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Abstract

Using correlation, factor, regression, and reliability analyses, this research explored the nature of Academic Self-Regulation (ASR) while simultaneously establishing the construct validity of a new self-report questionnaire; the S*urvey of Academic Self-Regulation* (SASR). The SASR was pilot-tested (N = 205) and cross-validated (N = 491) on samples of college students from upstate New York. Exploratory factor analyses were used to both extract a six factor structure from the SASR (*Extrinsic Motivation*, *Intrinsic Motivation*, *Metacognition*, *Personal Relevance and Control*, *Self-Efficacy*, and *Self-Regulation*) and to explore the current state of the ASR construct. The *Learning and Study Strategies Inventory* and *Motivated Strategies for Learning Questionnaire* were used as comparison instruments in a modified multitrait (correlation) matrix to establish convergent and discriminant validity for the SASR factors. Regression analyses also provided support for construct validity by establishing relationships between the SASR factors and achievement (GPA). Complex relationships were found through the use of polynomial and interaction regression.

Keywords: academic self-regulation; construct validity; factor analysis; self-regulated learning; self-report questionnaire

Introduction

After decades of research, the boundaries of the construct of *academic self-regulation* (ASR) have become blurred. Sometimes referred to as the *skill*, *will*, or *regulation* of learning, no unified definition of ASR exists (Boekaerts, de Koning, & Vedder, 2006; Boekaerts, Pintrich, & Zeidner, 2000; Zimmerman, 2001). Additionally, multiple ASR theories posit widely diverse explanations of the construct and its processes, which leads to research based on ill-defined goals, and a lack of empirical support for the multiple, independently hypothesized components (Puustinen & Pulkkinen, 2001; Schraw, 2000; Zimmerman & Schunk, 2001). Thus, a *fuzzy set* (Carver & Scheier, 1992) of defining characteristics for ASR now exists, and there is a need to improve its measurement in order to clarify its structure (Hofer, Yu, & Pintrich, 1998). The purpose of the present research was to fulfill this need through the development of a new self-report measure of ASR–the *Survey of Academic Self-Regulation*(SASR).

A number of ASR theories explain the processes of the construct using a wide range of components, even though there is a lack of empirical support for their independence (Boekaerts, 1997; Pintrich, Wolters, & Baxter, 2000; Zimmerman, 1995). These theories often use similar names for theoretically different components, and different names for theoretically similar components, a

problem known as *construct irrelevance* (Elliot, 2005; Entwistle & McCune, 2004; Zimmerman, 1994). This makes cross-study comparisons difficult (Pintrich et al., 2000).Adding to the construct irrelevance problem is the existence of multiple self-report measures of ASR, each grounded in its own theory but also based on an amalgamation of research on motivation, cognition, and metacognition, and possessing heterogeneous taxonomies (Alexander, 1995; Geisler-Bernstein & Schmeck, 1996; Hadwin, Winne, Stockley, Nesbit, & Woszcyna, 2001).

In addition to being the primary method for establishing construct validity (Carver & Scheier, 1992; Gall, Gall, & Borg, 2007), self-report questionnaires are the preferred method for assessing ASR due to their efficiency in content coverage, administration, scoring, time, and cost (Pintrich & Schunk, 2002). Self-report questionnaires can be susceptible to response biases such as social desirability (Creswell, 2005), as well as a lack of calibration (Winne & Jamieson-Noel, 2002) but these limitations have not negated their usefulness. Self-reported ASR has been found to predict academic achievement even when a lack of calibration exists, and it can discriminate between high and low achievers (Assor & Connell, 1992; Pintrich et al., 2000; Winne & Perry, 2000). Self-reported ASR has also contributed to our initial understanding of this construct (Patrick & Middleton, 2002; Pintrich et al., 2000).

Skepticism toward using self-report questionnaires to measure ASR can be partially attributed to the psychometric problems associated with the two most popular ASR self-report questionnaires; the *Learning and Study Strategies Inventory* (LASSI; Weinstein, Zimmerman, & Palmer, 1988) and the *Motivated Strategies for Learning Questionnaire* (MSLQ; Pintrich, Smith, Garcia, & McKeachie, 1991). Although used extensively in research and practice, empirical data do not support their respective theoretical factor structures. The LASSI is a general measure of ASR grounded in information processing theory, intended for use at the secondary and tertiary education levels as a diagnostic and prescriptive measure of students' study skills (Weinstein & Palmer, 1990; Weinstein et al., 1988). A second edition is purported to remediate psychometric issues with the first edition (e.g., high inter-scale correlations, unsupported factor structure) (Weinstein & Palmer, 2002), but initial research does not support this claim (cf., Prevatt, Petscher, Proctor, Hurst, & Adams, 2006). Most published empirical research using the LASSI involved the first edition; hence its prominence in this review. The study reported here used the second edition of the LASSI.

