An Examination of Convergent and Divergent Validity On the Missouri End-of-Course Assessments

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Evidence for construct-related validity—the meaning of test scores and the inferences they support—is a central concept underlying the validation process of test scores. Convergent and divergent validity are subtypes of construct validity. Convergent validity examines the extent to which theoretically related constructs are also empirically related, while divergent validity examines the extent to which theoretically unrelated constructs are, in fact, not empirically related. In Missouri, eight end-of-course assessments are administered to students, and each of these assessments measures unique content in the fields of mathematics, English, social studies, or science. We expect that each of these assessments will measure student ability in distinct, yet related, ways. We anticipate that particular relationship patterns exist between these assessments and that these patterns can be measured empirically. This paper will pay particular attention to the divergent validity of the varying end-of-course (EOC) assessments in Missouri; however, it is difficult to study divergent validity of differing constructs without at least mentioning convergent validity between those constructs.

Theoretical Relationship Between the EOC Assessments

Eight tests comprise the Missouri EOC assessment family: English I, English II, Algebra I, Algebra II, Geometry, Biology, Government, and American History. The Algebra I, English II, and Biology EOC assessments are required of all Missouri students prior to graduation and fulfill the requirements of the No Child Left Behind act (NCLB, 2002). In addition, Missouri school districts are required to administer the Government EOC assessment to all students prior to graduation. All other EOC assessments are optional.

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When conducting a study of divergent validity, it is important to first theorize on the relationships that we expect to occur between the assessments. There are three major groups of EOC assessments: mathematics, English, and social studies. The mathematics EOC assessments are Algebra I, Algebra II, and Geometry; the social studies EOC assessments are Government and American History; and the English EOC assessments are English I and English II. We anticipate that EOC assessments within each of these groups will be more related to each other than they are with other assessments from the other groups.

There are also methodological artifacts that may artificially strengthen the relationship between EOC assessments from seemingly unrelated content areas. EOC assessments that require a good deal of reading and/or writing are probably more strongly related to English I and English II than those EOC assessments that do not. For example, the Biology assessment had an embedded performance event in 2009 and 2010 but not in 2011. We anticipate that Biology will be more related to English I and English II in 2009 and 2010 than it is in 2011 simply because of the requirements of the performance event.

Data

The data come from the Spring 2009, 2010, and 2011 operational administrations of the MAP EOC assessments. The following abbreviations are used in all tables for the EOC assessment names:

- English I: E1
- English II: E2
- Algebra I: A1
- Algebra II: A2
- Geometry: GE
- Biology: B1
- American History: AH
- Government: GV

At the strand level, the following abbreviations are used:

- R: Reading
- W: Writing
- A: Algebraic Relationships
- D: Data and Probability
- N: Numbers and Operations
- G: Geometric and Spatial Relationships
- M: Measurement
- EC: Changes in Ecosystems and Interactions of Organisms with Their Environment
- IN: Scientific Inquiry
- LO: Characteristics of Living Organisms
- GS: Principles and Processes of Governance Systems
- PC: Principles of Constitutional Democracy
- H: Missouri, United States, and World History
- TO: Total

The data were limited to first-time test takers. Students who had taken a retest were pulled from the data set. The cross-year, student-level data were matched using Missouri's unique student identification number. The EOC assessments are course dependent, and students will not take all of the EOC assessment within a single grade level; therefore, it is necessary to match students across years of test data in order to capture multiple test scores for the same student. Table 1 shows the total number of first-time test takers for each MAP EOC assessment in 2009, 2010, and 2011. Table 2 shows the number of students who had multiple administrations of an EOC assessment across 2009, 2010, and 2011.

Table 3 shows the lower triangle of a data matrix containing the number of students who were matched for use in the data analyses by pairs of assessments. To be included in the analyses, students had to take two or more of the MAP EOC assessments in 2009, 2010, and/or 2011. The data on the diagonal represents the number of students taking a test in a given year. For example, 60,769 students were tested in Algebra I (A1) in 2010.

The columns of the matrix show the first year an EOC assessment was taken, and the rows of the matrix contain the second year. To read the data in this table, start with a year/content combination in the column and find the row with the year/content combination that

is of interest. Suppose you want to know the number of students who took English I (E1) in 2010 and English II in 2011. Find English I within the cluster of columns under 2010 and then find English II within the cluster of rows for 2011. The data in the table show that 36,635 students took English I in 2010 followed by English II in 2011.

Only those pairs of data where $n \geq 1{,}000$ were included in the analyses presented below. We want to examine patterns of relationships with the data in this study that apply to the typical test takers, not ones who take tests in an anomalous sequence from their statewide peer group. Test pairs with less than 1,000 most likely represent atypical relationships where a very small number of students took the EOCs in a manner that is inconsistent with the rest of the state.

Table 1. Total Number of Students Tested in 2009–2011 by Content Area EOC Assessment

Year	E2	A1	B1	E1	A2	GE	GV	AH
2009	62507	60527	60913					
2010	61672	60769	61507	42629	22067	27262	38189	33495
2011	62255	63538	63503	41813	22364	26122	40921	35362

Table 2. Total Number of Students with Multiple Administrations by Content Area EOC Assessment Across 2009, 2010, 2011

EOC Assessment	Number of Students with Multiple Administrations
A1	5532
A2	295
AH	365
B1	2372
E1	480
E2	2914
GE	270
GV	977

Table 3. Number of Students Taking Pairs of EOC assessments Within and Across Years

Year	EOC Assessment	EOC assessment first taken in:																		
		2009			2010								2011							
		E2	A1	B1	E1	E2	A1	A2	GE	B1	GV	AH	E1	E2	A1	A2	GE	B1	GV	AH
2009	E2	62507																		
	A1	9227	60527																	
	B1	33884	12797	60913																
2010	E1	206	7641	250	42629															
	E2		29203	11330	597	61672														
	A1	3333		3203	19959	9630	60769													
	A2	10448	4292	8213	1227	7541	256	22067												
	GE	5001	20369	5205	5380	13989	405	1251	27262											
	B1	10565	23498		6668	33552	13514	7450	11498	61507										
	GV	15032	7692	10765	8075	6547	7697	4368	4299	7193	38189									
	AH	11336	6942	7506	12621	6669	8100	6237	5743	8460	843	33495								
2011	E1	50	246	43		124	8045	15	176	160	113	97	41813							
	E2		12273	714	36635		27949	1239	5475	12458	9871	11948	236	62255						
	A1	2249		1937	7197	3527		547	427	3429	3213	3554	20014	10932	63538					
	A2	1696	14475	2346	7271	10440	5173		13560	8538	3105	4756	1294	8099	129	22364				
	GE	799	3158	952	11879	5046	19810	1712		5387	3037	5760	5400	13621	295	1251	26122			
	B1	1793	11781		23678	10549	23431	2587	6274		9271	10792	7108	33739	15294	8063	11150	63503		
	GV	4144	9615	5231	4555	15925	8075	2858	4723	11631		6199	6264	7603	8668	4614	4315	8024	40921	
	AH	610	7603	1988	5760	11526	7652	2883	5290	8005	2310		13757	7245	9283	6240	6152	8745	740	35362

Statistical Methodology

Two statistical tests were used to analyze the data. Test reliability was estimated using Cronbach's (1951) coefficient alpha. The internal consistency coefficient (Cronbach's alpha) is a measure of item homogeneity. In order for a group of items to be homogeneous, they must measure the same construct (construct validity) or represent the same content domain (content validity). Divergent validity was examined using Pearson product-moment (PPM) correlation coefficients.

