use while reading academic materials in English. The MARSI contains 30 items that measure three factors: Global Reading Strategies (13 items), Problem-Solving Strategies (8 items), and Support Reading Strategies (9 items). The global factor reflects strategies related to the global analysis of text. The problem-solving factor includes repair

strategies that are used when text becomes difficult to read. The support factor reflects practical strategies like taking notes and consulting a dictionary. The MARSI was designed for use with individuals or groups with reading ability ranging from 5th grade to college level. The primary uses of the MARSI include the following: (a) enhancing student awareness, (b) planning instruction, and (c) clinical or classroom research. To date the MARSI has only been validated with a sample of students enrolled only in grades 6-12. More details on the psychometric adequacy of MARSI are provided in a section to follow.

Mokhtari and Sheorey (2002) developed the *Survey of Reading Strategy* (SORS), an adapted version of the MARSI (Mokhtari & Reichard, 2002) with minor adjustments to test the difference between non-native and native English users of different reading abilities. SORS has three subscales: Cognitive (all 10 items belong to MARSI's Global Reading Strategies factor), Meta-cognitive (12 items, including MARSI's 8 Problem-Solving Strategies, 3 Global Reading Strategies, and 1 Support Reading Strategy) and Support Strategies (6 Support Reading Strategies from the MARSI). They showed that higher reading ability students use more support strategies. Both native and non-native higher reading ability students have higher reported meta-cognitive reading strategies usage than their lower reading ability cohorts. A recent study (Anderson, 2006) demonstrated that even though this measure was reliable with English as foreign language students (r = .79-.93), the correlation with self-reports of reading ability was negligible (r = -.028).

The *Meta-cognitive Reading Strategies Questionnaire* (MRSQ) was developed by Taraban et al. (2004). The MRSQ was designed as a 22 item self-report questionnaire to measure college students' use of reading strategies for comprehension and for studying while reading school related materials. Taraban et al. (2004) further explored usage of different types of strategies among adults and determined that the MRSQ has a two-factor structure: Analytic and Pragmatic (r = .25, p<.001). The Analytic factor represents behaviors that are used to comprehend text such as evaluating (like the Global Reading Strategies in MARSI), determining the meanings of unknown words and visualizing (like the Problem-Solving Strategies in MARSI). The Pragmatic factor represents behaviors that help a reader to remember text such as highlighting, annotating, rereading, and underlining (like the Support Reading Strategies in MARSI). The analytic factor had a higher correlation with expected grades than the Pragmatic factor (r = .18, p<.001).

1.2 Psychometric Properties of MARSI

Our goal was to examine the construct validity of the MARSI for populations of adults to see if it may be appropriate for instructional planning and research in college classrooms. There are several ways to assess the quality of a measure. The major ways to garner evidence are to establish validity and reliability. While reliability, the repeatability or consistency of a measure, is important, construct validity also should always be examined in order to support test interpretation and justify the use of a test (Messick, 1989). Construct validity refers to the degree to which inferences can be made on the basis of the way in which a theoretical construct has been operationalized. One method to establish construct validity is to examine the relation between multiple measures of meta-cognitive awareness (e.g., think-aloud protocols, multiple choice questionnaires, log files, eye movement records, etc.) or to compare a meta-cognitive measure with a measure of a construct that it is theoretically associated with (e.g., reading comprehension). This type of construct validity is commonly referred to as convergent validity.

The MARSI has documented reliability from several sources. Mokhtari and Reichard (2002) report that the MARSI has good internal consistency (α = .89). Cromley and Azevedo (Cromley, 2004; Cromley & Azevedo, 2004, 2006) also report good internal consistency of MARSI for ninth grade students (α = .71, α=.87; and α=.88 respectively in those three studies). There, however, are only two studies that have addressed the convergent validity of the MARSI, and both used samples of secondary school students. Cromley and Azevedo (2006) reported that the MARSI was not significantly correlated with think-aloud protocols, a multiple-choice strategy use measure, or a standardized test of reading comprehension in a small sample of ninth grade students. Conversely, Mokhtari and Reichard (2002) provided evidence for convergent validity by relating MARSI performance to self-reported reading ability. Readers who rated themselves as *Excellent* reported they used more Global and Problem-Solving strategies than readers who rated themselves as *Average* or *Not So Good*. In addition, readers who rated themselves as *Average* also reported using more Global strategies than readers who rated themselves as *Not So Good.*

There are still some unanswered questions regarding the validity of the MARSI when determining the appropriateness with college readers. First, the MARSI was a theory-based measure designed to be appropriate for measuring meta-cognitive strategy use within children and adolescents. It is not known if the relation between self-reported usage of meta-cognitive strategies changes at the upper end of the distribution of reading

ability. The original validation sample was selected from participants who only were enrolled in grades as high as 12 (Mokhtari & Reichard, 2002). In addition, given the design of their study, there is no way to equate grade enrollment with grade level reading ability or to determine if *Excellent* as reported by an adolescent is the same level as *Excellent* as reported by an adult.