Research utilizing the LASSI is plagued with methodological and psychometric problems (Blackwell, 1992; Hayes, 1992; Turnbough & Christenberry, 1997). Aside from limited methodologies and sampling, several studies have revealed low reliability and validity for the LASSI. Flowers(2003) reported that six of the ten LASSI scales had test-retest coefficients below .70.Yip and Chung (2005) found that test-retest reliabilities ranged from .64 to .81, and scale alphas ranged from .60 to .87. The Attitude scale seems particularly problematic. The scales also lack criterion validity support from classification and regression studies. For example, Yip and Chung found that only three of the ten LASSI scales differentiated between high- and low-achievers. Deming, Valeri-Gold, and Idleman (1994) found developmental students actually scored higher than the

LASSI norms on three scales and no different on four. Using logistic regression, Hewlett, Boonstra, Bell, and Zumbo (2000) found the LASSI scales correctly identified only 3 of 22 poor readers. More importantly, classic factor analytic studies using either edition of the LASSI fail to support its theoretical 10-scale structure. Using various American and foreign college student samples, Bliss and Sandiford (2002), Cano (2006), Olaussen and Braten (1998, 1999), Olejnik and Nist (1992), Olivarez and Tallent-Runnels (1994), Prevatt et al. (2006), Samuelstuen (2003), and Stevens and Tallent-Runnels (2004) have all found only three factors.

Similar to the LASSI in purpose and audience (Pintrich & De Groot, 1990), the MSLQ is also different because it is a situation-specific measure grounded in social-cognitive theory (Pintrich et al., 2000). Exploratory factor analyses were used during development of the MSLQ (Pintrich & Garcia, 1991), but only confirmatory factor analysis results are reported in the *User's Manual*, and these statistics are less than optimal (Dowson & McInerney, 2004); the developers attributed this to the wide variety of contexts in which it was tested. Research using college students has shown that the MSLQ (Pintrich &Garcia, 1991) is also be set with psychometric issues (cf., Benson, 1998; Gable, 1998).

Bassili (2008) found nine MSLQ scales, Jacobson and Harris (2008) found six, and Artino (2005) found five with alpha reliabilities below .70; the Help-Seeking scale tends to perform more poorly than the others. Artino also found 13 interscale correlations exceeding .50, suggesting considerable scale overlap, and Bassili found no significant correlations between the MSLQ scales and course grades (although an abbreviated version performed better). Kanfer, Ackerman, and Heggestad (1996) attempted to factor analyze the MSLQ, but found the results too complex to interpret. Buyukazturk, Akgun, Ozkahueci, and Demirel(2004) attempted a Turkish version of the MSLQ and, using exploratory and confirmatory factor analysis, found a poor fit of the original model. Finally, using confirmatory factor analysis across three subject areas (math, science, and English), Rotgans and Schmidt (2009) found an invariant factor structure, bringing into question the context-specific nature of the MSLQ.

Problem Statement

Because existing measures of ASR have limited construct validity, there is a need to develop a new self-report measure of ASR to better clarify the construct. The purpose of this research was to establish the construct validity of a new self-report questionnaire developed using standard construct validity procedures. The *Survey of Academic Self-Regulation* (SASR) was developed, pilot tested, and retested on large samples of college students from semi-urban institutions of higher education located in upstate New York. Correlational, reliability, factor, and regression analyses were combined to explore the construct validity of ASR, as measured with the SASR.

Methodology

Participants

Using purposive (convenience) sampling, 205 participants volunteered for the pilot study, and 491 participants volunteered for the main study. Participants were sampled from a small, private, four-year, liberal-arts college, and a large, public, state university, both located in a semi-urban setting in upstate New York. The combined sample (N = 696) had a mean age of 22.77, was mostly white (82%), female (61%), university students (67%), and Education majors (53%),and were spread across all grades levels, although graduate (28%) and junior undergraduate (25%) students made up more than half of the sample. For their participation, participants were offered either a movie ticket (pilot study), or individual- and group-level feedback on their ASR skills (main study).

