

Chapter 5



5

CBAS questionnaire results

Male responses to questionnaire items were more polarised than female replies. They usually strongly disagreed or strongly agreed with statements more than females, who tended towards more neutral categories. Motivation for the computer-based test was higher than for the paper-and-pencil test across all countries. Students enjoyed the computer-based test more than the paper-and-pencil test. Most students preferred to do a computer-based test than a paper-and-pencil test. Most students reported that they put the same amount of effort into both tests. Test enjoyment and motivation seemed to have little to do with achievement. Test preference and relative effort reports showed no association with test performance.



The CBAS questionnaire was administered so that the relationship between achievement and test engagement factors (enjoyment, motivation and effort) could be investigated. This section examines firstly whether there were any differences across countries and genders in terms of test engagement and secondly, whether these differences (if any) can explain variations in performance between tests.

Male and female responses to the questions regarding enjoyment and motivation for the computer-based and paper-and-pencil tests are displayed in Table 17 below. Each question is then discussed individually in the following sections.

Table 17.

Male and female students responses to the CBAS questionnaire across countries

		Strongly Disagree		Disagree		Agree		Strongly Agree		
		n	%	n	%	n	%	n	%	
"I found the computer-based test enjoyable"	Denmark	Females	19	4,5	37	8,7	243	57,2	126	29,6
		Males	26	6,5	35	8,7	198	49,1	144	35,7
	Iceland	Females	56	15,2	124	33,6	172	46,6	17	4,6
		Males	88	22,9	105	27,3	155	40,4	36	9,4
	Korea	Females	18	2,7	80	12,0	367	55,2	200	30,1
		Males	43	5,4	88	11,2	385	48,8	273	34,6
"I found the paper-and-pencil test enjoyable"	Denmark	Females	61	14,6	172	41,1	168	40,1	18	4,3
		Males	99	25,2	152	38,7	124	31,6	18	4,6
	Iceland	Females	129	35,8	143	39,7	78	21,7	10	2,8
		Males	144	38,8	145	39,1	72	19,4	10	2,7
	Korea	Females	93	14,0	328	49,3	199	29,9	45	6,8
		Males	161	20,4	349	44,2	216	27,4	63	8,0
"I would do another computer-based test just for fun"	Denmark	Females	90	21,2	148	34,8	149	35,1	38	8,9
		Males	100	24,8	150	37,2	95	23,6	58	14,4
	Iceland	Females	143	38,8	128	34,7	77	20,9	21	5,7
		Males	146	38,0	112	29,2	91	23,7	35	9,1
	Korea	Females	165	24,8	329	49,5	139	20,9	32	4,8
		Males	147	18,6	350	44,4	218	27,6	74	9,4
"I would do another paper-and-pencil test just for fun"	Denmark	Females	143	33,9	178	42,2	86	20,4	15	3,6
		Males	180	45,0	165	41,3	38	9,5	17	4,3
	Iceland	Females	162	43,9	128	34,7	69	18,7	10	2,7
		Males	155	40,4	142	37,0	69	18,0	18	4,7
	Korea	Females	147	22,1	276	41,5	207	31,1	35	5,3
		Males	151	19,1	324	41,1	247	31,3	67	8,5



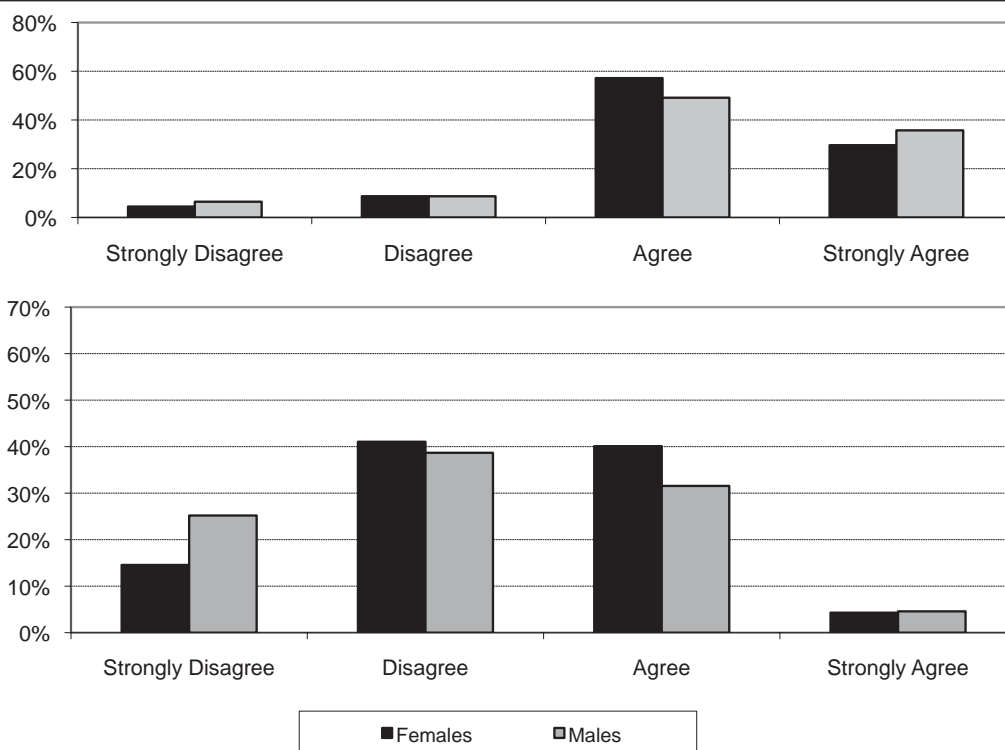
TEST ENJOYMENT ACROSS TEST MODALITIES AND GENDERS

Students were asked to rate on a four-point Likert scale how much they enjoyed the paper-and-pencil and computer-based tests and whether they would do a test “just for fun” if the answers were given at the end. Fisher’s exact probability test was performed to investigate whether there were any differences between enjoyment reported by males and females in each country.