Reliability

It is necessary to consider validity information in the context of reliability. In general, we expect to see lower correlation coefficients between variables that are less reliable. The reliability of the raw scores on the EOC assessment and domains was evaluated using Cronbach's (1951) coefficient alpha, which is a lower-bound estimate of test reliability. The reliability coefficient is a ratio of the variance of true test scores to those of the observed scores, with the values ranging from 0 to 1. The closer the value of the reliability coefficient is to 1, the more consistent the scores, where 1 refers to a perfectly consistent test. As a rule of thumb, reliability coefficients that are equal to or greater than 0.8 are considered acceptable for tests of moderate lengths.

Cronbach's coefficient alpha was computed using the formula

$$\alpha = \frac{n}{n-1}\left[1 - \frac{\sum_{i=1}^{n} \sigma_i^2}{\sigma_X^2}\right],$$

where n is the number of items on the test, σ_i^2 is the variance of item i and σ_x^2 is the variance of the total test score.

Pearson Product-Moment Correlation

The divergent relationship between test pairs was estimated using PPM correlation coefficients. In addition, the correlation coefficients were estimated between the domains that comprise the assessments. The domain-level correlation coefficients were estimated both within and between EOC assessments.

Because the correlation coefficients will be affected by the limited number of items measuring each domain, the correlation coefficient between two content standard subscores may be artificially low because of measurement error. For this reason, we correct correlation coefficients for attenuation when examining the content standard strand scores. The American Educational Research Association, American Psychological Association, and National Council on Measurement in Education (1999) Standard 1.18 states:

> When statistical adjustments, such as those for restriction of range or attenuation, are made, both adjusted and unadjusted coefficients, as well as the specific procedure used, and all statistics used in the adjustment, should be reported.

We can correct for the attenuation of the correlation coefficient (r_{ca}) statistically using Spearman's formula

$$r_{ca} = \frac{r_{xy}}{\sqrt{r_{xx} r_{yy}}},$$

where r_{xy} is the PPM between two content standards, r_{xx} is the reliability of one of those content standards, and r_{yy} is the reliability of the other content standard.

Interpreting Results

The correlation coefficient represents the strength of the relationship between two variables. Unfortunately, there is not a widely accepted rule about how to interpret the strength of a correlation coefficient. The way in which a correlation coefficient is interpreted will depend on the field of study. For example, a correlation coefficient of $r = 0.45$ may be considered a strong relationship for some psychological measures, while researchers in another field would consider that relationship to be quite weak. For this report, we use the following criteria to provide context to the correlation coefficients between sets of assessments. These criteria are based on our experiences in dealing with educational assessments.

- Strong relationship: $r > |0.70|$
- Moderate relationship: $|0.30| < r < |0.69|$
- Weak relationship: $0.0 < r < |0.29|$

In addition, it is important to pay attention to the relationships among the variables. Does the pattern of correlation coefficients make sense? Do higher correlations occur where the tests are expected to be related and lower correlations occur where tests are not expected to be related?

Results

In this section, we first examine the relationship between the total EOC assessments. This is followed by an examination of the component parts of the EOC assessment.

Total-Test EOC Assessment

Table 4 shows the lower triangle of the correlation matrix between EOC assessment pairs both within a year and across years. Again, the columns of the matrix show the first year a student took an EOC assessment and the rows show the second year. The reliabilities for each

EOC assessment are presented on the diagonal of the matrix. The numbers of test items are shown in the table in the third column and row.

Reliabilities

Table 4 shows that all EOC assessments had reliability coefficients that were 0.81 or larger. In 2009 and 2010, all tests had coefficients that were 0.85 or larger. In 2011, all EOC assessments had coefficients that were .84 or higher, with the exceptions being American History, Geometry and Algebra II. Nonetheless, all tests were of acceptable reliability for tests of moderate length.

Within-Year Results

In 2009 and 2010, the Biology assessment appears to have a strong relationship with all other assessments, except Algebra I (2009) and Algebra II (2010), when the performance event (PE) is included in the assessment. When the PE was removed from the assessment in 2011, the strength of the relationship (as based on the correlation coefficient) between Biology and the other content areas is lessened.

As anticipated, the correlation coefficients between the EOC assessments in the mathematics group indicate a strong relationship between Algebra II and Geometry within years. The within-year relationship between English I and English II cannot be measured because too few students took both the English I and English II EOC assessments in a single year. The same is true for Algebra I and the other mathematics EOC assessments as well as the Government and American History EOC assessments.

The pattern of correlation coefficients between the EOC assessments within the mathematics group and those EOC assessments within the English group demonstrate only moderate relationships. Similarly, there are only moderate relationships between the social

studies EOC assessments and the mathematics EOC assessments. The Government assessment appears to be more strongly related to the English assessments than does the American History assessment, as indicated by higher correlation coefficients between the English I, English II, and Government EOC assessments than the correlation coefficients between the English I, English II, and American History EOC assessments.

One-Year Lag Between EOC assessments

For the most part, there is a strong relationship between the mathematics EOC assessments when there is a one-year lag. There are a couple of exceptions. When Algebra I is administered in 2010 and Algebra II in 2011, there is a moderate relationship between the two EOC assessments. In this case, $r = 0.69$ which is just below the cutoff for a strong relationship. When Algebra II is administered in 2010 and Geometry is measured in 2011, there is a moderate relationship ($r = 0.62$). It is important to note that this administration order appears to be atypical with only $n = 1{,}712$ students taking the test in this administration order. When Geometry was taken in 2010 and Algebra II in 2011, then the relationship is strong ($r = 0.70$ and $n = 13{,}560$).

There is a strong relationship ($r = 0.73$) between performance on English I administered in 2010 and English II administered in 2011. There tends to be a strong relationship between Biology and Government when Biology is administered in the first year and the other EOC assessment is administered in the second year. There is a strong relationship between American History and Government when there is a one-year lag between tests.

The pattern of correlation coefficients again reveals lower correlation coefficients between the mathematics EOC assessments and the English EOC assessments. This same pattern is seen between the mathematics and social studies EOC assessments. The correlation coefficients are higher, yet still moderate, between the English EOC assessments and the social studies EOC assessments.

Two-Year Lag

The Biology test is strongly related to both Algebra I and Government when there is a two-year lag where Biology is taken in 2009 and the other EOC assessments are taken in 2011. There is a moderate relationship (r = 0.69) between Algebra I and Algebra II when Algebra I is taken in 2009 and Algebra II is taken in 2011.

The pattern of correlation coefficients is again smaller between the mathematics EOC assessments and the English EOC assessments and between the mathematics EOC assessments and the social studies EOC assessments than they are between the English and social studies EOC assessments.

Tables 5, 6, and 7 disaggregate each of the EOC assessments into its strand-level components for 2009, 2010, and 2011, respectively. Because some strands have very few items (e.g., writing (W) has only 6 items), we also show the reliabilities and the correlation coefficients that have been corrected for attenuation (r_{ca}). In each of these tables, the same sorts of patterns emerge. The r_{ca} is higher when comparing strands within an EOC assessment. Also, the correlation coefficients between the Biology strands and the mathematics group strands for the EOC assessments are lower than the correlation coefficients between the Biology strands and the English group strands for the EOC assessments. The correlation coefficients between the EOC assessments in the English group and the social studies group appear, for the most part, to be moderately related to each other.