Interestingly, Mokhtari and Sheorey (2002), however, suggested that with minor changes MARSI also is suitable for use with non-native English speaking international university students. Mokhtari and Reichard (2004) compared performance differences on the MARSI between native English speaking (L1) college freshmen and L2 (English as a second language) college freshmen. Both groups of students provided self-reports of their reading ability on a 1-5 Likert scale, which ranged from *Poor* to *Excellent*. The average score on the ACT was reported for the L1 sample. Both L1 and L2 students had average self-reported reading ability levels that were in the mid-range (3.6 and 3.4 respectively). Since the purpose of Mokhtari and Reichard (2004) was not to validate the measure, only descriptive statistics were provided about the overall score and subscale scores on the MARSI for both groups and differences between each group's endorsement of the individual items.

Overall, there currently is limited evidence to support the construct validity of MARSI. Construct validity previously was verified using a self-report measure of reading ability to predict the frequency of strategies that children and adolescents would report (Mokhtari & Reichard, 2002); however, the relation between self-reported reading ability and reading ability as assessed with a standardized test is not known. Even if there is a relationship between self-reported reading ability and reading ability as assessed with a standardized test, it is not known how this relationship changes with age.

1.3 Overview of the Current Study

Participants were chosen from the college student population, making our participants older and more advanced readers than the participants used in the MARSI's original validation sample (Mokhtari & Reichard, 2002). Given the nature of this population, two hypotheses were proposed regarding the validity of the MARSI with college students. Related to convergent validity, it was expected that we could replicate Mokhtari and Reichard's (2002) finding that reading ability is positively correlated with the frequency of usage of both Global Reading and Problem-Solving Strategies. This hypothesis is motivated by the data that suggest that good comprehenders or more sophisticated readers have more knowledge of meta-cognitive strategies than younger or poorer readers (Baker & Brown, 1984a; Gambrell & Heathington, 1981). We also explored the relationship of MARSI to reading comprehension skill as measured both by self-report and standardized reading assessments.

Related to construct validity more generally, it was hypothesized that the original factor structure of the MARSI would replicate in our population. Quantitative methods (CFA) and qualitative analyses (pattern analysis) were used to test the construct validity of the MARSI and explore a possible model to represent the nature of meta-cognitive reading strategies in the college-attending adult population. Confirmatory factor analyses were conducted using the MARSI's original three-factor structure. These analyses were aimed at determining whether this original factor structure has a good fit or if a possible condensed structure of the inventory would better represent the perceived meta-cognitive strategy usage of advanced readers.

2. Method

2.1 Participants

Participants (n=189) living in two Southeastern university communities in the U.S.A were recruited primarily from college psychology and education courses. These communities included undergraduate and graduate students who were attending either 2- or 4-year postsecondary institutions. The mean age of participants was 22 years (range: 17-45 yrs.), and 68% of the participants were female. All of the participants were native speakers of English. They were given either course credit or paid $10.00 for participation in the research study.

2.2 Study Instruments

2.2.1 Nelson-Denny Reading Comprehension Subtest (NDRT)

This NDRT subtest (Form H; Brown, Fishco, & Hanna, 1993) is a standardized reading comprehension test that consists of seven prose passages and a total of 38 multiple choice questions, each with five answer choices. The manual for the Nelson-Denny outlines two different types of administration criteria, standard administration and extended time administration. We selected the "Extended Time" version so that readers' comprehension would be assessed without a speed component and students' performance would reflect a purer form of reading comprehension. The "Extended Time" version of the test allows 32 minutes for participants to complete the test.

Participants' scores were computed by giving them one point for each item that they answered correctly. All raw

scores were transformed to standard scores using the norms for "Extended Time" administration and 2-4 year colleges or universities. The technical manual reported a Kuder-Richardson 20 raw-score reliability coefficient of .81. Specific validity studies for Form H were not reported. Studies that have used earlier versions of the test showed good predictive validity for academic success, with regression coefficients of .5 and above (Feldt, 1988).

2.2.2 Meta-cognitive Awareness of Reading Strategies Inventory (MARSI)

The MARSI (Mokhtari & Reichard, 2002) is a self-report, online questionnaire of meta-cognitive knowledge of reading strategies. It contains 30 items, each of which describes briefly the reading situation and the corresponding reading strategy to be applied, such as "I have a purpose in mind when I read" and "I preview the text to see what it's about before reading it". Each strategy is in alignment with one of the three strategy subcategories: Problem-Solving, Global Reading, and Support Reading Strategies. See Appendix A for a copy of the original measure. Participants read the questions on a computer screen and clicked on the rating that best described their use of each strategy. Each participant took approximately 10 to 12 minutes to complete the test.

Participants' responses were scored for each subscale. Participants received a raw score for each item and a mean score for each factor subscale. The mean for each factor subscale was computed by dividing the raw score by the number of questions on a given subscale. Mean scores were divided into three pre-determined levels of strategy use based on the criteria outlined by Mokhtari and Reichard (2002) for each factor subscale: high (3.5 and above), medium (2.5 to 3.4), and low (2.4 and less). An overall score was calculated by summing the raw scores across the subscales and dividing by 30. The overall score indicates how often participants use reading strategies when reading academic materials. The sub-score for each strategy subcategory indicates how often participants use Problem-Solving, Global Reading, or Support Reading Strategies during academic reading.