Enjoyment of the CBAS test results indicate clearly different patterns of enjoyment for females and males in Iceland and Korea, but no differences in Denmark.¹ On the whole, more males strongly agree and strongly disagree that they enjoyed the test, whereas females tend towards the middle categories of agree and disagree. These patterns are illustrated in Figure 28 to Figure 30 below, which are grouped country-by-country so as to avoid comparisons between culturally-specific response patterns.

Figure 28.

Danish students’ endorsement of the statement “I found the CBAS test enjoyable” (top) and endorsement of the statement “I found the paper-and-pencil test enjoyable” (bottom)

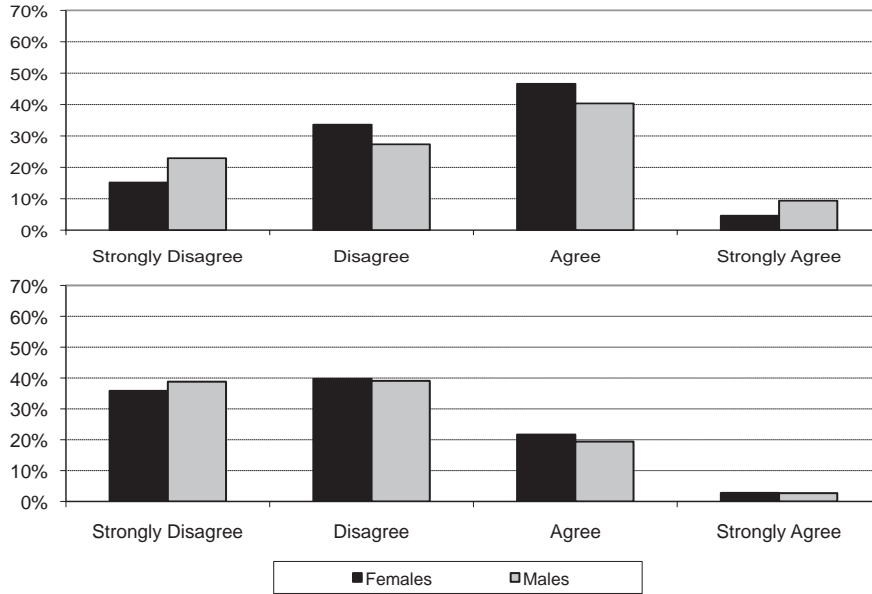


On the paper-and-pencil test, the Fisher’s exact probability test identifies differences in the patterns of enjoyment for females and males in Denmark and Korea. Here one can see a middle tendency for the females with more females than expected agreeing or disagreeing that they enjoyed the test. More males on the other hand, as in CBAS, tend to strongly disagree and strongly agree that they enjoyed the test. In Iceland, the tendency indicates that females enjoyed the paper-and-pencil test more than males with more females than males strongly agreeing that they enjoyed the test and more males than females strongly disagreeing that they enjoyed the test.²



Figure 29.

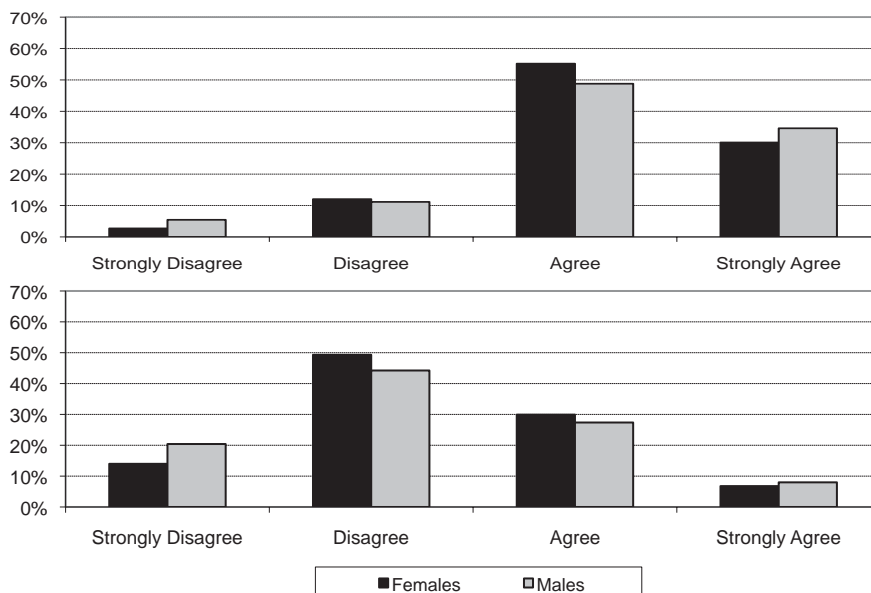
Icelandic students' endorsement of the statement "I found the CBAS test enjoyable" (top) and endorsement of the statement "I found the paper-and-pencil test enjoyable" (bottom)



In comparing Figure 29 to Figure 28 and Figure 30, one can note that Icelandic students overall show less enjoyment of the CBAS and the paper-and-pencil test compared to students in Denmark and Korea, indicating a specifically cultural pattern of low enjoyment reported by students.

Figure 30.