Design, Analysis, and Variables

This research followed a quantitative survey design. ASR was measured using a new self-report questionnaire, the SASR. Due to space limitations, the SASR is not provided here but can be obtained by e-mailing the primary author. The LASSI and MSLQ were used for comparison purposes because, despite their limitations, they are the most widely used and comprehensive self-regulation measures available. Factor scores derived from the SASR were correlated with those from the LASSI and MSLQ, and also used in regression analyses to predict Estimated GPA (pilot study) and actual GPA (main study),as well as course grades (main study). Statistical analyses used to establish the construct validity of ASR, as measured with the SASR, included factor analytic procedures outlined by Cooper (2002), Darlington (1990), Kline (1994, 2000), Tabachnick and Fidell (2001), and Wuensch (2006), as well as standard internal consistency reliability procedures, a modified multitrait-*uni*method procedure developed by Trochim (2006), and ordinary least squares regression analyses as recommended by Cohen, Cohen, West, and Aiken (2003).

Measures

Three self-report measures of ASR were used in this research: the *Learning and Study Strategies Inventory* (LASSI; Weinstein & Palmer, 2002); the *Motivated Strategies for Learning Questionnaire* (MSLQ; Pintrich et al., 1991); and the *Survey of Academic Self-Regulation* (SASR). The LASSI (2nd ed.; Weinstein & Palmer, 2002; Weinstein et al., 2002) contains 80 items measured on a 5-point, Likert-type scale (*a= "Not at all typical of me"* to *e = "Very much typical of me"*), and evenly distributed over 10 subscales: *Anxiety*, *Attitude*, *Concentration*, *Information Processing*, *Motivation*, *Selecting Main Ideas*, *Self-Testing*, *Study Aids*, *Time Management*, and *Test Strategies*. Internal consistency reliabilities reported in the *User's Manual* (Weinstein & Palmer) range from α = .72 (*Study Aids*) to α = .86 (*Selecting Main Ideas*).

The MSLQ (Pintrich, Smith, Garcia,& McKeachie, 1991, 1993) contains 81 items scored on a 7-point, Likert-type scale (1 = *"Not at all true of me"* to 7 = *"Very true of me"*), and unevenly distributed over 15 subscales comprising two sections; Motivation and Learning Strategies. Motivation subscales include *Extrinsic Motivation*, *Intrinsic Motivation*, *Control of Learning*, *Self-Efficacy*, *Task Value*, and *Test Anxiety*. Learning Strategies subscales include *Critical Thinking*, *Effort Regulation*, *Elaboration*, *Help Seeking*, *Metacognition*, *Organization*, *Peer Learning*, *Rehearsal*, and *Time and Study Environment*. Internal consistency reliabilities reported in the *User's Manual* (Pintrich et al., 1991) range from α = .52 (*Help-Seeking*) to α = .93 (*Self-Efficacy*).

The SASR was constructed based on standard questionnaire development procedures (cf., Gall et al., 2007; Kline, 1994, 2000; Schraw, 2000; Thorndike, 2005). Content validity was established based on current ASR theory, measures, and research. The pilot study version of the SASR contained 17 scales comprised of 200 items measured on a 6-point Likert-type scale (*"Strongly Disagree"* 6 = *"Strongly Agree"*). These items were adapted and modified from self-regulation measures used most often in the empirical literature, including the LASSI and MSLQ. An initial principle components analysis using varimax rotation, in conjunction with examination of a scree plot, was used to identify six separate factors (i.e., scales) for extraction in a subsequent principal-axis factor analysis. High inter-item correlations, item-total correlations, and reliability analyses were analyzed and used to further reduce the SASR to its present 6-factor, 63-item form. Whereas the LASSI and MSLQ take 25-30 minutes to administer, the SASR takes approximately 15-20 minutes.

Procedures and Analyses

Participants for the pilot study were solicited via posters and personal contacts. The initial 200-item version of the SASR was administered to participants individually and during various courses spanning five college disciplines (computer and political sciences, criminal justice, education, and sociology). Following pre-factor analytic checks (e.g., ensuring individual and overall Kaiser-Meyer-Olkin values over .60, and mostly small or zero correlation residuals from a reproduced matrix), principle components and principal axes factor analyses were conducted, and factor scores were saved and used as predictor variables in multiple regressions, using estimated GPA as a criterion, to establish initial content, criterion, and construct validity.

The revised 6-factor, 63-item SASR was then administered to the larger main study sample, which was solicited via e-mails to instructors and professors from different disciplines in two institutions. The same pre-factor and factor analysis procedures used in the pilot study were followed. Along with the SASR, half of the participants were administered the LASSI, and half were administered the MSLQ during scheduled course times. Coding procedures were used to protect confidentiality of the responses (except in cases where students wanted feedback), and tomatch questionnaire data to achievement data (Grades and GPA) collected at the end of the semester.