2.2.3 Self-Reported Reading Ability Scale (SRRAS)

The authors designed a scale containing one self-report item that allowed participants to indicate their reading ability level. This scale had 3 points: *Below Average, Average*, and *Above Average*. On the rating scale, descriptions of how each of these points corresponded to the reading ability labels used by Mokhtari and Reichard (2002) were indicated in parentheses. *Below Average* corresponded to *Not So Good* reading ability. *Average* corresponded to *Average* reading ability. *Above Average* corresponded to *Excellent* reading ability. Participants placed a check mark by the level that they thought best reflected their reading skill level.

2.3 Procedure

Each participant was administered the NDRT followed by the MARSI. The MARSI was completed using a personal computer with access to the Internet. Data were collected using *Flashlight* (Washington State University Center for Teaching, Learning, and Technology, 1998-2006), a web-based system for creating surveys, gathering responses, and analyzing data. Instructions were provided within *Flashlight*. The MARSI questions were administered in the order suggested by the instrument's authors (Mokhtari & Reichard, 2002). Participants from one university community were individually administered the tests and participants from the other university were administered the test in small groups ranging from two to ten persons.

3. Results

3.1 Preliminary Analyses

3.1.1 Descriptive Statistics

Table 1 provides the descriptive statistics for the entire sample and for each measure that was used in the study. The ratio of sample size to item number was 6.3. To test whether the distribution of scores on each measure within our sample deviated from normal and to determine if there was a ceiling effect, skewness and kurtosis values were examined. The skewness value of -.04 (*SEM* =.18) and the kurtosis value of .23 (*SEM* =.35) indicated a relatively normal distribution on the MARSI. In contrast, a Kolmogorov-Smirnov test of normality revealed that the negative skewness value of - .88 (*SEM* =.18) was significant for the NDRT, *K-S* = 1.78, *p*=.004. The kurtosis value of .74 (*SEM* =.35) was normal. Given that statistically significant skewness often does not make a substantial difference in analyses with large samples (Tabachnick & Fidell, 1996), we decided not to transform the NDRT scores. A Kolmogorov-Smirnov test of normality also revealed that the negative kurtosis value of -.77 (*SEM* =.60) was significant for the SSRAS, *K-S* = 2.86, *p*=.001. The skewness value of .04 (*SEM* =.30) was normal. Only two participants rated themselves as *Below Average* readers. Thus, the *Below Average* and *Average* categories were combined, and self-reported reading ability was treated as a dichotomous variable.

It was important for us to examine the relation between self-report reading ability ratings and reading scores obtained from a standardized comprehension measure since there have not been any studies to demonstrate this

relation to date. We observed a statistically significant relationship between the SRRAS and the NDRT. These two measures were positively correlated (r=.33). College students with lower standardized scores rate themselves as *Below Average/Average* readers and college students with higher standardized reading scores rate themselves as *Above Average* readers.

We also tested to see whether our mean scores on the MARSI and the MARSI subscales were different from the other reported means for adults (see Table 1). The overall mean on the MARSI (3.38 out of 5), the Global Reading Strategies subscale mean (3.43 out of 5), and the Problem-Solving Strategies subscale mean (3.34 out of 5) were greater than the means reported by Mokhtari and Reichard (2004), $t(328)=2.33$, $p=.02$; $t(328)=3.27$, $p<.001$; $t(328)=5.14$, $p<.001$ respectively. The Support Reading Strategies subscale mean (2.92 out of 5) was lower than the support subscale mean reported by Mokhtari and Reichard (2004), $t(328)=6.76$, $p<.001$.

3.1.2 Reliability of MARSI

Several statistics were computed to examine the reliability of the MARSI and the internal subscale correlations. Cronbach's alpha coefficients were computed for the entire set of 30 items ($\alpha = .77$). Cronbach's alphas also were computed for the Global Reading Subscale ($\alpha = .75$), for the Problem-Solving Subscale ($\alpha = .73$), and for the Support Reading Subscale ($\alpha = .88$) in order to obtain estimates of internal consistency reliability for each subscale.

3.1.3 Inter-correlations between MARSI, NDRT, and SRRAS

The inter-correlations between the subscales were examined to see if the pattern of correlations resembled the original factor correlations. Table 2 shows that the correlations ranged from .51-.69 in our sample. The Global Reading Strategies subscale and the Problem-Solving Strategies subscale were moderately correlated, r=.69, which is larger than the originally reported weak correlation of r=.20 (Mokhtari & Reichard, 2002). The Global Reading subscale and the Support Reading subscale were moderately correlated, r=.55, which is weaker than the originally reported moderate correlation of $r = .73$ (Mokhtari & Reichard, 2002). The Support Reading subscale and the Problem-Solving subscale also were moderately correlated, $r = .51$, which is more strongly correlated than the originally reported weak correlation of r=.09 (Mokhtari & Reichard, 2002).

To test whether each correlation was statistically different than the correlations in Mokhtari and Reichard's validation sample each correlation was first transformed into a z score (i.e., Fischer transformation, see Meng, Rosenthal, & Rubin, 1992). The results of t-tests comparing the observed correlations in the current study (n = 189) to those obtained by Mokhtari and Reichard (n=825) were all significant ($ps<.001$).