Korean students' endorsement of the statement "I found the CBAS test enjoyable" (top) and endorsement of the statement "I found the paper-and-pencil test enjoyable" (bottom)



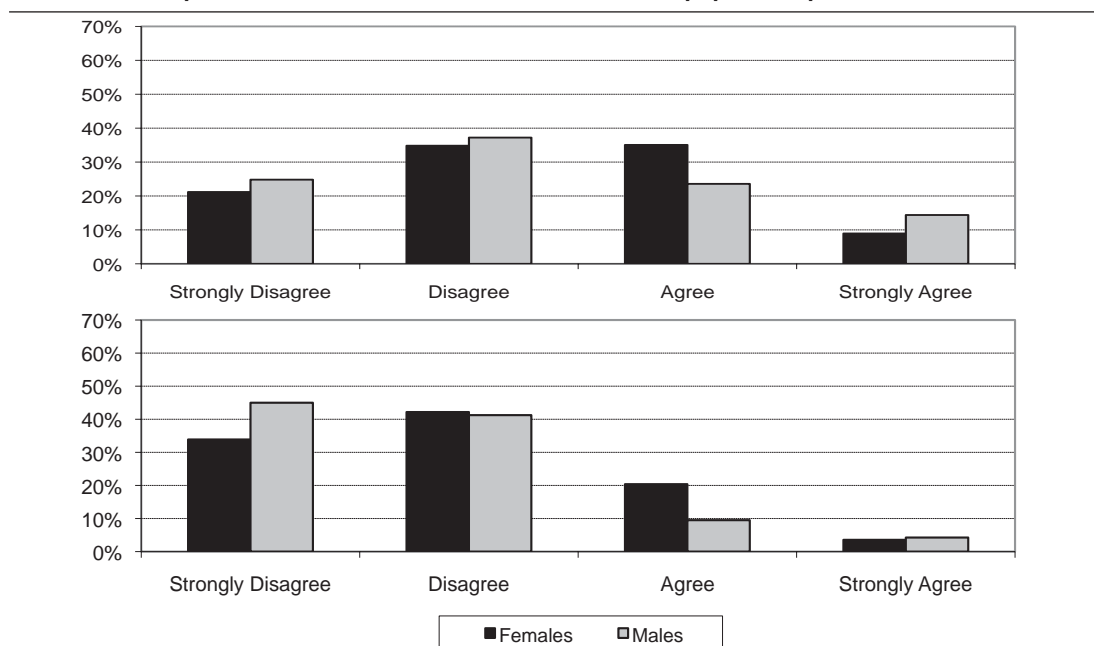


TEST MOTIVATION ACROSS TEST MODALITIES AND GENDERS

Similar to the results displayed regarding test enjoyment, Figure 31 below shows that in Denmark, males responses are more polarised than the female with more males strongly disagreeing with the statement that they would do the computer-based test “just for fun” and more males than females strongly agreeing that they would do the test “just for fun”. (Fisher’s exact test for probability shows that this difference is statistically significant (FET =16, $p < 0.05$). The figure also shows that motivation on the paper-and-pencil test was weaker with a stronger tendency for all students to disagree to ‘do the test just for fun’. However, again we observe a middle tendency for the females who are more likely to agree or disagree to do the paper-and-pencil test just for fun than males who are, in return, more likely to strongly disagree or strongly agree. (The Fisher’s exact test for probability shows this to be a statistically significant pattern (FET=23, $p < 0.05$).

Figure 31.

Danish students’ endorsement of the statement “I would do another computer-based test for fun” (top) and endorsement of “I would do another paper-and-pencil test for fun”



The pattern in Figure 32 in Iceland indicates a clearer trend with males more motivated than females on the CBAS test. Females are more likely than males to strongly disagree or disagree to do the computer-based test “just for fun” whereas males are more likely than females to agree or strongly agree. The Fisher’s exact test reveals however that these differences are not significant (FET =5, $p > 0.05$). Note that the patterns of motivation are relatively similar for the paper-and-pencil test of motivation with most Icelandic students disagreeing or strongly disagreeing to do the test “just for fun”. No gender differences are however apparent in motivation for this test (FET =3, $p > 0.05$). Again, Icelandic students appear to be the ‘least motivated’ out of students from all three countries, with the most common response being that they strongly disagree to do another test (regardless of modality) “just for fun”.



Figure 32.

Icelandic students' endorsement of the statement "I would do another computer-based test for fun" (top) and endorsement of "I would do another paper-and-pencil test for fun" (bottom)

