

LASSI: An Australian evaluation of an enduring study skills assessment tool

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This study assesses the reliability and validity of the Learning and Study Strategies Inventory (LASSI), an American survey instrument, in an Australian context. The results of this study were compared with those generated by a comparison study held at a different Australian university and also against other internationally published research. There was a high degree of similarity between the LASSI scores from the students at the two Australian universities, however these scores were considerably different from norms published in the LASSI manual. The students' scores in this study were also compared with data on their gender and age and the analysis demonstrated significant differences in both instances. A comparison of the results from this research against its earlier companion study suggests a degree of test-retest reliability for the LASSI instrument in the Australian undergraduate context in which the studies were conducted. However, a principal component analysis of the data in this study raises questions about the validity of the LASSI as a measure of students' study skills and learning strategies.

Key Words: LASSI, learning and study strategies, Bradley students.

1. Introduction

This paper investigates aspects of the reliability and validity, in an Australian context, of the Learning and Study Strategies Inventory (LASSI), an American questionnaire designed to evaluate the study skills of university students. The study analyses the LASSI scores of an Australian undergraduate cohort and compares these results with data from an earlier companion study (Carpenter, Dearlove, & Marland, 2015). The two studies tested comparable cohorts from two medium-sized universities in New South Wales, Australia.

The earlier companion study to this research discussed the collective study skills profile provided by the LASSI of an Australian undergraduate cohort in the first weeks of university studies in the context of the broadening of the Australian undergraduate population mandated by the Bradley Review (Bradley, Noonan, Nugent, & Scales, 2008). The potential value of a tool that promises to provide a valid and reliable snapshot of students' learning strategies is clear. This study extends the focus of the companion study on the preparedness of first-year undergraduates in the current demand-driven enrolment system by providing comparative data captured at a similar university. This study also recognises that the considerable potential value of information relating to student profiles provided by survey instruments such as the LASSI depends on the confidence users may reasonably place in the consistency of each survey's results, and its effectiveness in measuring what the survey claims to measure. Our study makes a particular contribution to research on the LASSI as the first investigation to critically examine the instrument's use with Australian undergraduate students.

Instruments designed to test students for predictive, diagnostic and intervention purposes as well as for the evaluation of interventions (using pre-test, post-test designs) are widespread in the United States. The majority of the widely-used American tests were developed by educational psychologists and focus on psychological characteristics such as attitudes, personality traits and behaviours. A minority of instruments measure competence in language use or critical thinking.

Most of the instruments in common use measure students' affective, behavioural and cognitive approaches to study and do this at different points in their enrolments to evaluate their strengths and weaknesses. For example, a number of instruments are used for early (orientation week) prediction of potential difficulties with their studies. These include: the Student Readiness Inventory (SRI) (Southern Illinois University Board of Trustees, 2014); the College Success Factors Index (Cengage Learning Incorporated, 2012); the College Student Inventory (Noel-Levitz, 1998-2014); the Transition to College Inventory (Pickering, Calliotte, Macera, & Zerwas, 2005, p. 2); the EQ-I (Multi-Health Systems Inc., 2004-2014); and the Anticipated Student Adaptation to College Questionnaire (Beyers & Goossens, 2002). In addition to instruments designed to predict academic success, some are designed to diagnose strengths and weaknesses, and these instruments usually provide more information than those intended solely for prediction. Examples include: the Motivated Strategies for Learning Questionnaire (MSLQ) (Artino, n.d.); and the Study Behavior Inventory (SBI) (Bliss, 2003). There are also a number of instruments (Wabash College, 2013) that are normally used to measure academic outcomes and experiences later in students' careers than the predictive instruments, such as: the Collegiate Assessment of Academic Proficiency (CAAP); the Miville-Guzman Universality-Diversity Scale (M-GUDS); the Socially Responsible Leadership Scale (SRLS-R2); the Ryff Scales of Psychological Well-Being; and the National Survey of Student Engagement (NSSE).

The Learning and Study Skills Instrument (LASSI) is an example of an instrument designed to diagnose strengths and weaknesses, and as a diagnosis of weakness implies a prediction of difficulty, it is also used for predictive purposes. The widespread use of the LASSI in the United States to guide decisions on the provision of academic support services is of particular significance to the readers of this journal, in a Higher Education environment that places increasing emphasis on the "objective" demonstration of educational outcomes (Marginson, 2009). Similarly significant is the established role the LASSI has played in the evaluation of the educational interventions provided by academic support services.