3.2 Construct Validity of MARSI—Convergent Validity

3.2.1 MARSI with SRRAS

First, an attempt was made to replicate Mohktari and Reichard's (2002) results using the self-reported reading ability item. The frequency of strategy use was compared across self-reported levels of reading ability within the sub-sample of participants (n= 62) who had completed the SRRAS. Table 3 shows the mean frequency of strategy use for the overall inventory and across subscales by level of reading ability. One-way ANOVAs were computed comparing the MARSI responses between each self-reported ability level group. Numerically the means for the overall MARSI score and the Global Reading Strategies subscale followed the pattern that was originally reported by the authors of the MARSI. The numeric difference in the means for the Global Reading subscale approached significance, $F(1, 60) = 3.53$, p=.07. There were no significant differences between groups on the overall score, the Problem-Solving subscale, or the Support Reading subscale, all Fs < 1.

3.2.2 MARSI with NDRT

The convergent validity of the MARSI was examined further by dividing the sample adult readers into three reading levels using the NDRT stanine scores. Using the following criteria, *Above Average* (Stanine 7-9), *Average* (Stanine 4-6), and *Below Average* (Stanine 1-3), only two readers were classified as *Below Average*. Given the small n for the *Below Average*, we combined it with *Average* group. Table 4 shows the means for each reading ability level. Similar to the trend found when using the SRRAS, results of one-way ANOVAs revealed that only the Global Reading Strategies subscale of MARSI differed across reading ability groups, $F(2, 186) = 7.135$, $p<.001$. A post-hoc independent samples t-test revealed that *Above Average* readers reported more frequent usage of the strategies on the Global Reading Subscale than *Average Readers*, $t(185)=-3.47$, $p<001$.

3.3 Construct Validity of MARSI—Factor Structure

3.3.1 Confirmatory Factor Analyses (CFA)

Since the authors of the MARSI to date have only reported the results of an exploratory factor analysis, we

conducted a series of confirmatory factor analyses to further test the validity of the measure in a college sample. There are several rules of thumb for determining the adequacy of sample size for computing CFAs (DeCoster, 1998). Three separate CFAs were computed using structural equation modeling with the *AMOS* 5.0 software (Arbuckle, 2003). The first model tested the independence of the three subscales (see Figure 1).

There were no-cross loadings in this model. This first CFA yielded a poor fit, χ^2 (402) = 927.9, p<.001. The p-value associated with the χ^2 test is the probability of obtaining the observed variance/covariance matrix if the model is true for the population. Thus, a non-significant χ^2 is desired. However, the χ^2 test is overly sensitive to sample size. Therefore, the values of four fit indices also were examined. Analysis of four fit indices also suggested that the model had a poor fit, GFI=.740, CFI=.525, NFI =.654 and RMSEA =.083. GFI and CFI larger than 0.95, NFI larger than 0.8, and RMSEA smaller than .05, have been suggested as the representative of a well-fitting model (Hu & Bentler, 1995).

The second model (see Figure 2) that was computed reflected the cross-loadings of items on more than one factor. Considering the cross-loading effects in the original MARSI EFA report (Mokhtari & Reichard, 2002), a new CFA was run with Item 3 cross-loaded on both the Global Reading and Problem-Solving Strategies subscales, Item 23 cross-loaded on both the Global and Support Reading subscales, and Item 5 cross-loaded on Problem-Solving and Support Reading subscales.

Both the chi-square statistic and the fit indices for the CFA that reflected the cross-loading of items suggested that the second model also did not have a good fit, χ^2 (394) =904.1, p<.001; GFI=.478, CFI=.666, NFI =.537 and RMSEA =.082. Table 5 compares the factor loadings from this analysis to the original factor loadings reported by Mokhtari and Reichard (2002) in their Exploratory Factor Analysis (EFA).

The third model took into account the possibility of inter-item contextual effects. To explore this alternative clusters of items were created that belonged to each subscale by randomly assigning each item within a subscale to one of two clusters. Taking into account the sensitivity of the chi-square statistic to sample size (χ^2 (6) = 16.04, p=.014), the third model showed the greatest promise. There was improvement in all but one of the fit indices, GFI=.972, CFI=.978, NFI=.967, RMSEA=.094.

3.3.2 Inter-item Correlations

Since the factor structure of the MARSI could not be replicated, the items were examined to see whether the analyses suggested they should be modified or deleted. Crocker and Algina (1986) suggested looking at whether each item contributed or detracted from the reliability of the subscales. The covariance matrix for each subscale and the overall inventory's covariance matrix were examined, searching for standardized residuals larger than 2.5 and negative correlation coefficients among the items in the same subscale. Items 4 and 5, 21 and 28, were problematic in our college sample due to their large covariance residues. Items 5, 13, 16, 17, 18, 23, 25, 27, 28, and 29 had moderate inter-item correlation coefficients with more than one item within each subscale or the overall inventory. The suggested model modification should consider the contextual effects and delete the problematic items for furture contextualized analysis.