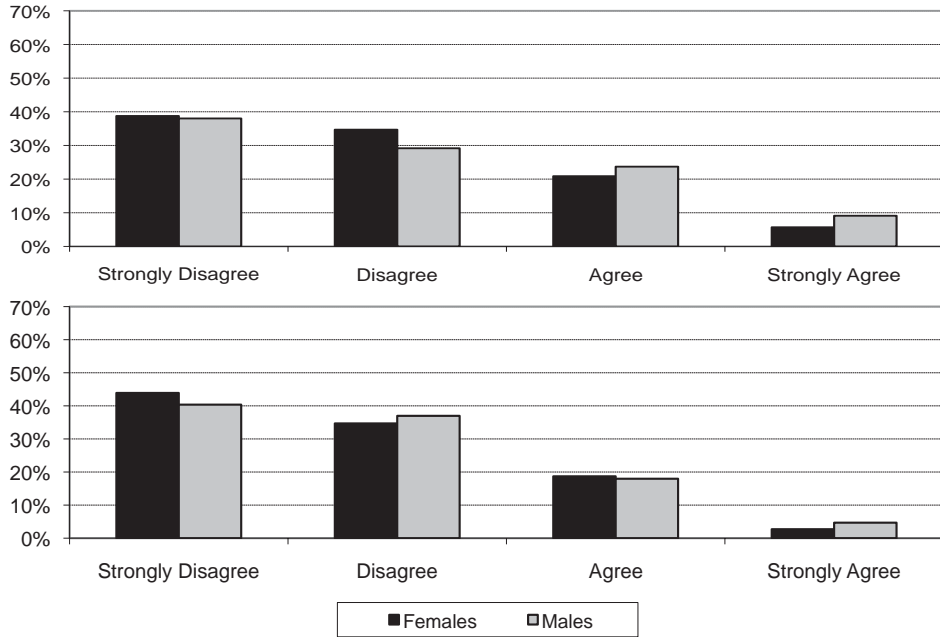
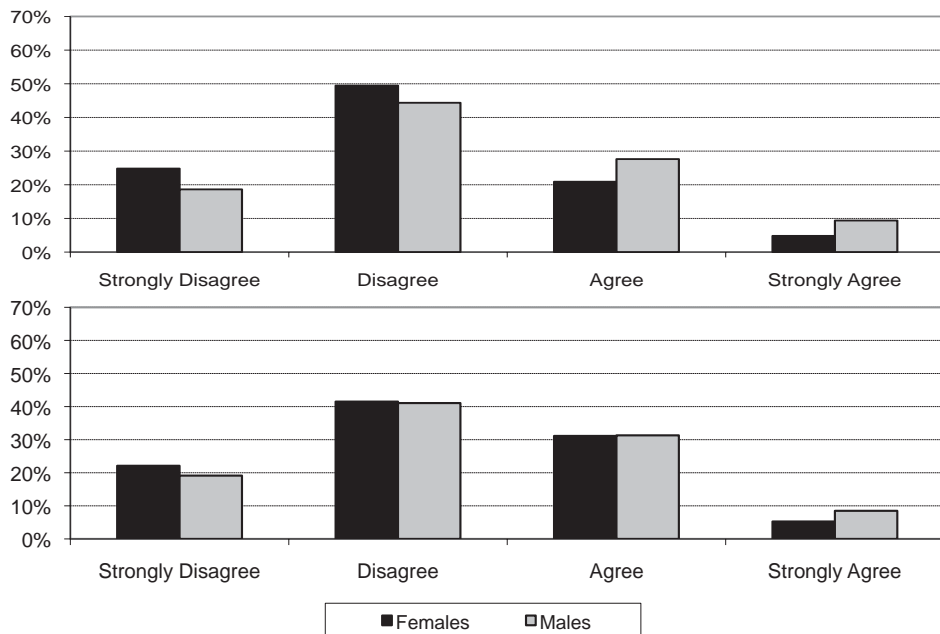


Figure 33.

Korean students' endorsement of the statement "I would do another computer-based test for fun" (top) and endorsement of "I would do another paper-and-pencil test for fun" (bottom)





Similarly, as Figure 33 displays, in Korea the males appear more motivated on the CBAS test with more females than males disagreeing or strongly disagreeing that they would do the computer-based test “just for fun” and more males than females agreeing or strongly agreeing that they would do the test “just for fun”. The Fisher’s test reveals that this is statistically significant (FET =25, $p < 0.05$). It is interesting to note that whereas approximately half of all students in Korea disagree to do the computer-based test just for fun, much fewer would disagree to do the paper-and-pencil test “just for fun”. This pattern is unique to Korea and is in direct contrast to the results observed in Denmark and Iceland. In terms of gender difference in motivation on the paper-and-pencil test, there is nothing to indicate that there are gender differences in the degrees of motivation (FET =7, $p > 0.05$).

RELATIVE EFFORT APPLIED TO TESTS ACROSS GENDERS

Table 18 displays the actual frequencies of responses to the question “Which test did you try harder on”. Gender differences per country are analysed and discussed in the following paragraphs.

Table 18.
Relative effort across genders and tests

		Put more effort into the CBAS test (N)	Same amount of effort on both tests (N)	Put more effort into paper-and- pencil test (N)
Denmark	Females	81	259	81
	Males	50	259	88
	Total	131	518	169
Iceland	Females	57	246	59
	Males	56	235	90
	Total	113	481	149
Korea	Females	123	398	145
	Males	148	449	189
	Total	271	847	334

As the responses to the question ‘Which test did you put more effort into’ in Figure 34 below show, the majority of students say that they put about equal amounts of effort into both tests. This contrasts with the effort thermometer results that we will examine later that indicate that students tried harder on CBAS, however it should be noted that these results show a strong middle tendency and that the effort thermometer may be a more sensitive measure. Fisher’s exact test reveals that a higher proportion of males in all three countries report that they put more effort into the CBAS test, whereas a higher proportion of females in Denmark and Iceland report that they put more effort into the paper-and-pencil test.³

Preference for the computer-based or paper-and-pencil test

Table 19 below displays the frequency counts for female and male responses to the question asking students to choose between a two hour paper-and-pencil test, a two hour computer-based test or one hour of each. Gender differences in each country are analysed and discussed in the following paragraphs.

Figure 35 clearly shows that on the whole, more students would prefer to do two hours of computer-based testing than two hours of paper-and-pencil testing. This directly supports the work of Singleton, 2001 and Zandvliet and Farragher, 1997 who found that students preferred computer-based testing to paper-and-pencil testing. In every country there were more females than males who would choose one hour of each test. Fisher’s exact probability test results however reveal that this gender difference is only significant in Iceland and Korea, and that in both of these countries there is a strong middle tendency from the females while the males out-represent the females both in the two categories of preference. Here again, it seems that females are more likely to “sit on the fence” or err towards the middle of an opinion-based continuum than males.⁴