2. LASSI

The LASSI is designed to provide diagnostic information to inform interventions (by students or institutions) to improve academic outcomes, and like other instruments of this kind, it is sometimes also used for predictive or evaluative purposes. The focus of the LASSI is on individual students' cognitive, behavioural and attitudinal approaches to their studies. The LASSI is an established, norm-referenced instrument that has been used and studied in a number of countries, and there are therefore data for the comparison of LASSI scores across universities and countries (Olaussen & Braten, 1998; Braten & Olaussen, 1998; Melancon, 2002; Flowers, 2003; Yip & Chung, 2005; Cano, 2006; Marrs, Sigler, & Hayes, 2009; Ola, Morakinyo, & Adewuya, 2009; Ning & Downing, 2010; Prevatt, Petscher, Proctor, Hurst, & Adams, 2006; Bender & Garner, 2010; Carson, 2011; Flowers, Bridges, & Moore, 2011).

The LASSI (Version One) was developed in 1987 and revised in 2002 (Version Two). Version Two was norm-referenced against the scores of 1,092 American undergraduate students and included individuals of both sexes and a range of ethnicities and ages (Weinstein & Palmer, 2002, p. 18); however, the developers of the instrument do not provide the dates of the norming tests, so the currency of the data is difficult to evaluate. The reliability and validity of Version One, the precursor of the version used in this study, has been the object of a number of investigations. In his 2006 study, Cano concluded that three latent constructs (namely "Affective

Strategies”, “Goal Strategies” and “Comprehension Monitoring Strategies”) underlie the ten subscales in the LASSI Version One (see Table 1).

Table 1. Scale/descriptors for the LASSI from Weinstein, Palmer, and Schulte (2002, p. 13).

Scale	Description
ANX	Anxiety and worry about school performance
ATT	Attitude and interest
CON	Concentration and attention to academic tasks
INP	Information processing, acquiring knowledge, and reasoning
MOT	Motivation, diligence, self-discipline, and willingness to work hard
SFT	Self-testing, reviewing, and preparing for classes
SMI	Selecting main ideas and recognizing important information
STA	Use of support techniques and materials
TMT	Use of time management principles for academic tasks
TST	Test strategies and preparing for tests

The developers of Version Two have presented the revised instrument as having an underlying structure of three factors, which they designated “Skill”, “Will” and “Self-regulation”. However, this particular three-factor structure was not empirically tested and does not align with the three factors reported in other research (Olaussen & Braten, 1998; Cano, 2006; see also Melancon, 2002). In the revised version of the LASSI, the original 77 items were extended to 80 – eight per subscale and a substantial number of these (42) were new items. This revised LASSI instrument replicated the ten subscales of Version One. These scales and their reliability measures are reported by Weinstein and Palmer (2002) as indicated in Table 2.

Table 2. Reliability measures for LASSI as reported by Weinstein and Palmer (2002, pp. 4-6).

Subscale	Cronbach’s alpha	Component
Information processing	.84	Skills
Selecting main ideas	.89	Skills
Test strategies	.80	Skills
Anxiety	.87	Will
Attitude	.77	Will
Motivation	.84	Will
Concentration	.86	Self-Regulation
Time management	.85	Self-Regulation
Study aids	.73	Self-Regulation
Self-testing	.84	Self-Regulation

The use of these ten subscales to evaluate students’ learning strategies is premised on the assumption that student success is primarily a function of individual cognitive skills and attitudes. It should be noted that scholarship on this area has broadened to include relational and socially-situated analyses – referred to in the literature as “student engagement” (Kuh, Cruce, Shoup, Kinzie, & Gonyea, 2008; Bryson & Hand, 2007; Trowler, 2010). Student engagement is based

on a constructivist view of learning and relies on the assessment of a wide variety of criteria. The LASSI focuses on that part of student engagement that is specifically associated with a student's agency and their approaches to academic tasks.

3. Methods

The study analysed test scores from 223 students at a Sydney campus of a regional university to evaluate the LASSI.

3.1. Research questions

1. What scores were obtained by the current Australian undergraduate cohort on the LASSI, and how do these results compare with:
 - the scores recently obtained in a study of another Australian undergraduate cohort, and
 - the published American norms for the LASSI?
2. Do the LASSI scores of the present cohort differ by gender and age?
3. What is the reliability of the LASSI subscales for this cohort?
4. What validity do the LASSI subscales have for this cohort?