4. Discussion

We investigated the relation between self-reported reading strategy usage and reading ability in college students. Participants in our study on average were at a grade level that was equivalent to 2 years post high school or grade 14 in reading. They self-reported medium levels of usage on the overall MARSI and on each of the MARSI subscales. We also provide the first data that demonstrates using a self-reported reading ability measure is comparable to using a standardized test of reading ability in adult readers. The self-report reading ability scores of our participants were positively associated with their reading ability scores gained from a standardized assessment. This means that reading ability ratings taken from college students corresponds with reading ability scores taken from a measure that assesses comprehension of written text. This finding has implications for instruction. The administration of a self-report measure is less time consuming than the administration of a standardized measure and the ratings are self-explanatory.

College students' reports of their frequency of usage of certain strategy types differed from the L1 college students examined in Mokhtari and Reichard's (2004) study. Our overall mean on the MARSI and the mean on the Global Reading and Problem-Solving Strategies subscales were higher than Mokhtari and Reichard (2004) reported. In contrast, our mean on the Support Reading Strategies subscale was lower than the mean that Mokhtari and Reichard (2004) reported. It is hard to make direct comparisons between our samples, however, because our samples may have differed in reading comprehension ability. Only the mean on the ACT was reported by Mokhtari and Reichard (2004).

Our data also do not support Mokhtari and Reichard's (2002) findings that the frequency of usage of both Global Reading Strategies and Problem-Solving Strategies increased between readers who were at the upper end of the ability continuum and readers who are in the middle of the continuum. We only found significant differences between these two groups of readers on the Global Reading subscale of the MARSI when reading ability was assessed using the standardized reading test. The current sample differed from the MARSI's original validation sample in several ways. The current sample was significantly smaller, and these two samples might be representative of two different sample populations (n=189 and n= 825, respectively). The original validation sample consisted of readers in grades 6-12, with no standardized assessment of grade level reading ability indicated. The grade level equivalents on the Nelson Denny Reading Comprehension Subtest were two years beyond the actual grade levels in which students from the original MARSI validation sample were enrolled. Our findings suggest that once an individual reaches the upper end of the reading ability continuum their perceptions of the frequency of the usage of certain strategies may change.

In addition, the fact that neither measure of reading ability was correlated with the overall MARSI challenges its validity in college students (Pressley & Ghatala, 1990; Swanson, 1990). It is promising, however, that the Global Reading and Problem-Solving Strategies subscale scores were correlated with the NDRT and that the magnitude of the correlation between the Global Reading subscale and the SRRAS was equivalent to the magnitude of the correlation between the Global Reading subscale and NDRT (although not significant).

Though the MARSI was selected for this study because it had a comprehensive sampling of strategy types and preliminary construct validity, several confirmatory factory analyses were unsuccessfully able to replicate the MARSI's original factor structure within a population of proficient adult readers. We also observed moderate inter-correlations between the Global Reading and Problem-Solving Strategies subscales and between the Problem-Solving and Support Reading Strategies subscales in our college student sample. These inter-correlations were higher than the correlations reported by Mokhtari and Reichard (2002). This pattern brings into question the discriminant validity among subscales for the adult college population. Our sample size (n=189), however, was less than the several hundred that is recommended.

Our data, nonetheless, suggest that the Meta-cognitive Awareness Reading Strategy Inventory (Mokhtari & Reichard, 2002; Mokhtari & Sheorey, 2002) may not be appropriate for use with adult college readers (i.e., grade level equivalents beyond 12th grade) in its current format. Even though this inventory has been shown to be valid and reliable for 6-12th graders, when the target population changes we have demonstrated that patterns of responding on the MARSI changes. Therefore, further investigation also is needed to verify whether the MARSI is appropriate to use with adult L2 learners as suggested by Mokhtari and Sheorey (2002). Given that the usage of the MARSI with adult readers is called into question by the current findings, extensive usage of the MARSI for assessing adult L2 learners is cautioned until the factor structure has been validated in L1 adults. While it is possible that adult L2 learners may have reading ability levels that are comparable to the reading ability levels of the students in the MARSI's validation sample, the actual construct nature of L2's meta-cognitive reading strategy use has yet to be accurately identified.

There are, nevertheless, several plausible alternative explanations for the poor validity evidence obtained on the MARSI in our adult sample besides adopting the conclusion that the MARSI does not have good measurement quality. Some have argued that students use strategies to a different extent in different contexts, even in academic reading, and that context-free measures do not accurately reflect strategy use for any of those contexts (e.g., Hadwin et al., 2001). On the other hand, Cromley and Azevedo (2006) argue that high comprehending students may be systematically under-estimating and low-comprehending students systematically overestimating their use of the strategies on the MARSI measure, which may account for the lack of relationship between self-report and reading comprehension measures.

We should also point out the limitations of our study. One of the limitations of the current study includes the usage of NDRT Form H, as the NDRT Form H developed by Brown, Fishco, and Hanna (1993) had any validation indices. Another limitation of the current study is that we did not collect data to evaluate the test-retest reliability of the MARSI inventory. These issues could be addressed in future research. Future research with a larger sample so that additional factor structures can be tested is also advised.