Figure 34.
Male and female students' relative effort across assessments

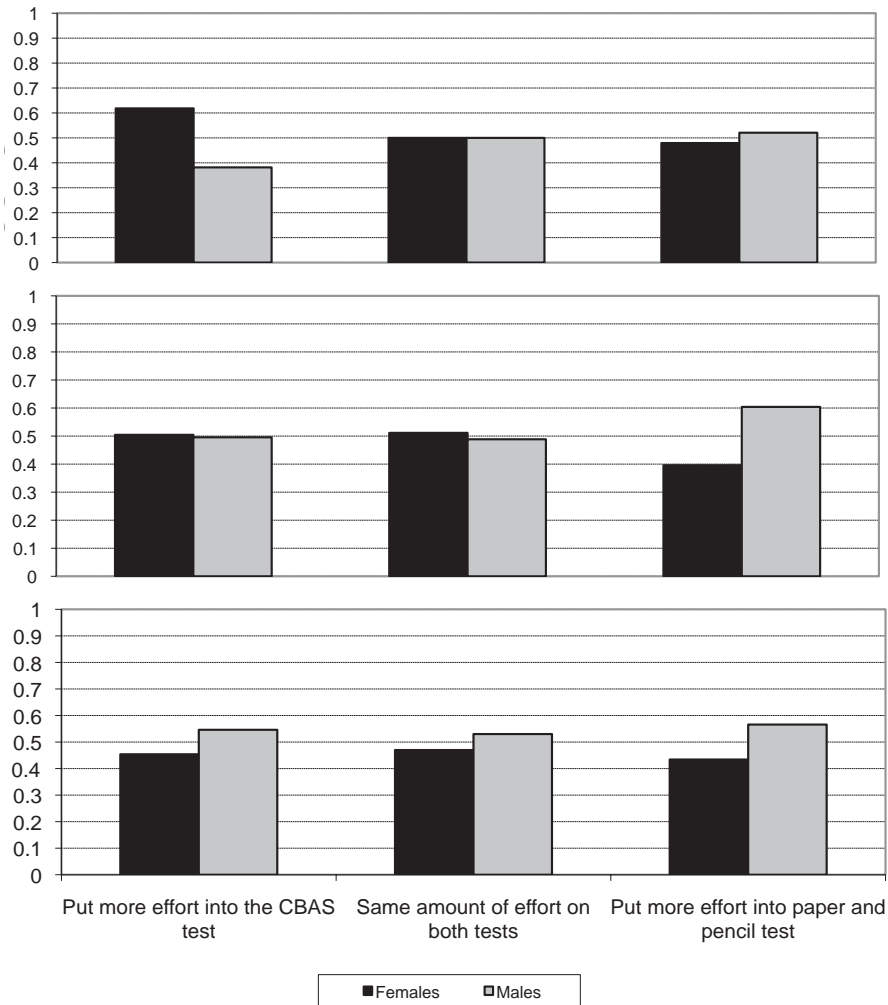
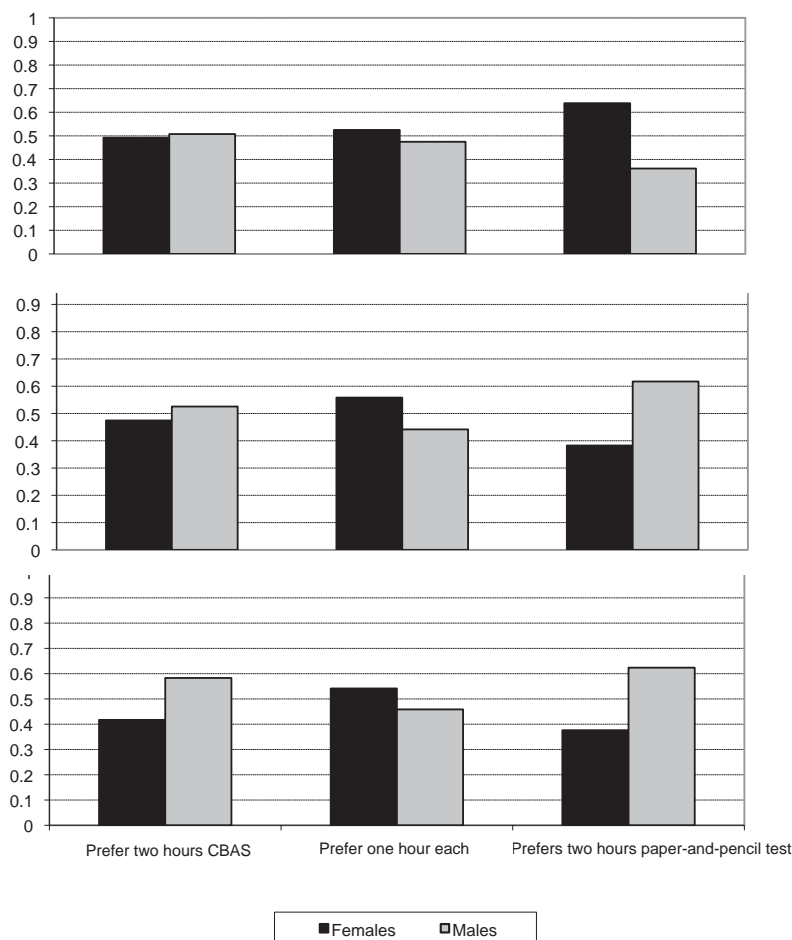


Table 19.
Female and male students' preference for the CBAS or paper-and-pencil test across countries

		Prefer two hours CBAS (N)	One hour each (N)	Prefer two hours paper-and-pencil (N)
Denmark	Females	226	168	30
	Males	233	152	17
	Total	459	320	47
Iceland	Females	167	158	44
	Males	185	125	71
	Total	352	283	115
Korea	Females	347	281	38
	Males	485	238	63
	Total	832	519	101



Figure 35.
Students' preference for the computer-based or paper-and-pencil test



Impacts of motivation and enjoyment on achievement

Figure 36 and Figure 37 show that, overall, there is no association between achievement and test motivation or test enjoyment. The only pattern appearing in Denmark seems to be that as males' motivation increases, their achievement decreases. In Iceland, again the females' response pattern differentiates from all other groups, as they are the only group to show a real association between higher motivation and enjoyment and higher achievement. Males in Iceland also slightly support this pattern, however, achievement drops off in the highest category of motivation. In Korea, greater enjoyment is to some extent associated with higher achievement for males and females.