Following factor analyses of the SASR, LASSI, and MSLQ using the same procedures described above, factor scores from the SASR, LASSI, and MSLQ were saved and correlated to assess the convergent and discriminate validity of the SASR factors. The SASR factor scores were also used in regression equations as predictor variables, with course Grades and GPA serving as criterion variables in separate equations. Results of all analyses were then reviewed to assess overall evidence of construct validity of ASR, as measured with the SASR. The analyses reported here constitute a small part of a larger set of analyses. Due to space limitations, a brief summary of the pilot study results is provided below, and only the main study results are reported in some detail. A full report of both studies can be obtained from the first author.

Summary of Pilot Study Results

Pre-factor and factor analyses reduced the original 17-scale, 200-item SASR down to a 6-factor, 63-item measure. The six factors were labeled *Metacognition*; *Self-Regulation*; *Personal Relevance and Control*; *Intrinsic Motivation*; *Self-Efficacy*; and *Extrinsic Motivation,* based on the items loading most strongly on each factor, and the *a priori* scales from which they came. Alpha reliabilities of the six scales ranged from .80 (*Extrinsic Motivation,* 6 items) to .88 (*Metacognition,* 15 items), with an overall alpha = .92. After eliminating multivariate outliers based on commonly used distance statistics (e.g., leverage, Student's t), results from multiple regression analyses revealed that Self-Regulation (β = .32, p < .001), Intrinsic Motivation (β = .31, p < .001), Self-Efficacy (β = .27, p < .001), and Personal Relevance and Control (β = .13, p < .05) were significant predictors of estimated GPA, with Extrinsic Motivation approaching significance (β = -.12, p = .053). However, a check of the pre- and post-regression assumptions indicated nonlinear and/or interaction relationships between the SASR factors and their relationship with estimated GPA. Therefore, more advanced analyses of nonlinear and interaction relationships wereconducted in the main study, where actual GPA and Grades were used.

Main Study Results

Descriptive Statistics

Missing data (< 1%) in the main study was handled using mean substitution and a "Not Indicated," or NI category. A total of 491 participants in the main study were distributed as follows: for Age (measured continuously and categorically), there were 135 18-19-year-olds, 107 20-year-olds, 103 21-22-year-olds, 69 23-25-year-olds, and 77 over-26-year-olds; for Gender, there were 199 males and 280 females (NI = 12); for Ethnicity, there were 395 whites and 87 persons of color (NI = 9); for Academic Major, there were 246 education, 103 computer science, 66 political science, 40 sociology, and 36 criminal justice majors; for Grade Level, there were 63 freshmen, 118 sophomores, 121 juniors, 65 seniors, and 119 graduate students (NI = 5); and lastly, for School, there were 108 private college

and 383 public university participants. Mean age of the group was 22.53 (*SD* = 5.70, *skew* = 2.76, *kurtosis* = 8.80). Participants had an average GPA of 3.08 (*SD* = 0.64, *skew* = -0.73, *kurtosis* = 0.34) and average Course Grade (GRD) of 3.27 (recoded as F = 0, A = 4; *SD* = .80, *skew* = -1.24, *kurtosis* = 1.41).

Before cross-validating (i.e., factor analyzing) the SASR in the main study, the 6 pilot study scales were assessed for internal consistency, and were found to have reliabilities ranging from α = .71 (*Extrinsic Motivation*, *k* = 6) to α = .87 (*Self-Regulation*, *k* = 13), with an overall α = .92 (*k* = 63). The LASSI and the MSLQ were also checked for internal consistency. The LASSI had reliabilities ranging from α =.62 (*Motivation*, *k* = 8) to α =.88 (*Time Management*, *k* = 8), with an overall α =.95 (10 scales, *k* = 80). The MSLQ had reliabilities ranging from α =.60 (*Help-Seeking*, *k* = 4) to α =.91 (*Task Value*, *k* = 6; and *Self-Efficacy*, *k* = 8), with an overall α =.93 (15 scales, *k* = 81).

Factor Analyses

The SASR, LASSI, and MSLQ scales were analyzed using standard factor analysis procedures. The two comparison measures–the LASSI and MSLQ–were factor analyzed for the purpose of producing valid factor scores, based on the present data, to assess convergent and discriminate validity of the SASR factors. When checking item distributions, only one item each from the SASR, LASSI, and MSLQ had skew values in excess of a preferred ±2.0 criterion; in the context of so many items, they were deemed to have little influence on the factor analyses.