Call for a theoretically sound, population-adjustable and construct-transparent measure of meta-cognitive reading strategies is urgent. Various types of research methodologies besides a self-report questionnaire would be complementary to each other. Direct observations during academic functioning (Zimmerman & Martinez-Pons, 1988) and self-recall (Taraban et al., 2004), to name a few, could provide educators and researchers with additional criteria of construct validity to draw a comprehensive perspective of meta-cognitive strategy

knowledge and usage. Other areas for future research include developmental issues related to meta-cognition, reading goals, and language proficiency.

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Table 1. Descriptive statistics

	Mean	Std. Deviation	Std. Error
NDRC	219.09	20.89	1.52
SRRAS	1.34	.54	.07
MARSI OVERALL	3.38 (3.25)	.51 (.49)	.04
GLOB	3.43 (3.23)	.57 (.52)	.04
PS	3.43 (3.10)	.56 (.60)	.04
SUP	2.92 (3.39)	.58 (.68)	.05

Note. NDRC= Nelson Denny Reading Comprehension Test; SRRAS= Self-Report Reading Assessment Scale; GLOB=global; PS=problem-solving; SUP=support. Mokhtari & Reichard (2004) values in parentheses.

Table 2. Inter-correlations between *Meta-cognitive Awareness of Reading Strategies Inventory* (*MARSI), Self-Report Reading Ability Scale (SRRAS)* and *Nelson-Denny Reading Test (NDRT)*

	MARSI Overall	Global Reading Strategies	Problem Solving Strategies	Support Reading Strategies	NDRT	SSRAS
MARSI Overall	1	--	--	--	--	--
MARSI Global	.89**	1	--	--	--	--
MARSI Problem Solving	.83**	.69** (.20)	1	--	--	--
MARSI Support	.80**	.56** (.73)	.51** (.09)	1	--	--
NDRT	.13	.19**	.15*	-.03	1	
SRRAS	.12	.24†	-.02	.00	.33**	1

Note. †=p<.10;*=p<.05; **=p<.01. NDRT = Nelson Denny Reading Comprehension Subtest, SRRAS = Self-Report Reading Assessment Scale. Mokhtari & Reichard (2002) values are in parentheses.

Table 3. One-way analysis of variance of perceived strategy use by SRRAS scores

Strategy Use	Whole n=62		Above Average (Excellent) n =23		Below Average/ Average (Not So Good/Average) n =39				
	Mean	*SD*	Mean	*SD*	Mean	*SD*	*MSE*	*F*(1,60)	*p*
Glob	3.38	.58	3.55	.64	3.27	.52	1.12	3.53	.07
PS	3.79	.52	3.77	.46	3.79	.46	.01	.02	.88
SUP	2.85	.63	2.85	.78	2.85	.54	.00	.00	.99
Overall	3.33	.47	3.40	.57	3.29	.40	.19	.88	.35

Note. SRRAS= Self-Report Reading Ability Scale; Glob=Global; PS=Problem-solving; SUP=Support.

Table 4. One-way analysis of variance of perceived strategy use by Nelson-Denny Reading Test (NDRT) scores

Oneway ANOVA											
Strategy Use	Whole n=189		Stanine 7-9 (Excellent) n =63		Stanine 4-6 (Average) n =124		Stanine 1-3 (Not so good) n =2				
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	MSE	F(2,186)	P
Glob	3.43	.56	3.62	.51	3.33	.57	4.00	.11	.299	7.135	.001
PS	3.80	.58	3.90	.61	3.75	.56	3.75	.35	.330	1.345	.263
SUP	2.92	.67	2.88	.67	2.94	.65	3.22	1.10	.434	.333	.717
Overall	3.38	.51	3.48	.49	3.32	.52	3.70	.38	.260	2.356	.098

Note. Glob=Global; PS=Problem-solving; SUP=Support.

Table 5. Confirmatory factor analysis

	Inventory Item	Global	Problem Solving	Support
Item 1	I have a purpose in mind when I read.	.42 (.639)		
Item 3	I think about what I know to help me understand what I am reading.	.42(.418)	(.404)	
Item 4	I preview the text to see what it's about before reading it.	.31(.470)		
Item 7	I think about whether the content of the text fits my purpose.	.42(.597)		
Item 10	I skim the text first by noting characteristics like lengths and organization.	.55(.640)		
Item 14	I decide what to read closely and what to ignore.	.28(.582)		
Item 17	I use tables, figures, and pictures in text to increase my understanding.	.43(.385)		
Item 19	I use context clues to help me better understand what I'm reading.	.36(.407)		
Item 22	I use typographical aids like boldface type and italics to identify key information.	.41(.425)		
Item 23	I critically analyze and evaluate the information presented in the text.	.52(.308)		(.354)
Item 25	I check my understanding when I come across conflicting information.	.64(.352)	(.325)	
Item 26	I try to guess what the text is about when reading.	.43(.373)	(.303)	
Item 29	I check to see if my guesses about the text are right or wrong.	.42(.389)		
Item 8	I read slowly but carefully to be sure I understand what I'm reading.		.57(.454)	
Item 11	I try to get back on track when I lose concentration.		.50(.679)	
Item 13	I adjust my reading speed according to what I'm reading.		.51(.512)	
Item 16	When text becomes difficult, I begin to pay closer attention to what I'm reading.		.61(.553)	
Item 18	I stop from time to time to think about what I'm reading.		.69(.605)	
Item 21	I try to picture or visualize information to help me remember what I'm reading.		.49(.632)	
Item 27	When text becomes difficult, I reread to increase my understanding.		.59(.634)	
Item 30	I try to guess the meaning of unknown words or phrases.		.32 (.533)	
Item 2	I take notes while reading to help me understanding what I'm reading.			.54(.728)
Item 5	When text becomes difficult, I read aloud to help me understanding what I'm reading.		(.375)	.29(.375)
Item 6	I write summaries to reflect on key ideas in the text.			.57(.773)
Item 9	I discuss my reading with others to check my understanding.			.50(.573)
Item 12	I underline or circle information in the text to help me remember it.			.52(.616)
Item 15	I use reference materials such as dictionaries to help me understanding what I'm reading.			.32(.493)
Item 20	I paraphrase (restate ideas in my own words) to better understand what I'm reading.			.56(.526)
Item 24	I go back and forth in the text to find relationships among ideas in it.			.67(.511)
Item 28	I ask myself questions I like to have answered in the text.			.50(.510)