If the relationship between enjoyment and performance is examined further by considering the correlations in Table 20, one sees that the link between these enjoyment and motivational factors and achievement is in fact very weak or non-existent. The only group that indicates a consistent association between higher motivation and enjoyment and higher achievement are the Icelandic females. The more the Icelandic females students enjoy the test or feel motivated towards the test, the higher they achieve, although the link is not strong. This is strong evidence to indicate that higher scores on the computer-based test, particularly for males, cannot solely be explained by greater enjoyment of the test.



Figure 36.
Motivation for CBAS test and achievement

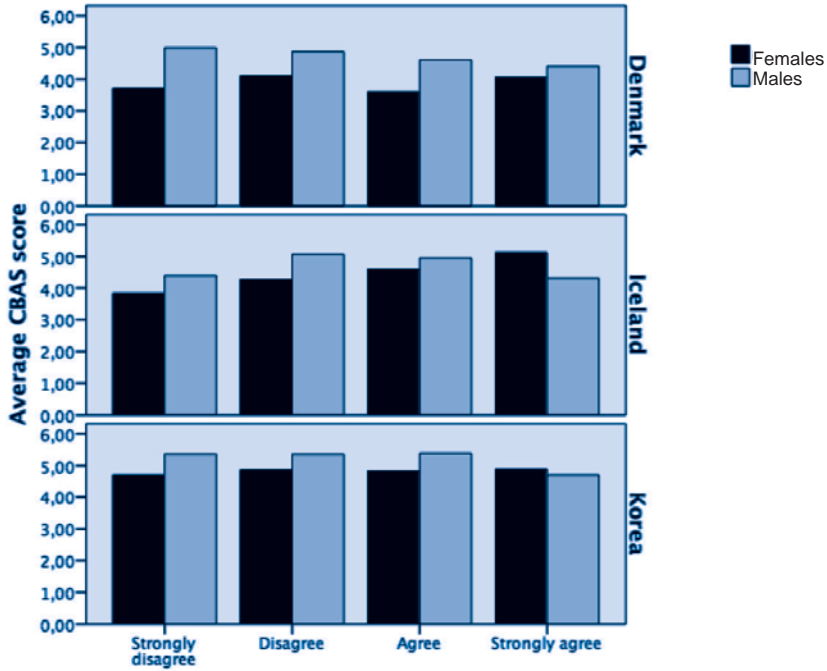


Figure 37.
Enjoyment of CBAS test and achievement

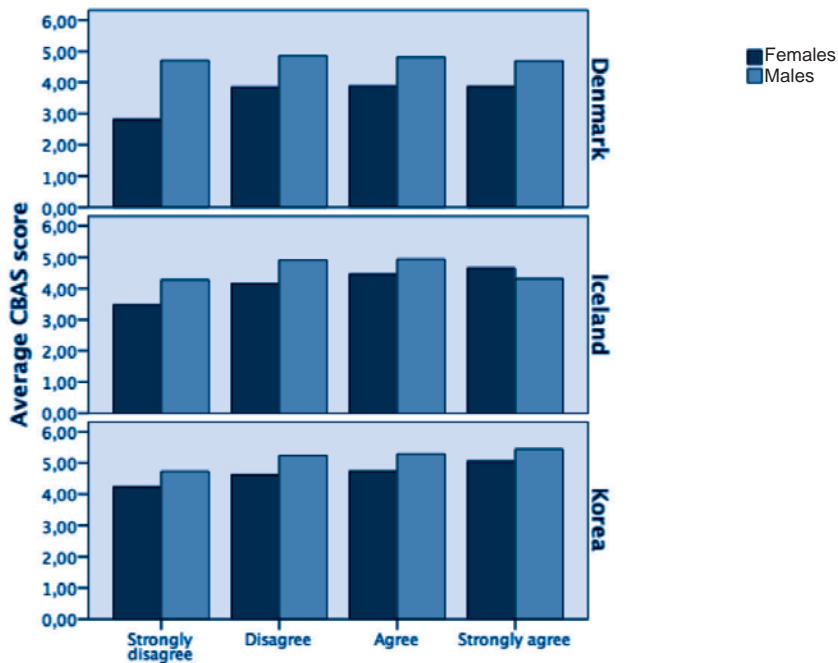




Table 20.
Correlations between CBAS enjoyment, motivation and achievement

	CBAS Enjoyment and achievement		CBAS Motivation and achievement		CBAS Motivation and enjoyment	
	Females	Males	Females	Males	Females	Males
Denmark	0.074	-0.020	-0.011	-0.117	0.347	0.386
Iceland	0.183	0.064	0.201	0.056	0.442	0.507
Korea	0.098	0.073	0.025	-0.058	0.319	0.310

*Correlations significant at the 0.05 level (2-tailed) are displayed in bold.

Figure 38 below displays the relationship between test motivation and the average performance on the paper-and-pencil science scale graphically. Here we see that as motivation increases for females in Denmark and Korea, performance also increases. For Korean males and Icelandic students, performance increases with motivation until the highest category of motivation giving an inverted U-shape distribution. Figure 39 shows the relationship between enjoyment and average achievement indicating that as enjoyment increases in Denmark, so does performance. The effects are similar in Korea but the relationship weaker. In Iceland, we see two inverted U-shape curves with performance increasing for males until the last category and performance increasing for females until the second response category. On the whole, no distinct patterns emerge other than a slightly stronger relationship between motivation and achievement for females, yet the correlations showed this to be weak.