3.2. Participants

The data on LASSI scores were gathered from a census (population) sample of undergraduate students enrolled at a satellite site of a regional university in New South Wales. The sample comprised 223 students, 82 (36.8%) male and 141 (63.2%) female; 85 (38.5%) first-year students, 72 (32.6%) second-year students, 51 (23.1%) third-year students, and 13 (5.9%) fourth- and fifth-year students. This study follows the traditional division in research on student study skills of a student cohort into two genders. The participants were also divided into two groups according to their ages – those less than 20 years old (17 years: 1.4% $n = 3$; 18 years: 17.1% $n = 38$; 19 years: 18.5% $n = 41$), and those 20 years or older (63.1% $n = 140$), with the oldest recorded age being 55 (n.b.: one student failed to specify age). The students were enrolled in the following bachelor degrees: Commerce: 55.7% ($n = 122$); Nursing: 38.8% ($n = 85$); Business: 3.7% ($n = 8$); other degrees: 1.9% ($n = 4$) (n.b.: four students failed to specify the degree courses in which they were enrolled).

3.3. Site

The site of this study is located in a relatively affluent suburb of Sydney described by Baum, O'Connor, and Stimson (2005) as socio-economically secure. The area has: "high salaries", "more high than low income households", "higher proportions of educated professionals", "low unemployment" (Baum, O'Connor, & Stimson, 2005, p. 68) and is comfortable and "advanced" (Baum, O'Connor, & Stimson, 2005, p. 67).

This study is a companion study to that conducted by Carpenter, Dearlove, and Marland (2015) at a different university's Sydney campus, whose location is described by Baum, O'Connor, and Stimson (2005) as having similar demographics.

3.4. Procedure

The students were approached at the beginning or end of their core tutorials in week three of first semester 2013 and received explanations about the research. No inducements were used and participation was voluntary, with students completing the inventory anonymously and returning them at the time. They also provided information on their sex, age, year of enrolment and the degree in which they were enrolled.

3.5. Method of analysis

The inventories were scored and the calculated scores were entered into an Excel spreadsheet. This was imported into SPSS v19 and the data were analysed using descriptive and inferential

statistics. The results were compared against the published norms, the companion study and other related literature.

4. Results and Discussion

4.1. LASSI scores

The mean scores (see Table 3) of the two Australian undergraduate cohorts across the ten subscales of the LASSI were remarkably similar (Carpenter, Dearlove, & Marland, 2015), suggesting a high degree of test-retest reliability (see discussion in Sub-section 4.3). In Table 4, these mean scores are superimposed as line graphs on the LASSI scoring chart reproduced in Table 1 of the LASSI Inventory (Version Two) (Weinstein, Palmer, & Shulte, 2002).

The mean LASSI scores of the two Australian undergraduate groups in all but one instance fall at or below the 50th percentile ranking given in the American LASSI norms (Weinstein & Palmer, 2002). The scores of the Australian cohorts suggest that both cohorts' learning and study skills are relatively (and similarly) weak, when assessed against the norms published by the LASSI. However, these low scores may indicate that the American norms are not culturally appropriate in the Australian context or may be an artefact of the size of the samples used. The two Australian studies were undertaken on samples from similar universities and it would be important to carry out further research using samples from a wider range of Australian universities to provide a more representative analysis.

Table 3. Mean scores and standard deviation of the participant group on the LASSI instrument.

Subscale	ANX	ATT	CON	INP	MOT	SFT	SMI	STA	TMT	TST
Mean [Solid line]	25.00	29.76	24.21	28.12	28.66	23.78	27.32	24.55	23.85	27.61
Std Deviation	7.642	5.002	5.848	5.385	5.560	5.270	5.745	5.502	6.310	5.362
Study 1 Mean [Dotted line]	24.02	29.66	25.73	27.68	28.81	24.45	28.24	24.46	23.25	27.70