Table 8 shows the r_{ca} paired across 2009 and 2010 or 2009 and 2011, with the 2009 strand reliabilities in the diagonal. The students in the data have been matched across years. The number of students in each pair can be found in Table 3. (This same information for the uncorrected correlation coefficients may be found in Table A.1 in the Appendix.) Table 9 shows

the r_{ca} paired for 2010 and 2011, with the 2010 strand reliabilities in the diagonal. (This same information for the uncorrected correlation coefficients may be found in Table A.2 in the Appendix.) The patterns of r_{ca} found in Tables 8 and 9 reveal the same patterns revealed in earlier tables. The mathematics EOC assessments appear to be strongly related. The Biology EOC assessment is strongly related to the English and social studies EOC assessments. The English EOC assessments appear to be strongly related to the social studies EOC assessments. The mathematics EOC assessments are only moderately related to the other EOC assessments.

Table 4. PPM Correlation Between EOC Assessment Pairs with Reliability on the Diagonal for Within-Year Matrices

Year	EOC	2009				2010									2011								
			E2	A1	B1		E1	E2	A1	A2	GE	B1	GV	AH		E1	E2	A1	A2	GE	B1	GV	AH
		# of items	36	36	46	# of items	40	36	36	40	40	47	40	40	# of items	40	35	35	40	40	34	40	40
2009	E2	36	0.87																				
	A1	36	0.51	0.86																			
	B1	46	0.72	0.68	0.89																		
2010	E1	40		0.53		40	0.87																
	E2	36		0.52	0.69	36		0.85															
	A1	36	0.52		0.62	36	0.58	0.57	0.86														
	A2	40	0.46	0.73	0.58	40	0.54	0.51		0.85													
	GE	40	0.47	0.72	0.62	40	0.53	0.54		0.82	0.87												
	B1	47	0.67	0.68		47	0.75	0.71	0.71	0.67	0.70	0.89											
	GV	40	0.66	0.60	0.73	40	0.70	0.68	0.58	0.56	0.60	0.75	0.88										
	AH	40	0.59	0.52	0.66	40	0.66	0.63	0.51	0.50	0.57	0.71		0.85									
2011	E1	40				40			0.46						40	0.84							
	E2	35		0.58	0.61	35	0.73		0.55	0.55	0.53	0.72	0.65	0.60	35		0.86						
	A1	35	0.59		0.72	35	0.52	0.56				0.62	0.55	0.45	35	0.54	0.59	0.87					
	A2	40	0.42	0.69	0.54	40	0.52	0.45	0.69		0.70	0.60	0.55	0.50	40	0.49	0.53		0.81				
	GE	40		0.64		40	0.51	0.45	0.72	0.62		0.61	0.51	0.47	40	0.47	0.54		0.73	0.82			
	B1	34	0.60	0.64		34	0.65	0.63	0.62	0.56	0.65		0.66	0.64	34	0.68	0.69	0.64	0.60	0.58	0.84		
	GV	40	0.67	0.56	0.74	40	0.69	0.65	0.59	0.59	0.59	0.73		0.73	40	0.72	0.74	0.63	0.53	0.57	0.75	0.86	
	AH	40		0.51	0.65	40	0.64	0.60	0.52	0.44	0.51	0.67	0.70		40	0.66	0.66	0.52	0.50	0.54	0.67		0.81

Table 5. Correlation Coefficient (Lower Diagonal), Reliabilities (Diagonal), and r_{ca} (Upper Diagonal) by Strand for 2009

EOC	Strand	2009										
		English II			Algebra I				Biology			
		R	W	TO	A	D	N	TO	EC	IN	LO	TO
	# of Items	30	6	36	20	8	8	36	13	11	22	46
E2	R	0.85	0.91	1.14	0.56	0.54	0.55	0.58	0.82	0.76	0.77	0.82
	W	0.63	0.57	1.09	0.50	0.46	0.48	0.51	0.68	0.70	0.66	0.73
	TO	0.98	0.76	0.87	0.57	0.54	0.55	0.59	0.81	0.76	0.77	0.82
A1	A	0.45	0.33	0.47	0.77	0.99	0.97	1.17	0.66	0.71	0.70	0.76
	D	0.38	0.26	0.39	0.66	0.59	0.99	1.13	0.69	0.69	0.70	0.76
	N	0.40	0.29	0.41	0.68	0.61	0.64	1.12	0.67	0.67	0.67	0.73
	TO	0.50	0.36	0.51	0.95	0.81	0.83	0.87	0.69	0.72	0.72	0.78
B1	EC	0.63	0.44	0.64	0.49	0.45	0.45	0.54	0.71	0.82	0.94	1.06
	IN	0.61	0.46	0.62	0.54	0.46	0.47	0.58	0.61	0.76	0.81	1.06
	LO	0.64	0.45	0.64	0.56	0.48	0.48	0.60	0.71	0.64	0.81	1.07
	TO	0.72	0.52	0.73	0.63	0.55	0.55	0.68	0.85	0.87	0.91	0.89

Table 6. MAP EOC Assessment: PPM (Lower Diagonal), Reliabilities (Diagonal), and r_{ca} (Upper Diagonal) by Strand for 2010