Figure 38.
Motivation for paper-and-pencil test and paper-and-pencil science achievement

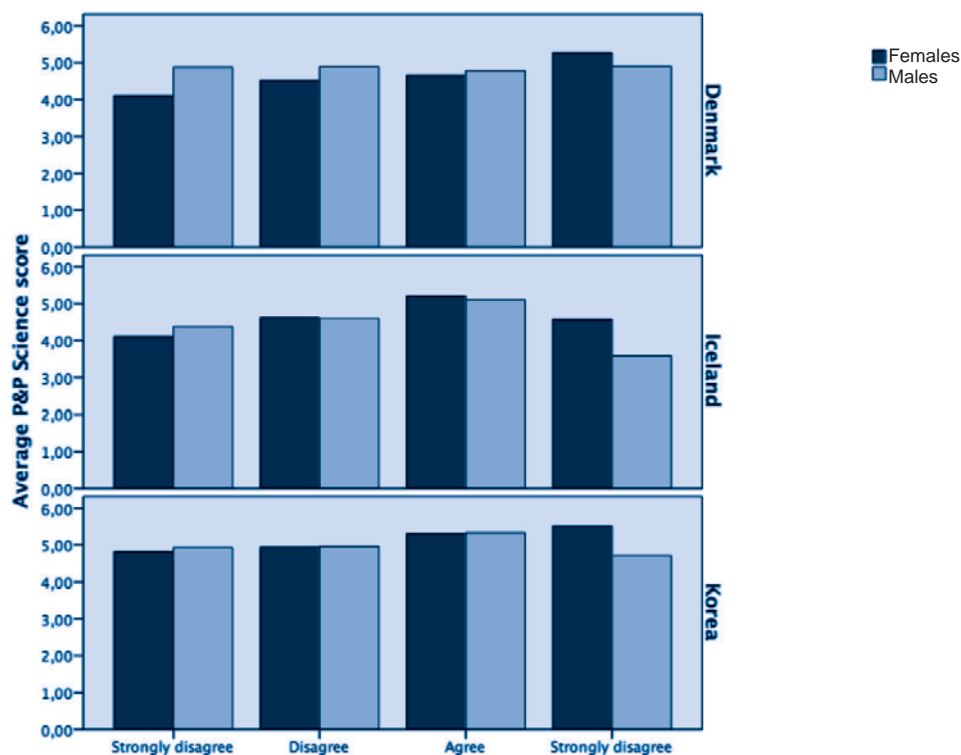




Figure 39.

Enjoyment of paper-and-pencil test and paper-and-pencil science achievement

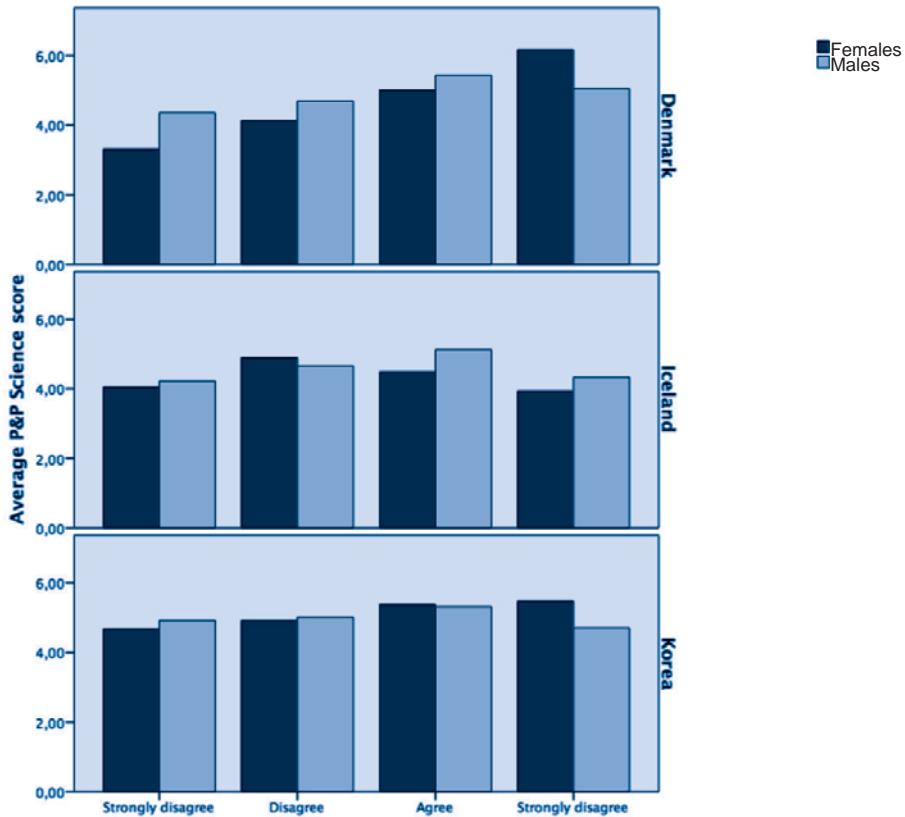


Table 21 shows the correlations between enjoyment, motivation and achievement on the paper-and-pencil test. In Denmark greater enjoyment of the paper-and-pencil test is associated with higher achievement for both males and females. For females in all three countries greater motivation for the test is associated with higher performance although all of these correlations are weak at best. However, this relationship is strongest in Iceland where females outperformed the males on the assessment of science by paper-and-pencil. Overall though, the poor strength of these relationships, along with the lack of clear patterns across countries, indicate that it is clearly not enjoyment and motivation that are causing the increase in performance for males when the test is presented via the computer.

Table 21.