Pre-factor analysis statistics for the three ASR measures were as follows: the SASR (*N* = 491, *k* =63) had an overall *KMO* = .913, an individual item *KMO* range of .717 to .955, an inverse correlation matrix with mostly small, negative, partial correlation coefficients, and items that possessed multivariate normality (*Bartlett's Test* χ^2 = 12335.89, *df* = 1953, *p*<.001). The LASSI (*n* = 253, *k* = 80) had an overall *KMO* = .876, an individual item *KMO* range of .719 to .942, an inverse correlation matrix with mostly small, negative, partial correlation coefficients, and items that possessed multivariate normality (*Bartlett's Test* χ^2 = 11915.44, *df* = 3160, *p*< .001). The MSLQ (*n* = 237, *k* = 81) had an overall *KMO* = .847, an individual item *KMO* range of .625 to .956, an inverse correlation matrix with mostly small, negative, partial correlation coefficients, and items possessed multivariate normality (*Bartlett's Test* χ^2 = 11738.17, *df* = 3240, *p*< .001).

Examination of scree plots (principal components, no rotation) indicated that six SASR factors, seven LASSI factors, and eight MSLQ factors should be extracted. Various factor extractions (varimax rotation) were compared for simple structure, while also extracting plus and minus one factor from what was suggested by the scree plots. All SASR items loaded on at least one factor, and although some "item swapping" across factors occurred between the pilot and main studies, all SASR factors retained the majority of their original items. Atotal of seven LASSI and three MSLQ items failed to load on any extracted factor above a .316 factor loading (10% of variance explained). It was also difficult to name the LASSI and MSLQ factors in parallel with the SASR factors because of the different theoretical and a priori scale structures of the former instruments after which the factors were

named. Nevertheless, the items from all three instruments were similar in content. Table 1 contains the factor score correlations computed for the multitrait-unimethod matrix used to compare the SASR to the LASSI and the MSLQ.

Table 1
Multitrait Matrix of SASR, LASSI, and MSLQ Anderson-Rubin (A-R) Factor Scores[ab]

LASSI and MSLQ	SASR A-R Factors					
A-R Factor Scores	META	SR	PRC	INTR	SE	EXTR
LASSI SMI	.01	.27**	.23**	.03	.40**	-.06
LASSI SR	.40**	.28**	-.27**	.27**	.07	.14*
LASSI INTR	.24**	.59**	.12	.01	-.03	.01
LASSI SE	-.06	-.09	-.02	.06	.60**	.07
LASSI INP	.24**	-.18**	.49**	.22**	-.02	.03
LASSI ATT	-.09	-.16*	.18**	.43**	-.15*	.10
LASSI SFT	.39**	-.01	.11	.03	-.02	-.16*
MSLQ SR	.46**	.61**	-.16*	.20**	-.01	.02
MSLQ CRIT	.34**	-.25**	.24**	.17*	.10	.04
MSLQ SE	.01	.14*	.36**	.04	.33**	-.15*
MSLQ TV	-.01	.15*	.11	.31**	-.14*	.03
MSLQ EXANX	.17*	-.19**	-.21**	-.04	-.55**	-.39**
MSLQ PEER	.11	.10	-.07	.00	-.08	-.06
MSLQ COG	.20**	.17**	.06	-.18**	-.01	-.04
MSLQ CTRL	-.04	.02	.30**	.13*	.03	-.05

Note. Scale abbreviations can be found in the previous table (Table 5).
[a] SASR N = 491; LASSI n = 253; MSLQ n = 237. [b] Boxed correlations represent the highest correlations between each SASR *A-R* factor score and the others from the LASSI and MSLQ.
[b] *A-R* factor scores within measures are uncorrelated (r = 0.00), andare omitted for clarity.
* $p < .05$. ** $p < .01$.

Although not immediately obvious due to the mismatch in nomenclature of the factors across the three measures, convergence (similar scales across different measures correlating well) is represented by the following factor score correlations because the factors contain similar items: SASR *Metacognition*x LASSI and MSLQ *Self-Regulation*; SASR *Self-Regulation* x LASSI *Intrinsic Motivation*; SASR *Personal Relevance and Control* x MSLQ *Self-Efficacy*; and SASR *Intrinsic Motivation* x MSLQ *Task Value*. The strong correlations between SASR *Metacognition* and LASSI and MSLQ *Self-Regulation* appear contradictory, but are not; SASR *Metacognition* contains strictly metacognitive or thinking items, whereas *Self-Regulation* from the LASSI and MSLQ combine thinking and regulatory behavior items. This also explains why SASR *Metacognition* also correlated well with LASSI *Self-Testing* and MSLQ *Critical Thinking*, all "thinking"

factors. Convergence was more direct through the following correlations: SASR *Intrinsic Motivation* x LASSI *Attitude*; SASR *Self-Efficacy* x LASSI and MSLQ *Self-Efficacy*; SASR *Self-Regulation* x MSLQ *Self-Regulation*; and SASR *Extrinsic Motivation* x MSLQ *Extrinsic Anxiety* (the negative correlation occurred because of opposing scoring schemes). Discrimination is indicated by several lower or non-existent correlations between dissimilar scales across measures.