EOC	Strand	2010																										
		English I		English II			Algebra I				Algebra II				Geometry				Biology				Government			American History	
	Strand	R	TO	R	W	TO	A	D	N	TO	A	D	N	TO	A	G	M	TO	EC	IN	LO	TO	GS	PC	TO	H	TO
	# of Items	40	40	30	6	36	20	8	8	36	22	10	8	40	8	24	8	40	13	12	22	47	20	20	40	40	40
E1	R	0.87	1.15				0.66	0.63	0.60	0.67	0.59	0.64	0.65	0.62	0.58	0.62	0.56	0.61	0.83	0.82	0.79	0.85	0.80	0.79	0.80	0.77	0.77
	TO	1.00	0.87				0.66	0.63	0.60	0.67	0.59	0.64	0.65	0.62	0.58	0.62	0.56	0.61	0.83	0.82	0.79	0.85	0.80	0.79	0.80	0.77	0.77
E2	R			0.83	0.94	1.17	0.63	0.64	0.61	0.65	0.53	0.59	0.58	0.57	0.57	0.61	0.54	0.60	0.79	0.78	0.73	0.80	0.80	0.78	0.79	0.74	0.74
	W			0.62	0.52	1.13	0.65	0.66	0.63	0.67	0.55	0.56	0.60	0.57	0.59	0.60	0.53	0.60	0.73	0.79	0.72	0.79	0.76	0.74	0.75	0.69	0.69
	TO			0.98	0.76	0.85	0.65	0.66	0.63	0.67	0.56	0.60	0.61	0.59	0.60	0.63	0.55	0.62	0.79	0.80	0.74	0.81	0.80	0.78	0.79	0.74	0.74
A1	A	0.54	0.54	0.51	0.42	0.53	0.79	0.95	0.97	1.17									0.68	0.81	0.73	0.81	0.66	0.64	0.66	0.59	0.59
	D	0.44	0.44	0.43	0.36	0.46	0.64	0.57	0.95	1.11									0.70	0.77	0.69	0.78	0.63	0.61	0.63	0.58	0.58
	N	0.43	0.43	0.42	0.35	0.44	0.66	0.55	0.59	1.13									0.64	0.73	0.63	0.73	0.62	0.61	0.63	0.55	0.55
	TO	0.58	0.58	0.55	0.45	0.57	0.96	0.78	0.80	0.86									0.70	0.81	0.72	0.81	0.67	0.65	0.67	0.60	0.60
A2	A	0.48	0.48	0.42	0.35	0.45					0.76	0.90	0.95	1.16	1.04	0.91	0.86	0.92	0.56	0.70	0.72	0.72	0.59	0.58	0.59	0.53	0.53
	D	0.47	0.47	0.42	0.32	0.44					0.62	0.62	0.96	1.12	1.03	0.96	0.94	0.97	0.67	0.79	0.74	0.80	0.67	0.65	0.67	0.62	0.62
	N	0.46	0.46	0.40	0.33	0.43					0.63	0.57	0.57	1.14	1.09	1.00	0.98	1.01	0.66	0.79	0.78	0.81	0.67	0.64	0.66	0.60	0.60
	TO	0.54	0.54	0.48	0.38	0.51					0.94	0.81	0.80	0.85	1.05	0.95	0.91	0.96	0.62	0.76	0.76	0.77	0.65	0.63	0.64	0.59	0.59
GE	A	0.40	0.40	0.39	0.32	0.41					0.68	0.60	0.61	0.72	0.55	0.96	0.94	1.13	0.62	0.76	0.73	0.77	0.68	0.68	0.68	0.65	0.65
	G	0.51	0.51	0.49	0.39	0.52					0.71	0.67	0.67	0.78	0.64	0.80	0.95	1.15	0.68	0.77	0.73	0.79	0.71	0.68	0.69	0.66	0.66
	M	0.43	0.43	0.40	0.31	0.42					0.61	0.60	0.61	0.69	0.57	0.70	0.67	1.09	0.64	0.74	0.69	0.76	0.64	0.63	0.64	0.64	0.64
	TO	0.53	0.53	0.51	0.40	0.54					0.75	0.71	0.71	0.82	0.78	0.96	0.84	0.87	0.68	0.78	0.74	0.79	0.69	0.67	0.69	0.66	0.66
BI	EC	0.67	0.67	0.62	0.46	0.63	0.53	0.46	0.42	0.56	0.42	0.46	0.43	0.50	0.40	0.53	0.46	0.55	0.76	0.85	0.90	1.03	0.81	0.80	0.80	0.80	0.80
	IN	0.67	0.67	0.62	0.50	0.64	0.63	0.51	0.49	0.66	0.54	0.54	0.52	0.61	0.49	0.60	0.53	0.64	0.64	0.77	0.88	1.09	0.84	0.83	0.83	0.77	0.77
	LO	0.64	0.64	0.57	0.45	0.59	0.56	0.45	0.42	0.58	0.54	0.50	0.51	0.60	0.47	0.56	0.49	0.59	0.68	0.67	0.75	1.10	0.81	0.80	0.81	0.77	0.77
	TO	0.75	0.75	0.69	0.54	0.71	0.68	0.55	0.52	0.71	0.59	0.59	0.57	0.67	0.54	0.66	0.58	0.70	0.84	0.90	0.89	0.89	0.86	0.85	0.85	0.82	0.82
GV	GS	0.66	0.66	0.64	0.49	0.65	0.52	0.42	0.42	0.55	0.46	0.47	0.45	0.53	0.45	0.56	0.46	0.57	0.62	0.65	0.62	0.72	0.78	1.01	1.14		
	PC	0.66	0.66	0.63	0.48	0.64	0.51	0.41	0.41	0.53	0.45	0.46	0.43	0.51	0.45	0.54	0.46	0.56	0.62	0.64	0.61	0.71	0.79	0.79	1.13		
	TO	0.70	0.70	0.68	0.51	0.68	0.55	0.45	0.45	0.58	0.48	0.49	0.47	0.56	0.48	0.58	0.49	0.60	0.66	0.68	0.65	0.76	0.95	0.95	0.88		
AH	H	0.66	0.66	0.62	0.46	0.63	0.49	0.40	0.39	0.51	0.43	0.45	0.42	0.50	0.44	0.54	0.48	0.57	0.64	0.62	0.61	0.71				0.85	1.17
	TO	0.66	0.66	0.62	0.46	0.63	0.49	0.40	0.39	0.51	0.43	0.45	0.42	0.50	0.44	0.54	0.48	0.57	0.64	0.62	0.61	0.71				1.00	0.85

Table 7. MAP EOC Assessment: PPM (Lower Diagonal), Reliabilities (Diagonal), and r_{ca} (Upper Diagonal) by Strand for 2011