4.2. Scores by gender

As Table 5 shows, the mean scores of the two genders in the current research cohort were significantly different in six of the LASSI subscales, namely Anxiety, Attitude, Motivation, Use of Study Aids, Self-Testing Activities, and Time Management. On all of the subscales for which there was a significant difference, women achieved a higher score than men, with the exception of Anxiety. The lower Anxiety score recorded by the female students indicates greater levels of anxiety according to the LASSI. However, evaluating LASSI in terms of Anxiety is complex as higher levels of Anxiety could be either beneficial or detrimental to students. As Downing, Chan, Downing, Kwong, and Lam (2008) have noted: “[D]epending upon the degree of anxiety experienced by female students, this could either improve academic performance by maintaining optimum levels of stress for most efficient functioning or damage performance by exceeding these levels and so become a debilitating factor” (p. 13). In both Australian cohorts, males were significantly less anxious than females and this is consistent with international studies conducted in other countries using both Version One and Version Two of the LASSI (Bråten & Olaussen, 1998 [Version One, Norway]; Agar & Knopfmacher, 1995 [Version One, South Africa]; Downing et al, 2008 [Version Two, Hong Kong]; Bender & Garner, 2010 [Version Two, USA]).

Table 4. Mean scores of this study's participant group (solid line) compared with mean scores from a recent Australian companion study (dotted line) superimposed on the LASSI scoring chart with American norms (the norms include those scores which fall between the shaded sections on the table).

Percentiles	ANX	ATT	CON	INP	MOT	SFT	SMI	STA	TMT	TST	Percentiles
99	40	40	40	40	40	40	40	38	40	40	99
95	37	39	37	38	39	36	38	35	37	38	95
90	35	-	35	35	38	33	37	33	35	36	90
85	33	38	34	34	37	31	35	32	33	35	85
80	32	37	33	33	36	30	34	30	32	34	80
75	31	-	32	31	-	29	33	29	31	33	75
70	30	36	31	30	35	28	32	-	30	32	70
65	29	-	30	-	34	27	31	28	29	-	65
60	28	35	29	29	33	26	30	27	28	31	60
55	27	-	-	28	-	-	29	26	27	30	55
50	26	34	28	27	32	25	-	-	-	-	50
45	25	-	27	-	31	24	28	25	26	29	45
40	24	33	26	26	30	23	27	24	25	28	40
35	23	-	25	25	28	22	26	-	24	27	35
30	22	32	24	24	27	-	25	23	23	27	30
25	21	-	23	-	28	21	24	22	22	26	25
20	20	31	22	23	27	20	23	21	21	25	20
15	18	30	21	22	26	19	22	20	20	24	15
10	17	28	19	21	24	17	21	19	18	23	10
5	14	26	17	19	22	15	18	17	16	21	5
1	10	21	13	15	18	12	13	13	12	18	1

Table 5. Mean scores of the participant groups on the LASSI instrument by gender.

	ANX	ATT	CON	INP	MOT	SFT	SMI	STA	TMT	TST
Male	26.60	28.57	23.34	27.68	27.56	22.66	27.38	22.63	22.44	28.02
Female	24.07	30.45	24.72	28.38	29.30	24.43	27.29	25.66	24.67	27.38
<i>p</i>	.016*	.007*	.088	.367	.019*	.040*	.914	.000*	.009*	.369
Effect size**	0.336	0.380	0.238	0.128	0.322	0.285	0.016	0.563	0.362	0.121

* Indicates significance at the 0.05 level using a t-test.

** Cohen's *d*, a measure of the influence of gender regardless of the size of each of the groups (small effect = 0.2, medium effect = 0.5; large effect 0.8).

A comparison of the published findings on gender differences on the LASSI subscales overall reveals a complex picture without any definite trend emerging. In the majority of studies, females outperform males, but the scales on which the differences were found and the level of significance for these differences vary considerably between studies, and also between national cohorts. This variability suggests that gender may not be a strong predictor of performance on individual LASSI subscales. Even in the results of this and the companion study, both of which have been conducted in the Australian context, there was a large variation between the levels of significance of difference between the genders on the different individual subscales.

4.3. Scores by age

On the five subscales (Concentration, Motivation, Study Aids, Time Management, and Test Strategies) on which there was a significant difference between participants in different age groups, the older participants (students aged 20 or older) scored significantly higher scores than younger students (students aged 17-19) (see Table 6). This contrasts with the companion study that identified significant differences on only two subscales (Attention and Study Aids). Again the older students recorded higher scores than the younger students. Differences in LASSI scores between students in different age groups have received only limited research attention. However, Braten, & Olaussen (1998), using Version One, found that older students scored significantly higher on Information Processing and younger students scored significantly higher on Study Aids. The paucity of information on age differences makes it very difficult to form firm conclusions other than that there is a need to extend research in this area. The variation across these three studies continues the trend of variations between study results reported in relation to gender above.