Note. Mokhtari & Reichard (2002) values are in parentheses.

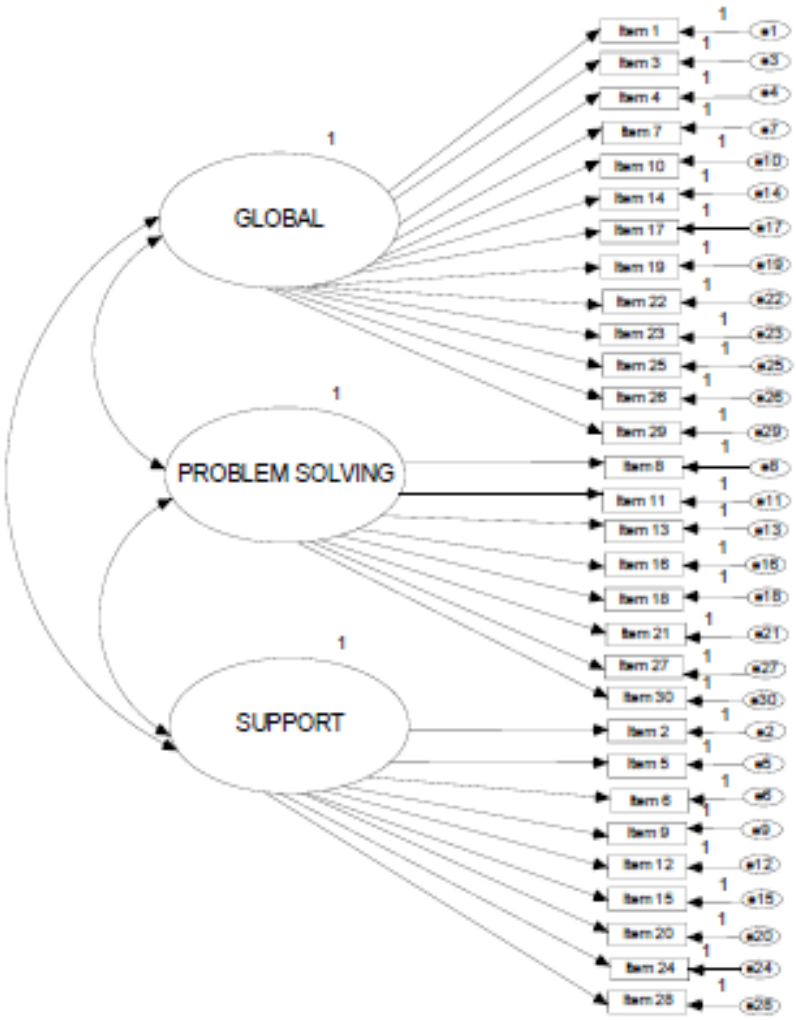

Figure 1. Path Diagram of MARSI: A model with three factors equivalent to the GLOBAL, PROBLEM SOLVING, and SUPPORT, with 13, 8 and 9 observed indicators for each latent variable