EOC	Strand	2011																									
		English I		English II			Algebra I				Algebra II				Geometry				Biology			Government			American History	
		R	TO	R	W	TO	A	D	N	TO	A	D	N	TO	A	G	M	TO	EC	LO	TO	GS	PC	TO	H	TO
	# of Items	40	40	30	5	35	19	8	8	35	22	9	9	40	8	24	8	40	13	21	34	20	20	40	40	40
E1	R	0.84	1.19				0.60	0.57	0.58	0.63	0.57	0.64	0.59	0.59	0.52	0.56	0.50	0.57	0.81	0.78	0.81	0.82	0.85	0.84	0.81	0.81
	TO	1.00	0.84				0.60	0.57	0.58	0.63	0.57	0.64	0.59	0.59	0.52	0.56	0.50	0.57	0.81	0.78	0.81	0.82	0.85	0.84	0.81	0.81
E2	R			0.85	0.87	1.16	0.63	0.69	0.63	0.68	0.60	0.64	0.64	0.62	0.67	0.60	0.57	0.63	0.82	0.78	0.81	0.86	0.88	0.87	0.79	0.79
	W			0.53	0.44	1.07	0.54	0.61	0.54	0.58	0.49	0.54	0.55	0.52	0.52	0.52	0.48	0.53	0.71	0.69	0.71	0.79	0.81	0.80	0.63	0.63
	TO			0.99	0.66	0.86	0.64	0.70	0.64	0.68	0.61	0.65	0.65	0.63	0.68	0.61	0.58	0.64	0.82	0.78	0.81	0.86	0.88	0.87	0.79	0.79
A1	A	0.49	0.49	0.51	0.32	0.52	0.78	0.93	0.95	1.15									0.66	0.73	0.72	0.68	0.69	0.69	0.60	0.60
	D	0.37	0.37	0.45	0.29	0.46	0.59	0.50	0.94	1.12									0.74	0.74	0.76	0.72	0.75	0.74	0.58	0.58
	N	0.44	0.44	0.48	0.30	0.49	0.70	0.55	0.69	1.10									0.68	0.69	0.71	0.69	0.70	0.71	0.60	0.60
	TO	0.54	0.54	0.58	0.36	0.59	0.95	0.74	0.85	0.87									0.70	0.75	0.75	0.71	0.73	0.73	0.63	0.63
A2	A	0.43	0.43	0.46	0.27	0.47					0.69	0.96	0.95	1.24	0.82	0.83	0.81	0.84	0.59	0.71	0.69	0.57	0.55	0.57	0.55	0.55
	D	0.42	0.42	0.42	0.26	0.43					0.57	0.52	0.99	1.21	0.88	0.92	0.96	0.94	0.68	0.77	0.76	0.66	0.65	0.67	0.65	0.65
	N	0.39	0.39	0.42	0.26	0.44					0.57	0.51	0.52	1.19	0.87	0.95	0.94	0.95	0.71	0.77	0.78	0.65	0.66	0.67	0.68	0.68
	TO	0.49	0.49	0.52	0.31	0.53					0.92	0.78	0.78	0.81	0.85	0.88	0.88	0.89	0.64	0.74	0.73	0.63	0.62	0.64	0.62	0.62
GE	A	0.35	0.35	0.45	0.25	0.46					0.50	0.46	0.46	0.56	0.53	0.94	0.93	1.16	0.65	0.69	0.70	0.66	0.67	0.67	0.66	0.66
	G	0.43	0.43	0.47	0.29	0.48					0.58	0.56	0.58	0.67	0.58	0.71	0.97	1.23	0.64	0.69	0.69	0.67	0.66	0.68	0.67	0.67
	M	0.32	0.32	0.37	0.23	0.38					0.48	0.49	0.48	0.56	0.48	0.58	0.50	1.19	0.58	0.64	0.64	0.67	0.65	0.67	0.64	0.64
	TO	0.47	0.47	0.52	0.32	0.54					0.63	0.61	0.62	0.73	0.77	0.94	0.76	0.82	0.65	0.70	0.70	0.68	0.67	0.68	0.67	0.67
BI	EC	0.64	0.64	0.64	0.40	0.65	0.50	0.45	0.48	0.56	0.42	0.41	0.44	0.49	0.40	0.46	0.35	0.50	0.73	0.93	1.13	0.86	0.88	0.87	0.82	0.82
	LO	0.61	0.61	0.62	0.39	0.63	0.56	0.46	0.49	0.60	0.50	0.47	0.48	0.57	0.43	0.50	0.39	0.54	0.68	0.74	1.20	0.87	0.87	0.87	0.79	0.79
	TO	0.68	0.68	0.69	0.43	0.69	0.59	0.50	0.54	0.64	0.52	0.50	0.52	0.60	0.47	0.54	0.42	0.58	0.88	0.95	0.84	0.88	0.89	0.88	0.82	0.82
GV	GS	0.66	0.66	0.70	0.46	0.70	0.52	0.45	0.50	0.58	0.41	0.42	0.41	0.50	0.42	0.49	0.42	0.54	0.65	0.65	0.71	0.77	1.01	1.16		
	PC	0.66	0.66	0.70	0.46	0.70	0.53	0.45	0.50	0.58	0.39	0.40	0.40	0.48	0.42	0.48	0.39	0.52	0.64	0.64	0.70	0.76	0.73	1.17		
	TO	0.72	0.72	0.74	0.49	0.74	0.57	0.49	0.54	0.63	0.44	0.45	0.45	0.53	0.46	0.53	0.44	0.57	0.69	0.69	0.75	0.94	0.93	0.86		
AH	H	0.66	0.66	0.66	0.37	0.66	0.48	0.37	0.45	0.52	0.41	0.42	0.44	0.50	0.43	0.51	0.41	0.54	0.62	0.61	0.68				0.81	1.24
	TO	0.66	0.66	0.66	0.37	0.66	0.48	0.37	0.45	0.52	0.41	0.42	0.44	0.50	0.43	0.51	0.41	0.54	0.62	0.61	0.68				1.00	0.81

Table 8. r_{ca} by Strand for Cross-Year Pairs of EOC Assessments— 2009, 2010 Pairs and 2009, 2011 Pairs with Reliabilities (Diagonal of Same Test pair) from 2009 Administration

EOC	Strand	2009, 2010 Pairs												2009, 2011 Pairs											
			English II			Algebra I				Biology					English II			Algebra I				Biology			
		# of	R	W	TO	A	D	N	TO	EC	IN	LO	TO	# of	R	W	TO	A	D	N	TO	EC	IN	LO	TO
		Items	30	6	36	20	8	8	36	13	11	22	46	Items	30	6	36	20	8	8	36	13	11	22	46
E1	R	40				0.61	0.60	0.59	0.62					40											
	TO	40				0.61	0.60	0.59	0.62					40											
E2	R	30	0.85			0.56	0.56	0.57	0.58	0.78	0.72	0.74	0.79	30	0.85			0.65	0.65	0.64	0.66				
	W	6		0.57		0.59	0.55	0.58	0.60	0.74	0.78	0.75	0.80	5		0.57		0.59	0.58	0.58	0.59				
	TO	36			0.87	0.58	0.58	0.59	0.60	0.78	0.74	0.75	0.80	35			0.87	0.66	0.66	0.65	0.67				
A1	A	20	0.57	0.48	0.57	0.77				0.64	0.68	0.66	0.71	19	0.66	0.62	0.66	0.77				0.69	0.78	0.77	0.79
	D	8	0.61	0.57	0.62		0.59			0.64	0.66	0.61	0.69	8	0.72	0.68	0.73		0.59			0.80	0.86	0.83	0.87
	N	8	0.53	0.49	0.54			0.64		0.59	0.61	0.57	0.64	8	0.68	0.61	0.68			0.64		0.78	0.81	0.78	0.83
	TO	36	0.59	0.52	0.60				0.87	0.64	0.68	0.65	0.71	35	0.68	0.64	0.68				0.87	0.74	0.80	0.79	0.82
A2	A	22	0.45	0.37	0.46	0.81	0.76	0.69	0.80	0.52	0.53	0.58	0.60	22	0.44	0.31	0.44	0.77	0.75	0.71	0.78	0.45	0.50	0.52	0.55
	D	10	0.56	0.46	0.56	0.82	0.83	0.81	0.85	0.64	0.62	0.64	0.69	9	0.54	0.34	0.53	0.83	0.86	0.81	0.85	0.57	0.58	0.64	0.67
	N	8	0.54	0.44	0.55	0.83	0.80	0.79	0.84	0.61	0.61	0.64	0.68	9	0.49	0.40	0.50	0.83	0.83	0.83	0.85	0.58	0.56	0.61	0.65
	TO	40	0.53	0.43	0.53	0.84	0.81	0.76	0.85	0.59	0.59	0.63	0.66	40	0.50	0.36	0.50	0.81	0.80	0.77	0.82	0.54	0.56	0.59	0.63
GE	A	8	0.52	0.39	0.52	0.86	0.83	0.79	0.85	0.56	0.61	0.61	0.65	8				0.76	0.74	0.72	0.77				
	G	24	0.54	0.45	0.55	0.80	0.81	0.79	0.82	0.62	0.65	0.64	0.70	24				0.71	0.71	0.70	0.73				
	M	8	0.47	0.37	0.46	0.76	0.79	0.78	0.79	0.59	0.58	0.60	0.65	8				0.69	0.66	0.68	0.71				
	TO	40	0.54	0.44	0.54	0.82	0.83	0.80	0.83	0.62	0.64	0.65	0.70	40				0.74	0.73	0.73	0.76				
B1	EC	13	0.72	0.58	0.71	0.63	0.67	0.67	0.66	0.71				13	0.71	0.59	0.69	0.67	0.70	0.71	0.69	0.71			
	IN	12	0.78	0.69	0.78	0.77	0.80	0.78	0.79		0.76												0.76		
	LO	22	0.69	0.58	0.68	0.72	0.72	0.70	0.73			0.81		21	0.70	0.64	0.69	0.76	0.77	0.74	0.76			0.81	
	TO	47	0.77	0.66	0.76	0.76	0.79	0.77	0.78				0.89	34	0.71	0.62	0.70	0.74	0.76	0.75	0.75				0.89
GV	GS	20	0.77	0.62	0.76	0.68	0.71	0.69	0.70	0.80	0.73	0.82	0.82	20	0.78	0.69	0.77	0.61	0.65	0.64	0.64	0.83	0.74	0.83	0.84
	PC	20	0.75	0.61	0.74	0.65	0.67	0.65	0.66	0.79	0.72	0.81	0.81	20	0.81	0.71	0.79	0.62	0.64	0.61	0.64	0.86	0.75	0.83	0.85
	TO	40	0.76	0.62	0.75	0.67	0.70	0.68	0.68	0.80	0.72	0.81	0.82	40	0.79	0.69	0.77	0.62	0.65	0.63	0.65	0.84	0.74	0.83	0.84
AH	H	40	0.70	0.52	0.68	0.60	0.62	0.60	0.61	0.75	0.63	0.74	0.75	40				0.58	0.61	0.60	0.61	0.79	0.63	0.77	0.77
	TO	40	0.70	0.52	0.68	0.60	0.62	0.60	0.61	0.75	0.63	0.74	0.75	40				0.58	0.61	0.60	0.61	0.79	0.63	0.77	0.77