Table 6. Mean scores of the participant groups on the LASSI instrument by age.

	ANX	ATT	CON	INP	MOT	SFT	SMI	STA	TMT	TST
17-19	23.77	28.99	22.59	27.85	27.46	23.00	26.50	23.35	21.51	26.44
20+	25.76	30.23	25.16	28.25	29.36	24.22	27.88	25.20	25.22	28.34
<i>p</i>	.069	.066	.001*	.590	.014*	.149	.081	.011*	.000*	.011*
Effect size**	0.258	0.253	0.455	0.075	0.345	0.197	0.242	0.348	0.615	0.360

* Indicates statistical significance between the two age groups at the 0.05 level using a t-test.

** Cohen's *d*, a measure of the influence of age regardless of the size of each of the groups (small effect = 0.2, medium effect = 0.5; large effect 0.8).

4.3. Reliability

The reliability of the LASSI instrument was assessed by comparing the results of the companion study to the results of this current study and by means of Cronbach's alpha, providing an indicator of parallel form reliability (Changing Works, 2002-2015; Trochim, 2006). Cronbach's alpha

is a statistical measure of the extent to which the items in each subscale are measuring the same constructs, that is the homogeneity of the scale's items (Henson, 2001). While the participants of each study were different, it was assumed that the cohorts of first-year undergraduate students under the demand-driven enrolment system in universities of similar standing and of similar geographical and socioeconomic locations were sufficiently alike to allow the results to be considered a measure of test-retest reliability. This measure of reliability appears to be high as the scores of this research cohort and the companion study cohort for each of the ten subscales diverge from each other by more than one mark on only one subscale (and by less than 1.75 in that case), and diverge by less than .5 on five of the LASSI subscales. The differences between the two cohorts are significant only on the subscale of Concentration ($r = 0.016$).

The descriptive and internal consistency analyses are presented below. Cronbach's alpha score across the ten subscales was .853, which indicates strong internal cohesion.¹ When each subscale was in turn excluded from the calculation of Cronbach's alpha, the exclusion of each of the subscales (with the exception of Anxiety) lowered the Cronbach alpha score, indicating that these nine subscales added reliability to the instrument overall (see Table 7 below). This suggests that the subscales are each measuring an underlying construct that is well represented by the items in each subscale and that these subscales are also related to each other, that is, measuring a similar or related phenomenon, although some doubt remains in relation to the use of the Anxiety subscale in this cohort. As the reliability score without Anxiety is higher than the score with Anxiety, it seems that the Anxiety subscale is detracting from the overall reliability of the Inventory in this cohort.

Table 7. Item-total statistics.

Subscale	Scale mean if item deleted	Scale variance if item deleted	Corrected item-total correction	Squared multiple correlation	Cronbach's alpha if item deleted
ANX	237.87	1277.672	.307	.400	.869
ATT	233.11	1266.785	.595	.427	.838
CON	238.66	1165.433	.761	.692	.821
INP	234.75	1284.486	.493	.408	.845
MOT	234.21	1214.858	.665	.526	.831
SFT	239.09	1217.046	.565	.519	.839
SMI	235.55	1224.717	.612	.540	.835
STA	238.32	1308.148	.415	.412	.851
TMT	239.02	1165.423	.693	.647	.827
TST	235.26	1253.200	.584	.541	.838

The inter-item correlations (see Table 8 below) further cloud the interpretation of scores on the Anxiety subscale. Half of the inter-item correlations with the Anxiety subscale are below .300 and one is negative, suggesting that the items on the Anxiety subscale are measuring phenomena unrelated (Kline, 1979) to those five subscales (INP, MOT, SFT, STA, TMT).

¹ While there is no definitive Cronbach's alpha score that indicates reliability in all situations, a score of .8 is generally considered to be quite high (Cano, 2006).

Table 8. Inter-item correlation matrix.