Multiple Regressions using GPA and Grades

To assess criterion validity, the SASR *A-R* factor scores were regressed onto GPA and Grades in separate equations. Pre- and post-regression assumption checks indicated the need for independent variable transformations, which were made after multivariate outliers were removed. Curve estimation was used in conjunction with the bivariate and residual scatter plots to determine transformations. Table 2 contains the combined results for these linear (original) and polynomial/interaction (specified) regressions.

Table 2
Standardized Regression Coefficients from Linear (l) and Polynomial/Interaction (p/i)

Regressions of SASR A-R Factor Scores on GPA and Grades (separate equations)

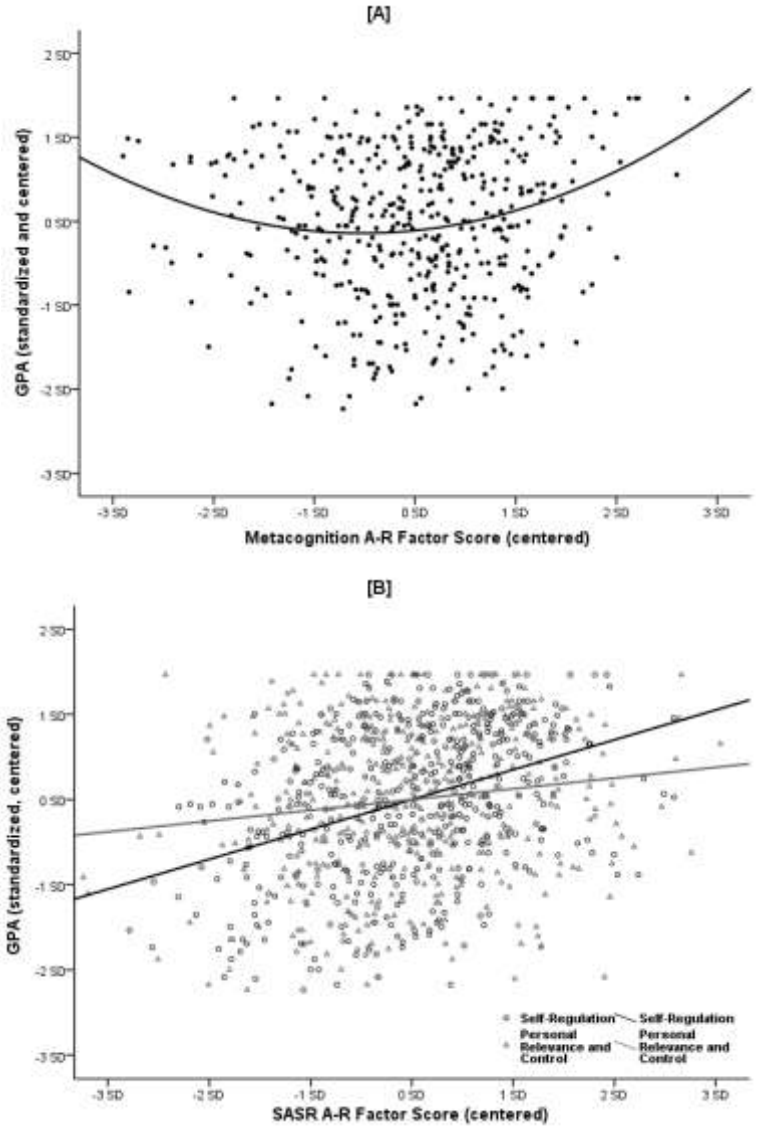
SASR *A-R* Factor Scores	GPA as criterion		Grades as criterion	
p/i terms	β (l)[a]	β (p/i)[b]	β (l)[c]	β (p/i)[d]
Metacognition (META)	.09*	.10*	--	--
META^2	--	.10*	--	--
Self-Regulation (SR)	.35***	.36***	.32***	.46***
SR^2	--	-.08*	--	-.01
SR^3	--	--	--	-.16*
Personal Relevance & Control (PRC)	.14***	.12**	.09*	.08
PRC^2	--	--	--	.09*
Intrinsic Motivation (INTR)	.19***	.18***	.09*	.11*
INTR^2	--	--	--	.12**
Self-Efficacy (SE)	.23***	.22***	.15***	.14**
Extrinsic Motivation (EXTR)	--	.11	--	--
EXTR^2	--	.03	--	--
EXTR^3	--	-.19*	--	--
SR x PRC (interaction)	--	-.16***	--	--
PRC x INTR (interaction)	--	.09*	--	--
SE x EXTR (interaction)	--	.09*	--	--