Table 9. r_{ca} by Strand for Cross-Year Pairs of EOC Assessments— 2010, 2011 Pairs with Reliabilities (Diagonal of Same Test pair) from 2010 Administration

EOC	Strand	2010, 2011																										
			English I		English II			Algebra I				Algebra II				Geometry				Biology				Government			American	
		# of	R	TO	R	W	TO	A	D	N	TO	A	D	N	TO	A	G	M	TO	EC	IN	LO	TO	GS	PC	TO	H	TO
		Items	40	40	30	6	36	20	8	8	36	22	10	8	40	8	24	8	40	13	12	22	47	20	20	40	40	40
E1	R	40	0.87					0.54	0.45	0.46	0.54																	
	TO	40		0.87				0.54	0.45	0.46	0.54																	
E2	R	30	0.84	0.84	0.83			0.62	0.60	0.57	0.63	0.58	0.69	0.66	0.63	0.55	0.61	0.56	0.60	0.80	0.81	0.75	0.82	0.75	0.75	0.75	0.70	0.70
	W	5	0.72	0.72		0.52		0.54	0.54	0.49	0.55	0.59	0.65	0.60	0.62	0.48	0.56	0.50	0.54	0.69	0.75	0.68	0.74	0.63	0.63	0.64	0.57	0.57
	TO	35	0.85	0.85			0.85	0.63	0.61	0.57	0.64	0.59	0.69	0.66	0.64	0.56	0.62	0.57	0.61	0.80	0.81	0.75	0.82	0.74	0.75	0.75	0.70	0.70
A1	A	19	0.55	0.55	0.60	0.65	0.62	0.79				0.69	0.83	0.85	0.78	0.77	0.80	0.80	0.81	0.56	0.66	0.60	0.66	0.62	0.61	0.63	0.48	0.48
	D	8	0.57	0.57	0.66	0.71	0.68		0.57			0.64	0.83	0.81	0.74	0.66	0.77	0.66	0.73	0.61	0.67	0.57	0.68	0.60	0.57	0.59	0.50	0.50
	N	8	0.57	0.57	0.60	0.66	0.62			0.59		0.62	0.82	0.74	0.71	0.71	0.80	0.77	0.79	0.61	0.70	0.57	0.68	0.60	0.56	0.59	0.51	0.51
	TO	35	0.60	0.60	0.63	0.69	0.65				0.86	0.67	0.83	0.82	0.77	0.74	0.80	0.77	0.79	0.61	0.71	0.61	0.71	0.63	0.61	0.63	0.52	0.52
A2	A	22	0.60	0.60	0.47	0.46	0.49	0.81	0.62	0.66	0.78	0.76				0.81	0.78	0.72	0.79	0.52	0.64	0.62	0.65	0.61	0.60	0.62	0.57	0.57
	D	9	0.63	0.63	0.53	0.51	0.55	0.88	0.75	0.76	0.87		0.62			0.85	0.85	0.78	0.86	0.60	0.71	0.69	0.74	0.69	0.70	0.71	0.64	0.64
	N	9	0.64	0.64	0.53	0.50	0.55	0.89	0.72	0.81	0.88			0.57		0.85	0.87	0.82	0.88	0.61	0.73	0.67	0.74	0.67	0.64	0.66	0.63	0.63
	TO	40	0.62	0.62	0.52	0.50	0.54	0.85	0.68	0.73	0.83				0.85	0.84	0.83	0.77	0.84	0.58	0.70	0.66	0.71	0.65	0.64	0.65	0.60	0.60
G3	A	8	0.62	0.62	0.54	0.48	0.55	0.86	0.76	0.79	0.86	0.65	0.73	0.66	0.72	0.55				0.57	0.68	0.62	0.69	0.58	0.55	0.57	0.55	0.55
	G	24	0.59	0.59	0.51	0.49	0.53	0.84	0.72	0.75	0.83	0.65	0.73	0.68	0.72		0.80			0.60	0.69	0.63	0.71	0.60	0.56	0.59	0.55	0.55
	M	8	0.57	0.57	0.44	0.45	0.47	0.84	0.74	0.79	0.84	0.61	0.64	0.59	0.66			0.67		0.52	0.66	0.58	0.65	0.58	0.54	0.57	0.55	0.55
	TO	40	0.61	0.61	0.53	0.50	0.55	0.86	0.74	0.78	0.85	0.68	0.75	0.70	0.75				0.87	0.60	0.71	0.64	0.72	0.61	0.57	0.60	0.57	0.57
B1	EC	13	0.75	0.75	0.74	0.70	0.75	0.68	0.65	0.64	0.68	0.52	0.64	0.62	0.58	0.66	0.70	0.67	0.69	0.76				0.72	0.73	0.73	0.74	0.74
	IN																				0.77							
	LO	21	0.73	0.73	0.71	0.72	0.72	0.74	0.67	0.67	0.73	0.63	0.69	0.71	0.67	0.76	0.76	0.72	0.76			0.75		0.76	0.76	0.77	0.74	0.74
	TO	34	0.76	0.76	0.74	0.73	0.75	0.73	0.69	0.67	0.73	0.60	0.69	0.70	0.66	0.74	0.76	0.72	0.76				0.89	0.76	0.77	0.77	0.76	0.76
GV	GS	20	0.79	0.79	0.75	0.70	0.75	0.69	0.65	0.62	0.69	0.63	0.69	0.70	0.68	0.64	0.69	0.63	0.68	0.79	0.78	0.80	0.83	0.78			0.85	0.85
	PC	20	0.80	0.80	0.77	0.73	0.77	0.68	0.63	0.62	0.68	0.65	0.68	0.72	0.68	0.66	0.67	0.62	0.67	0.80	0.79	0.80	0.83		0.79		0.86	0.86
	TO	40	0.80	0.80	0.76	0.72	0.76	0.70	0.65	0.63	0.69	0.64	0.69	0.72	0.68	0.66	0.69	0.63	0.69	0.80	0.79	0.80	0.83			0.88	0.85	0.85
AH	H	40	0.77	0.77	0.72	0.65	0.73	0.62	0.56	0.58	0.62	0.50	0.53	0.55	0.53	0.58	0.61	0.57	0.61	0.77	0.73	0.75	0.79	0.83	0.81	0.83	0.85	
	TO	40	0.77	0.77	0.72	0.65	0.73	0.62	0.56	0.58	0.62	0.50	0.53	0.55	0.53	0.58	0.61	0.57	0.61	0.77	0.73	0.75	0.79	0.83	0.81	0.83		0.85

Discussion

In this paper, we examined the convergent and divergent validity of the MAP EOC assessments. To do this, we examined the relationships between the EOC assessments across 2009, 2010, and 2011. In this section, we discuss the results for each content area and its relationship to the other content areas.