Subscale	ANX	ATT	CON	INP	MOT	SFT	SMI	STA	TMT	TST
ANX	1.000	.244	.339	.104	.131	.016	.516	-.129	.196	.538
ATT	.244	1.000	.580	.363	.529	.318	.375	.306	.465	.420
CON	.339	.580	1.000	.318	.589	.449	.545	.375	.752	.515
INP	.104	.363	.318	1.000	.470	.566	.301	.402	.325	.193
MOT	.131	.529	.589	.470	1.000	.522	.366	.443	.607	.359
SFT	.016	.318	.449	.566	.522	1.000	.313	.541	.520	.256
SMI	.516	.375	.545	.301	.366	.313	1.000	.154	.385	.654
STA	-.129	.306	.375	.402	.443	.541	.154	1.000	.471	.076
TMT	.196	.465	.752	.325	.607	.520	.385	.471	1.000	.417
TST	.538	.420	.515	.193	.359	.256	.654	.076	.417	1.000

5. Validity

Principal component analyses are useful for isolating unrelated variables (called principal components) from a set of data. A principal component analysis (see Table 9) provided a three-factor solution which accounts for 71.581% of the variance. This type of analysis was employed to replicate the method used in Cano's 2006 study of the validity of LASSI Version One.

Table 9. Total variance explained.

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	4.568	45.685	45.685	4.568	45.685	45.685	4.020
2	1.765	17.652	63.337	1.765	17.652	63.337	2.454
3	.824	8.244	71.581	.824	8.244	71.581	2.755
4	.650	6.500	78.081				
5	.482	4.818	82.899				
6	.458	4.584	87.483				
7	.381	3.806	91.289				
8	.362	3.616	94.906				
9	.310	3.097	98.002				
10	.200	1.998	100.000				

The pattern matrix (see Table 10) shows which of the subscales combined to form each of the three factors which emerged from the principal component analysis. The first factor accounts for 45.685% of the variance, the second factor accounts for 17.652% and the third for 8.244%. The eigenvalues are less than one on the first two factors, suggesting a two-factor solution is also possible. However, the subscales divide more distinctly into a three-factor solution.

This study's three-factor solution sits alongside several other studies which have also identified three-factor solutions from factor analyses of the LASSI subscales for both Versions One and Two of the inventory. While the studies consistently identified three-factor solutions, the subscales which comprised the three factors were different in each of the studies (see Table 11 be-

low), resulting in different titles for each of the three underlying constructs identified in the studies.

Table 10. Pattern matrix.

	Component 1	Component 2	Component 3
ANX	.909	-.024	-.045
ATT	.861	.204	-.086
CON	.673	.158	-.005
INP	.663	-.008	.245
MOT	.502	-.376	.410
SFT	-.045	.867	-.008
SMI	.158	.726	.238
STA	.302	.714	.011
TMT	-.138	.154	.954
TST	.249	-.047	.707

Table 11. Comparison of factor analyses.

LASSI Version One		LASSI Version Two	
Cano's (2006) Factor Solution	Olaussen and Braten (1998)	LASSI (Weinstein & Palmer, 2002)	This Study's Factor Solutions
"Affective Strategies"	"Effort Related"	"Self-Regulation Component"	
Time management	Time management	Time management	Time management
Motivation	Motivation	Concentration	Concentration
Concentration	Concentration	Study Aids	Study aids
Attitude	Attitude	Self-Testing	Attitude
	Test Strategies		Motivation
"Goal Strategies"	"Goal Orientation"	"Will Component"	
Test strategy	Test strategies	Anxiety	Anxiety
Anxiety	Anxiety	Attitude	Selecting Main Ideas
Attitude	Attitude	Motivation	Test Strategy
	Concentration		
	Information Processing		
	Selecting Main Ideas		
"Comprehension Monitoring Strategies"	"Cognitive Activities"	"Skill Component"	
Information Processing	Information Processing	Information Processing	Information Processing
Study aids	Study Aids	Selecting Main Ideas	Self-testing
Self-testing	Self-testing	Test Strategies	
	Selecting Main Ideas		

However, it is worth noting that in all four of the three-factor solutions in the table above, Time Management and Concentration are in one factor, Anxiety is in a separate factor and Information Processing is in a third factor. These subscales, then, appear to be measuring cross-disciplinary strategies that may warrant further investigation. Given the differences between all four of the three-factor solutions and the relatively small sample used in this study, attempts to identify and name the underlying constructs represented by the three-factor solution that emerged in this study are unlikely to add substance to the scholarship in this area. Thus, it seems that the LASSI is most likely measuring three constructs, but that these constructs are not reliably identifiable individually, as different subscales relate to different constructs for different cohorts. This raises questions about the validity of the LASSI when used in various contexts. These questions have been noted by other researchers (e.g. Urciuoli & Bluestone, 2013) and are in general related to the instrument's concentration on cognitive, behavioural and attitudinal approaches to learning in isolation from individual, national or disciplinary educational contexts.