[a] $R^2/Adj.R^2$ = .25/.24, SE_E = .79, $F_{5, 468}$ = 21.78, p< .001. [b] $R^2/Adj.R^2$ = .32/.30, SE_E= .75, $F_{13, 456}$ = 16.11, p< .001. [c] $R^2/Adj.R^2$ = .15/.14, SE_E= .80, $F_{4, 469}$ = 20.47, p< .001. [d] $R^2/Adj.R^2$ = .16/.15, SE_E= .79, $F_{8, 457}$ = 11.14, p< .001.
*p< .05. **p< .01. ***p< .001.

The respecified (polynomial/interaction) model accounted for significantly more variance in GPA (F_{INC}-5.54, df = 7, 450, p< .01) than the original (linear)

model. Results were somewhat different when Grades served as the criterion: there were three significant polynomial predictors, one significant linear predictor, and no significant interaction terms. Here, too, the respecified model accounted for more variance in Grades than the original model (F_{INC}-3.52, df = 4, 453, p < .01). As an example of the curvilinear and interaction relationships found in the regression of GPA on the SASR *A-R* factor scores, Figure 1 contains the scatter plots for the relationship between *Metacognition*^{2} and GPA, as well as the interaction between *Self-Regulation* and *Personal Relevance and Control*.

Figure 1. Scatterplots of [A] quadratic relationship between Metacognition and GPA, and [B] interaction between Self-Regulation and Personal Relevance and Control, from respecified model of GPA regressed on SASR A-R factor scores (standardized, centered variables).

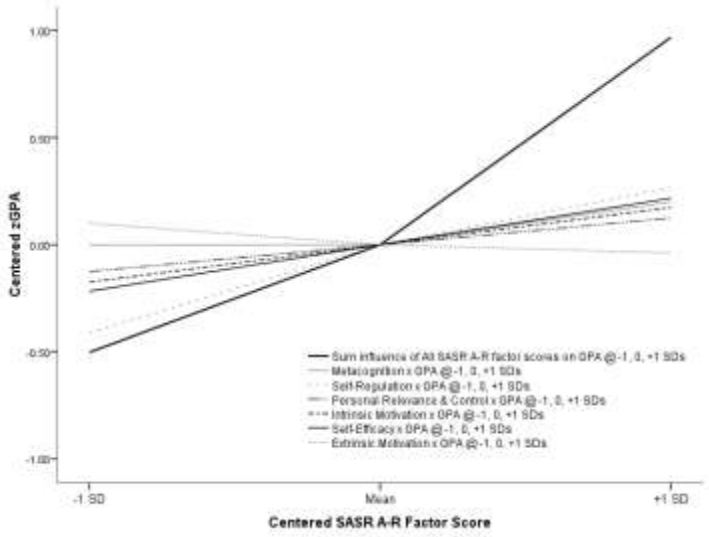


The curvilinear relationship between *Metacognition* and GPA (Figure 1A) is indicated by a negative slope (<1*SD* Metacognition) followed by a positive slope (> 0 *SD* Metacognition). The interaction between *Self-Regulation* and *Personal Relevance and Control* (Figure 1B) is indicated by the significantly more positive relationship between GPA and *Self-Regulation* than between GPA and *Personal Relevance and Control*. Together, these plots are representative of the complex relationships found between ASR and achievement, as measured with the SASR.

Simultaneous Consideration of Linear, Polynomial, and Interaction Predictors

As no precedent exists for the simultaneous consideration of predictors in a complex regression equation (cf., Cohen et al., 2003), an overlaid line graph showing the independent relationships between each predictor-criterion, in the context of the other predictors, was produced for the respecified models. These graphs were produced by plotting the relationships at low (-1SD), moderate (0 *SD*), and high (1SD) values of the individual predictors. Figure 2 contains the overlaid line graph for the respecified regression of GPA on the SASR *A-R* factors.

Figure 2.Overlaid line graph of predictor-criterion relationships from polynomial/interaction regression of GPA on SASR A-R factor scores (all variables centered and standardized).