Mathematics EOC Assessments

As anticipated, it is clear that the Algebra I, Algebra II, and Geometry EOC assessments are strongly related. Since all are measures of mathematics, it is expected that there will be strong relationships between these particular EOC assessments. In addition, the correlation coefficients indicated that the mathematics EOC assessments are only moderately related to the other EOC assessments, indicating divergent validity. This relationship between the mathematics EOC assessments and the other EOC assessments did not appear to be greatly influenced by the order of administration.

Social Studies EOC Assessments

It is clear that the Government and American History EOC assessments are tapping into a similar construct. Again, this was anticipated as both are considered aspects of the broader area of social studies. It was also not surprising that the English EOC assessments and the Government EOC assessments at times showed strong relationships. Both content areas involve a good amount of reading, and this is probably what the correlation coefficient is measuring. While these tests do appear to enjoy strong relationships, the relationships are not so strong as to cause concern that the English and social studies EOC assessments are measuring the same construct.

English EOC Assessments

Unsurprisingly, there was a strong relationship between the English I and English II EOC assessments, indicating good convergent validity.

Biology EOC Assessment

The Biology EOC assessment is the only high-school science assessment that DESE requires of Missouri high school students. This assessment displayed strong relationships with the English and social studies assessments, particularly when the tests were administered within the same school year. This relationship was mitigated by the removal of the PE from the 2011 test. Without the PE, the assessments appear to be only moderately related with the exception being the relationship between Biology and Government which continued to be strongly related. We suspect that the PE increased the amount of reading and writing necessary to complete the assessment, which strengthened the relationship of Biology to English and to American History. We suspect that the strong relationship between Biology and Government persist because both EOC assessments have heavy process and reading loads.

Administration Order of Assessments

In this study, we examined the relationship between constructs both within years and across years. In general, the same types of relationships were observed between the assessments regardless of the administration order of the assessment. Nonetheless, there were particular cases where a small group of students took a course sequence in a different order from the rest of the state, and in these cases, we did see some impact on the relationships between the EOC assessments. For example, the relationship between Geometry and Algebra II was strong when Geometry was taken first and only moderate when Algebra II was taken first. It was noted that the majority of students who tested take Geometry followed by Algebra II. It may be that the

theoretical relationship between the assessments is adversely impacted by students who sequence their coursework in an atypical fashion.

It is anticipated that most Missouri students take English I in their freshman year and English II in their junior year, meaning that there should be a two-year lag between the courses. The data presented here did not allow us to examine the relationship between the English I and English II tests with a two-year lag. Even so, there was still a strong relationship between English I and English II when there was a one-year lag.

Conclusions

The purpose of this study was to examine the relationships between the EOC assessments for evidence of divergent (and convergent) validity. In those cases where different content areas appeared to converge (e.g., Biology and Government), we suspect that the relationship reflects an artifact of test construction rather than the construct itself. In general, the results of this study suggest that, although correlated, the EOC assessments are appropriately related to each other and measure their own content areas, regardless of when the tests are administered.

References

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Appendix

Table 1a. *r* by Strand for Cross-Year Pairs of EOC Assessments— 2009, 2010 Pairs and 2009, 2011 Pairs with Reliabilities (Diagonal of Same Test pair) from 2009 Administration

		2009, 2010 Pairs													2009, 2011 Pairs											
			English II			Algebra I				Biology						English II			Algebra I				Biology			
		# of	R	W	TO	A	D	N	TO	EC	IN	LO	TO		# of	R	W	TO	A	D	N	TO	EC	IN	LO	TO
		Items	30	6	36	20	8	8	36	13	11	22	46		Items	30	6	36	20	8	8	36	13	11	22	46
E1	R	40				0.50	0.43	0.44	0.53						40											
	TO	40				0.50	0.43	0.44	0.53						40											
E2	R	30				0.45	0.39	0.41	0.49	0.60	0.57	0.61	0.68		30				0.52	0.46	0.47	0.56				
	W	6				0.37	0.30	0.34	0.40	0.45	0.49	0.48	0.55		5				0.34	0.29	0.31	0.37				
	TO	36				0.47	0.41	0.43	0.52	0.61	0.59	0.62	0.69		35				0.53	0.47	0.48	0.58				
A1	A	20	0.47	0.32	0.47					0.48	0.52	0.53	0.60		19	0.53	0.42	0.54					0.52	0.60	0.62	0.66
	D	8	0.42	0.32	0.43					0.40	0.43	0.41	0.49		8	0.47	0.36	0.48					0.48	0.53	0.53	0.58
	N	8	0.38	0.28	0.39					0.38	0.41	0.39	0.46		8	0.52	0.38	0.52					0.55	0.59	0.58	0.65
	TO	36	0.51	0.36	0.52					0.50	0.55	0.54	0.62		35	0.58	0.45	0.59					0.58	0.65	0.66	0.72
A2	A	22	0.37	0.25	0.37	0.62	0.51	0.48	0.65	0.38	0.40	0.46	0.50		22	0.33	0.19	0.34	0.56	0.48	0.47	0.60	0.32	0.36	0.38	0.43
	D	10	0.40	0.27	0.41	0.56	0.50	0.51	0.62	0.42	0.43	0.45	0.52		9	0.36	0.19	0.36	0.52	0.47	0.46	0.57	0.34	0.36	0.41	0.45
	N	8	0.38	0.25	0.38	0.55	0.46	0.47	0.59	0.39	0.40	0.44	0.49		9	0.32	0.22	0.34	0.52	0.46	0.48	0.57	0.35	0.35	0.39	0.44
	TO	40	0.45	0.30	0.46	0.68	0.57	0.56	0.73	0.46	0.47	0.52	0.58		40	0.41	0.24	0.42	0.64	0.55	0.55	0.69	0.41	0.44	0.48	0.54
GE	A	8	0.36	0.22	0.36	0.56	0.47	0.47	0.59	0.35	0.39	0.41	0.46		8				0.49	0.41	0.42	0.53				
	G	24	0.45	0.30	0.45	0.63	0.56	0.56	0.68	0.47	0.50	0.52	0.59		24				0.53	0.46	0.47	0.58				
	M	8	0.35	0.22	0.35	0.54	0.50	0.51	0.60	0.41	0.42	0.44	0.50		8				0.43	0.36	0.38	0.47				
	TO	40	0.47	0.31	0.47	0.67	0.59	0.60	0.72	0.49	0.52	0.54	0.62		40				0.59	0.51	0.52	0.64				
B1	EC	13	0.57	0.38	0.57	0.48	0.44	0.46	0.53						13	0.56	0.38	0.55	0.50	0.46	0.48	0.54				
	IN	12	0.63	0.45	0.64	0.60	0.54	0.54	0.64																	
	LO	22	0.55	0.38	0.55	0.54	0.48	0.48	0.58						21	0.56	0.41	0.56	0.57	0.51	0.51	0.61				
	TO	47	0.67	0.47	0.67	0.63	0.57	0.58	0.68						34	0.60	0.43	0.60	0.60	0.53	0.54	0.64				
GV	GS	20	0.63	0.42	0.62	0.53	0.48	0.48	0.57	0.60	0.56	0.65	0.69		20	0.63	0.45	0.63	0.47	0.43	0.45	0.52	0.62	0.57	0.65	0.70
	PC	20	0.62	0.41	0.62	0.51	0.46	0.46	0.55	0.60	0.56	0.64	0.69		20	0.63	0.46	0.63	0.47	0.42	0.42	0.51	0.62	0.56	0.64	0.69
	TO	40	0.66	0.44	0.66	0.55	0.50	0.51	0.60	0.63	0.59	0.68	0.73		40	0.67	0.48	0.67	0.51	0.46	0.47	0.56	0.66	0.60	0.69	0.74
AH	H	40	0.60	0.36	0.59	0.49	0.44	0.44	0.52	0.58	0.51	0.61	0.66		40				0.46	0.42	0.43	0.51	0.60	0.49	0.62	0.65
	TO	40	0.60	0.36	0.59	0.49	0.44	0.44	0.52	0.58	0.51	0.61	0.66		40				0.46	0.42	0.43	0.51	0.60	0.49	0.62	0.65