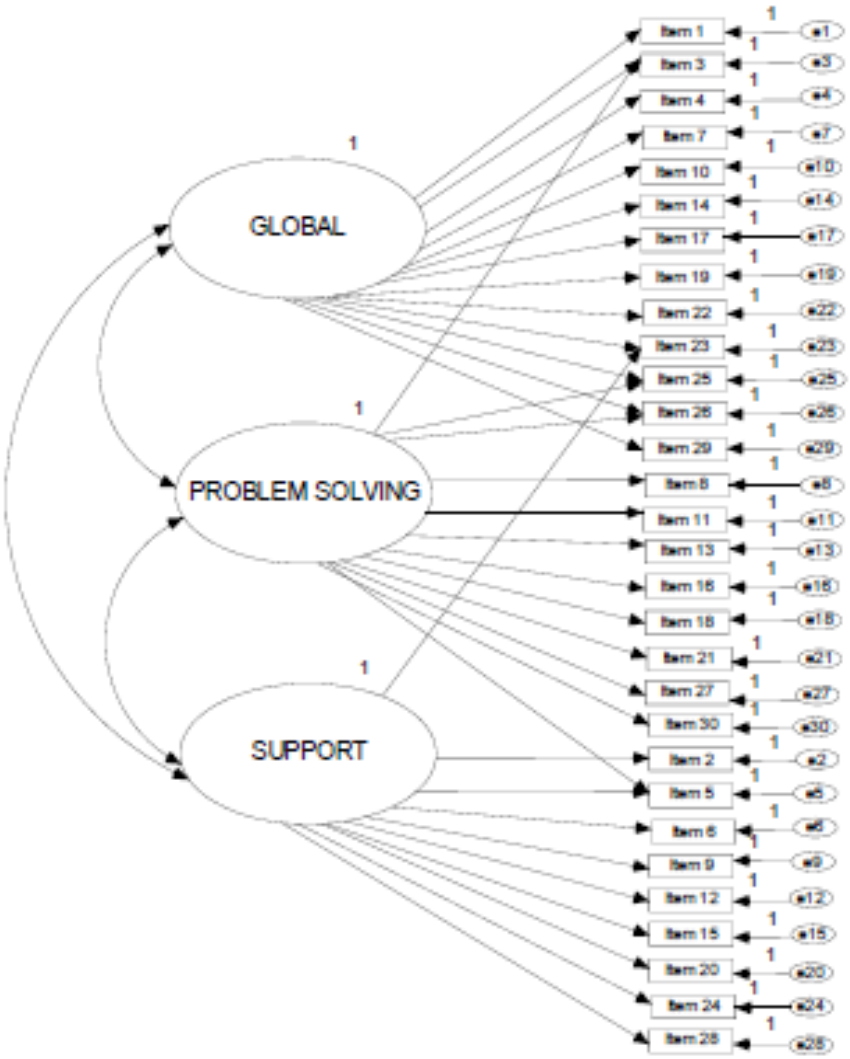

Figure 2. Path Diagram of MARSI with cross loading effect: A model with three factors equivalent to the GLOBAL, PROBLEM SOLVING, and SUPPORT subscales, with 13, 9 and 10 observed indicators for each latent variable

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Appendix A

Metacognitive Awareness of Reading Strategies Inventory
(MARSI) Version 1.0
Kouider Mokhtari and Carla Reichard © 2002

DIRECTIONS: Listed below are statements about what people do when they read academic or school-related materials such as textbooks, library books, etc. Five numbers follow each statement (1, 2, 3, 4, 5) and each number means the following:

1 means "I **never or almost never** do this."
2 means "I do this **only occasionally."**
3 means "I **sometimes** do this." (About **50%** of the time.)
4 means "I **usually** do this."
5 means "I **always or almost always** do this."

After reading each statement, **circle the number** (1, 2, 3, 4, or 5) that applies to you using the scale provided. Please note that there are **no right or wrong answers** to the statements in this inventory.

TYPE	STRATEGIES	SCALE				
GLOB	1. I have a purpose in mind when I read.	1	2	3	4	5
SUP	2. I take notes while reading to help me understand what I read.	1	2	3	4	5
GLOB	3. I think about what I know to help me understand what I read.	1	2	3	4	5
GLOB	4. I preview the text to see what it's about before reading it.	1	2	3	4	5
SUP	5. When text becomes difficult, I read aloud to help me understand what I read.	1	2	3	4	5
SUP	6 I summarize what I read to reflect on important information in the text.	1	2	3	4	5
GLOB	7. I think about whether the content of the text fits my reading purpose.	1	2	3	4	5
PROB	8. I read slowly but carefully to be sure I understand what I'm reading.	1	2	3	4	5
SUP	9 I discuss what I read with others to check my understanding.	1	2	3	4	5
GLOB	10. I skim the text first by noting characteristics like length and organization.	1	2	3	4	5
PROB	11. I try to get back on track when I lose concentration.	1	2	3	4	5
SUP	12. I underline or circle information in the text to help me remember it.	1	2	3	4	5
PROB	13. I adjust my reading speed according to what I'm reading.	1	2	3	4	5
GLOB	14. I decide what to read closely and what to ignore.	1	2	3	4	5
SUP	15. I use reference materials such as dictionaries to help me understand what I read.	1	2	3	4	5
PROB	16. When text becomes difficult, I pay closer attention to what I'm reading.	1	2	3	4	5
GLOB	17. I use tables, figures, and pictures in text to increase my understanding.	1	2	3	4	5
PROB	18. I stop from time to time and think about what I'm reading.	1	2	3	4	5
GLOB	19. I use context clues to help me better understand what I'm reading.	1	2	3	4	5
SUP	20. I paraphrase (restate ideas in my own words) to better understand what I read.	1	2	3	4	5
PROB	21. I try to picture or visualize information to help remember what I read.	1	2	3	4	5
GLOB	22. I use typographical aids like bold face and italics to identify key information.	1	2	3	4	5
GLOB	23. I critically analyze and evaluate the information presented in the text.	1	2	3	4	5
SUP	24. I go back and forth in the text to find relationships among ideas in it.	1	2	3	4	5

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