The combined influence of the significant, linear, polynomial, and interaction predictors on GPA is represented by the thick, solid black line in Figure 2, which is visibly greater than the influence of the individual predictors. The significant quadratic relationships are indicated by the deviation in slopes at values above the mean of the respective predictors, whereas the significant linear relationships are represented by straight lines. The cubic relationship from this regression is not visible because of plotting the relationship at only three data points.

The graph representing the relationships from the respecified model of Grades on the SASR *A*-R factors was similar in appearance.

Discussion

To better explore the validity of an over-expansive ASR construct, the SASR was developed, pilot tested, and administered to a large sample of college students, and then analyzed. Factor and reliability analyses established six independent and reliable scales within the SASR when pilot-tested, which were cross-validated in the main study. The validated scales included *Metacognition*, *Self-Regulation*, *Personal Relevance and Control*, *Intrinsic Motivation*, *Self-Efficacy*, and *Extrinsic Motivation*. Item swapping between factors across the pilot and main studies did occur, with *Personal Relevance and Control* the most differentiated, but all factors retained the majority of their original items, with the other five factors faring quite well.

After similarly factor analyzing two comparison measures of ASR–the LASSI and MSLQ–a multitrait-unimethod matrix was constructed to establish evidence of convergent and discriminant validity for the SASR factors. Limited by documented structural and psychometric issues with the comparison instruments(e.g., Bong & Hocevar, 2002; Buyukazturk et al., 2004; Cano, 2006; Entwistle & McCune, 2004; Melancon, 2002; Prevatt et al., 2006; Rao & Sachs; 1999; Stevens & Tallent-Runnels, 2004), these validities were not readily apparent but wereneverthless supported by appropriate correlations between factor scores from the three measures. Most problematic were moderate, convergent correlations between *Metacognition* and *Self-Regulation* across the measures, a previously established finding (Schraw, 2000), but the evidence was stronger for the remaining SASR factors. Future research will reveal if the independent *Metacognition* and *Self-Regulation* factors for the SASR hold up.

Scores from the SASR factors were then used in regression analyses using achievement outcomes (Grades and GPA) as criterion variables, and the factor scores as predictor variables. These predictive relationships were more complex than previous research would suggest(e.g., Dahl et al., 2005; Hativa & Birenbaum, 2000; Howey, 1999; Karabenick, 2004; Lopez, 2000; Pintrich & De Groot, 1990; Wolters & Pintrich, 1998). For example, *Metacognition* was found to have a u-shaped (quadratic) relationship, *Self-Regulation*an inverted-u (quadratic) relationship, and *Extrinsic Motivation*a significant cubic relationship with GPA, and significant interaction predictors from this regression included *Self-Regulation* by *Personal Relevance and Control*, *Personal Relevance and Control* by *Intrinsic Motivation*, and *Self-Efficacy* by *Extrinsic Motivation*. Additionally, the combined, significant, linear and nonlinear predictors accounted for more variance in GPA than in Grades, which suggests a more general, versus context-specific, nature to ASR, as measured with the SASR.

Research Limitations

Certain limitations apply to this research. First, the LASSI and MSLQ, previously criticized for their psychometric issues (e.g., Blackwell, 1992; Gable, 1998; Prevatt et al., 2006), are limited comparison measures, albeit the most widely used and comprehensive instruments available. A second limitation is the homogeneous sample used, which was comprised of mostly middle-class white students enrolled in education majors. And lastly, there are known limitations to the use of self-report questionnaires (e.g., socially desirable responses), which apply to the three measures used here. It remains for replications of this research to judge whether or not these limitations seriously affected the findings.

Implications for Theory, Research, and Practice

In regards to theory, this research supports previous research (e.g., Bong & Hocevar, 2002; Stevens & Tallent-Runnels, 2004) that has found that ASR is comprised of fewer components than usually theorized – seven for the LASSI, eight for the MSLQ, and six for the SASR. Thus, serious consideration should be given to revising long-standing theories on ASR, especially those that are the foundation of the development of the LASSI and MSLQ, given the recent and previous empirical evidence. If existing theories of ASR are to be revised, the complex relationships between ASR and achievement found here should also be considered.

The theoretical implications of this research require continuing research on ASR, specifically using the SASR. This research should be conducted in a variety of contexts with more diverse samples. In addition to attempting to cross validate the factor structure of the SASR, and the complex relationships found between ASR and achievement, future research could also examine the relationship between ASR and other variables, such as motivation. Doing so would help researchers better understand the construct of ASR which, in turn would allow for the development of more reliable and valid measures of the construct, perhaps using different methodologies. If practitioners have more psychometrically sound measures at their disposal, they will more accurately identify and remediate a lack of ASR skills in students when they truly exist.

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