Table 1b. r_{ca} by Strand for Cross-Year Pairs of EOC Assessments— 2010, 2011 Pairs with Reliabilities (Diagonal of Same Test pair) from 2010 Administration

			2010, 2011																										
			English I		English II			Algebra I				Algebra II				Geometry				Biology				Government			American History	
		# of	R	TO	R	W	TO	A	D	N	TO	A	D	N	TO	A	G	M	TO	EC	IN	LO	TO	GS	PC	TO	H	TO
		Items	40	40	30	6	36	20	8	8	36	22	10	8	40	8	24	8	40	13	12	22	47	20	20	40	40	40
E1	R	40						0.44	0.31	0.33	0.46																	
	TO	40						0.44	0.31	0.33	0.46																	
E2	R	30	0.72	0.72				0.51	0.41	0.40	0.54	0.46	0.50	0.46	0.54	0.38	0.50	0.42	0.52	0.64	0.65	0.59	0.71	0.61	0.61	0.65	0.60	0.60
	W	5	0.44	0.44				0.32	0.27	0.25	0.34	0.34	0.34	0.30	0.38	0.23	0.33	0.27	0.34	0.40	0.44	0.39	0.46	0.37	0.37	0.40	0.35	0.35
	TO	35	0.73	0.73				0.52	0.43	0.41	0.55	0.48	0.51	0.46	0.55	0.38	0.52	0.43	0.53	0.64	0.66	0.60	0.72	0.61	0.62	0.65	0.60	0.60
A1	A	19	0.45	0.45	0.48	0.42	0.50					0.53	0.57	0.57	0.64	0.51	0.63	0.58	0.67	0.43	0.51	0.46	0.55	0.49	0.48	0.52	0.39	0.39
	D	8	0.37	0.37	0.42	0.36	0.44					0.40	0.46	0.43	0.49	0.35	0.48	0.38	0.49	0.38	0.42	0.35	0.45	0.37	0.36	0.39	0.33	0.33
	N	8	0.44	0.44	0.46	0.39	0.48					0.45	0.53	0.47	0.55	0.44	0.59	0.52	0.61	0.44	0.51	0.41	0.53	0.44	0.42	0.46	0.39	0.39
	TO	35	0.52	0.52	0.53	0.46	0.56					0.54	0.61	0.58	0.66	0.51	0.66	0.59	0.69	0.50	0.58	0.49	0.62	0.52	0.50	0.55	0.45	0.45
A2	A	22	0.46	0.46	0.35	0.27	0.37	0.59	0.38	0.42	0.60					0.49	0.57	0.49	0.61	0.37	0.46	0.44	0.51	0.45	0.44	0.48	0.43	0.43
	D	9	0.42	0.42	0.35	0.26	0.36	0.56	0.40	0.42	0.58					0.45	0.55	0.46	0.58	0.37	0.45	0.43	0.50	0.44	0.45	0.48	0.42	0.42
	N	9	0.43	0.43	0.35	0.26	0.36	0.57	0.39	0.45	0.59					0.45	0.56	0.49	0.59	0.38	0.46	0.42	0.50	0.43	0.41	0.45	0.42	0.42
	TO	40	0.52	0.52	0.43	0.33	0.45	0.68	0.46	0.50	0.69					0.56	0.66	0.57	0.70	0.45	0.55	0.52	0.60	0.52	0.51	0.55	0.50	0.50
G3	A	8	0.42	0.42	0.36	0.26	0.37	0.56	0.42	0.44	0.58	0.42	0.42	0.37	0.49					0.36	0.44	0.39	0.48	0.37	0.36	0.39	0.37	0.37
	G	24	0.46	0.46	0.39	0.30	0.41	0.63	0.46	0.49	0.65	0.48	0.48	0.44	0.56					0.44	0.51	0.46	0.56	0.45	0.42	0.46	0.43	0.43
	M	8	0.37	0.37	0.29	0.23	0.30	0.53	0.39	0.43	0.55	0.38	0.35	0.32	0.43					0.32	0.41	0.36	0.44	0.36	0.34	0.38	0.36	0.36
	TO	40	0.51	0.51	0.43	0.33	0.45	0.69	0.50	0.54	0.72	0.53	0.53	0.48	0.62					0.47	0.56	0.50	0.61	0.49	0.46	0.51	0.47	0.47
B1	EC	13	0.60	0.60	0.58	0.43	0.59	0.51	0.42	0.42	0.54	0.39	0.43	0.40	0.46	0.41	0.53	0.47	0.55					0.55	0.55	0.59	0.58	0.58
	IN																											
	LO	21	0.58	0.58	0.55	0.45	0.57	0.56	0.44	0.44	0.58	0.47	0.46	0.46	0.53	0.49	0.59	0.51	0.61					0.58	0.58	0.62	0.59	0.59
	TO	34	0.65	0.65	0.62	0.48	0.63	0.60	0.47	0.47	0.62	0.48	0.49	0.48	0.56	0.50	0.62	0.54	0.65					0.62	0.62	0.66	0.64	0.64
GV	GS	20	0.65	0.65	0.60	0.44	0.61	0.54	0.43	0.42	0.56	0.49	0.47	0.47	0.55	0.42	0.54	0.45	0.56	0.60	0.60	0.60	0.68				0.69	0.69
	PC	20	0.64	0.64	0.60	0.45	0.61	0.52	0.41	0.41	0.54	0.48	0.45	0.47	0.54	0.42	0.51	0.43	0.54	0.60	0.59	0.59	0.67				0.68	0.68
	TO	40	0.69	0.69	0.64	0.48	0.65	0.57	0.45	0.44	0.59	0.52	0.50	0.50	0.59	0.45	0.57	0.48	0.59	0.64	0.64	0.64	0.73				0.73	0.73
AH	H	40	0.64	0.64	0.59	0.42	0.60	0.50	0.37	0.40	0.52	0.39	0.38	0.37	0.44	0.39	0.48	0.42	0.51	0.60	0.57	0.58	0.67	0.66	0.65	0.70		
	TO	40	0.64	0.64	0.59	0.42	0.60	0.50	0.37	0.40	0.52	0.39	0.38	0.37	0.44	0.39	0.48	0.42	0.51	0.60	0.57	0.58	0.67	0.66	0.65	0.70		