At the level of the individual student, some of the items in the inventory do not allow students to indicate that the situation described does not, or has not, applied to them and therefore the validity of the items will be dependent on the educational context. For example, item number 20 on the LASSI states: "If there is a web site for my textbook, I use the information provided there to help me learn the material" (p. 3). This item could have been confusing for a student to whose educational context the item is not relevant and who may therefore decide to answer "not at all typical of me" or fail to respond to the item; in both cases the student's overall score would have been lowered by this response.

Further, item number 71 states: "I try to find a study partner or study group for each of my classes" (our emphasis) (p. 7). This item assumes that group study is more effective than individual study for all students. The item also insists that students form a study group for "each" class, rather than any class. When students respond with "not at all typical of me" it is unclear whether they are indicating that they never choose to study in a group or whether they selectively choose the classes for which they study in a group.

The LASSI items do not consider disciplinary context or the year of study of the respondent. The use of the LASSI to predict the future performance of university students at the time of their enrolment assumes that their completion of the inventory on the basis of their high school experience will be valid for the tertiary context. At the same time, while the LASSI may provide a useful "snapshot" of the study skills of a mature-age student returning to study after a break, these results would need to be used with particular care in predicting future outcomes. In addition, many LASSI items appear not to be designed for studies in quantitative disciplines such as mathematics.

Finally, the cultural context in which the LASSI inventory was developed and normed may limit its validity in the Australian context. The results of this study and its companion study indicate that the two Australian undergraduate cohorts are scoring similarly and lower than the American norms suggest are necessary for study success. There are many possible explanations for these results and more research is necessary to investigate these possibilities. It could be that the American norms, developed at a minimum of ten years ago, are out of date with current educational practices and produce similar results in other cohorts. The disparity in the results may for example reflect general changes in methods of content delivery, as well as modes of literacy, attention and study strategies amongst the "digital natives" of the current decade. Alternatively, the samples in the two Australian studies are not representative of all Australian undergraduate students and this may have produced these results. Finally, the norms themselves could reflect an American cultural approach to study and be suited to the American educational system, thus producing the lower results in the Australian studies.

6. Conclusion

This study has investigated the confidence that users may reasonably have in the consistency of the LASSI and in its effectiveness in measuring what it claims to measure: cognitive, behav-

journal and attitudinal study skills and strategies that are relevant to successful study in a university context. The results of this study and its earlier companion study have suggested that the LASSI has a high degree of test-retest reliability in the Australian undergraduate contexts in which the studies were conducted. However, the validity of the LASSI appears to be less certain than its reliability.

The validity of the LASSI is questionable in part as a consequence of its assumptions that study skills and strategies can be successfully measured with relatively little regard for academic discipline or extent of university experience. In this study and its companion, Australian students scored notably lower on LASSI than the (American) norms suggested are adequate for successful university study. It seems *prima facie* implausible that significantly higher numbers of Australian students would not possess sufficient study skills to succeed at university compared with their American undergraduate counterparts and this raises questions over the cultural specificity of the norms and/or the inventory items. Similarly, the failure of the LASSI items to distinguish between disciplinary contexts (especially between text-based and number-based disciplines) or lengths of university experience raises questions about the validity of the instrument.

The validity of the Inventory is further clouded by the inconsistent results of analyses attempting to confirm the three constructs (Skill, Will and Self-regulation) proposed by the Inventory's developers. While there are commonalities between the constructs identified by different research studies and those proposed by the LASSI developers, there are also dissimilarities. This means that the instrument sometimes does, and sometimes does not, reflect the underlying constructs it purports to measure.

The results of this exploratory research are limited by the size of the sample ($n = 223$), which is relatively small for the statistical analysis that has been undertaken. In addition, the sample may not be representative of the Australian higher education population. Further research is necessary to confirm these findings before this instrument can be confidently introduced or rejected for use in the wider Australian educational context. Such research could also identify useful revisions of the Inventory. For example, it would seem useful to amend the Inventory so that it aligns with reliable underlying constructs, to eliminate scales that detract from the internal reliability of the Inventory and in so doing reduce its considerable length, and to consider cultural and disciplinary contexts of student learning.

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