Correlations between paper-and-pencil enjoyment, paper and pencil motivation and paper-and-pencil achievement

	Paper-and-pencil enjoyment and achievement		Paper-and-pencil motivation and achievement		Paper-and-pencil motivation and enjoyment	
	Females	Males	Females	Males	Females	Males
Denmark	0.331	0.199	0.125	-0.005	0.432	0.418
Iceland	0.074	0.135	0.179	0.044	0.388	0.474
Korea	0.138	0.025	0.112	0.031	0.360	0.343

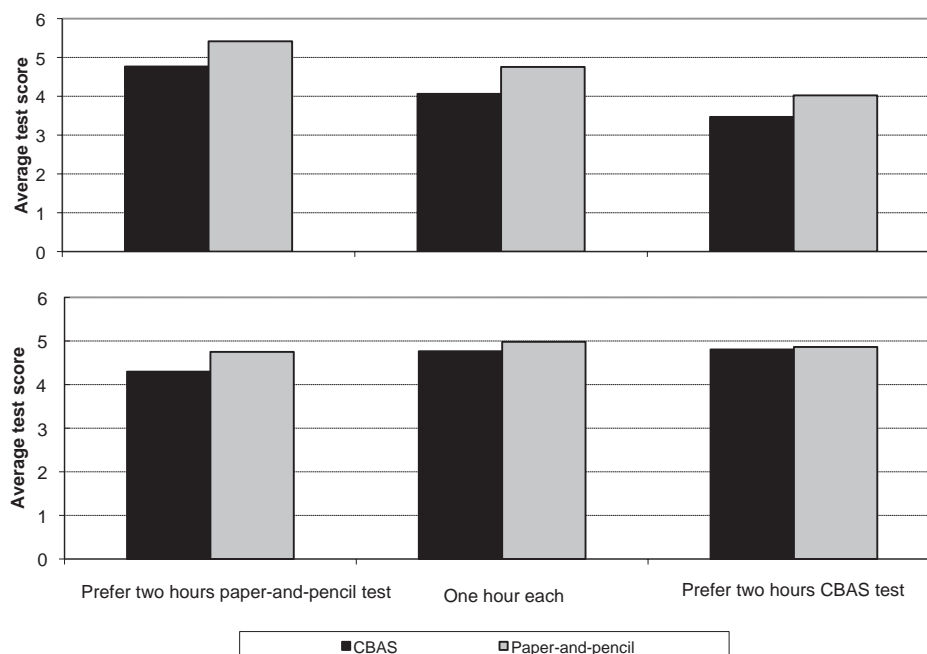
*Correlations significant at the 0.05 level (2-tailed) are displayed in bold.



IMPACTS OF TEST PREFERENCE AND RELATIVE EFFORT ON ACHIEVEMENT

The three figures below display the relationship in each country between test preference and achievement on the paper-based and the computer-based tests. Figure 40 shows that in Denmark the patterns are quite different for females and males. Females that would prefer a two-hour computer-based test score lower than females that prefer the paper-based test and those that would choose equal amounts of both. In contrast, the males who prefer the paper-based test score below the males that prefer the CBAS test and those that would choose equal amounts of both.

Figure 40.
Average CBAS and paper-and-pencil science achievement and test preference for Danish females (top) and males (bottom)



The Icelandic results in Figure 41 do not show any clear differences in achievement based on gender, nor on preference for either type of test.

Figure 42 shows that females in Korea who prefer to do a two hour paper-based test actually score well below females who would choose equal amounts of both types of tests or who would prefer the computer-based test, on both tests.



Figure 41.

Average CBAS and paper-and-pencil science achievement and test preference for Icelandic females (top) and males (bottom)

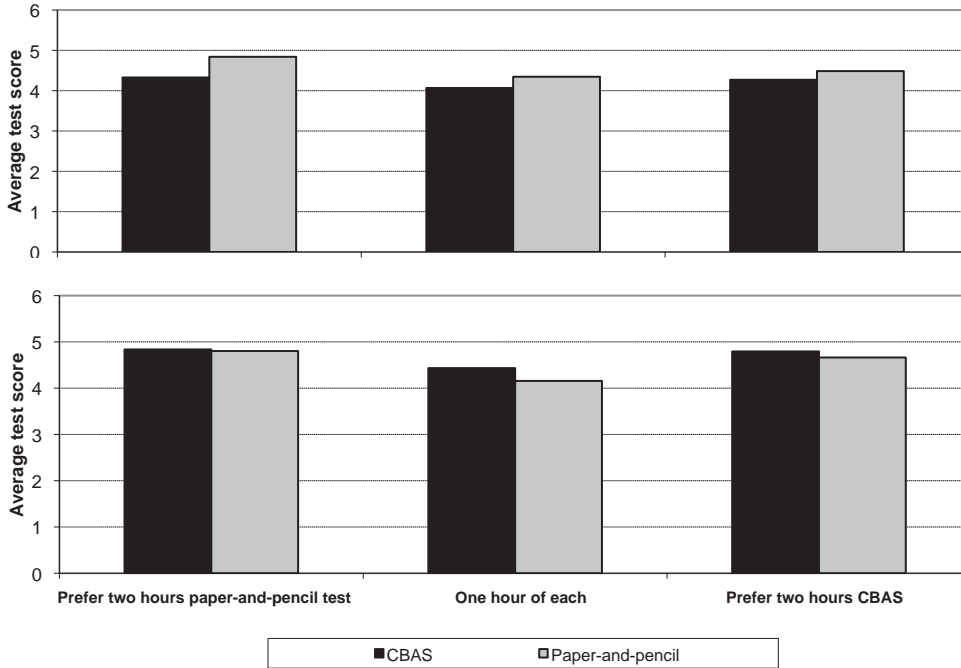


Figure 42.

Average CBAS and paper-and-pencil science achievement and test preference for Korean females (top) and males (bottom)

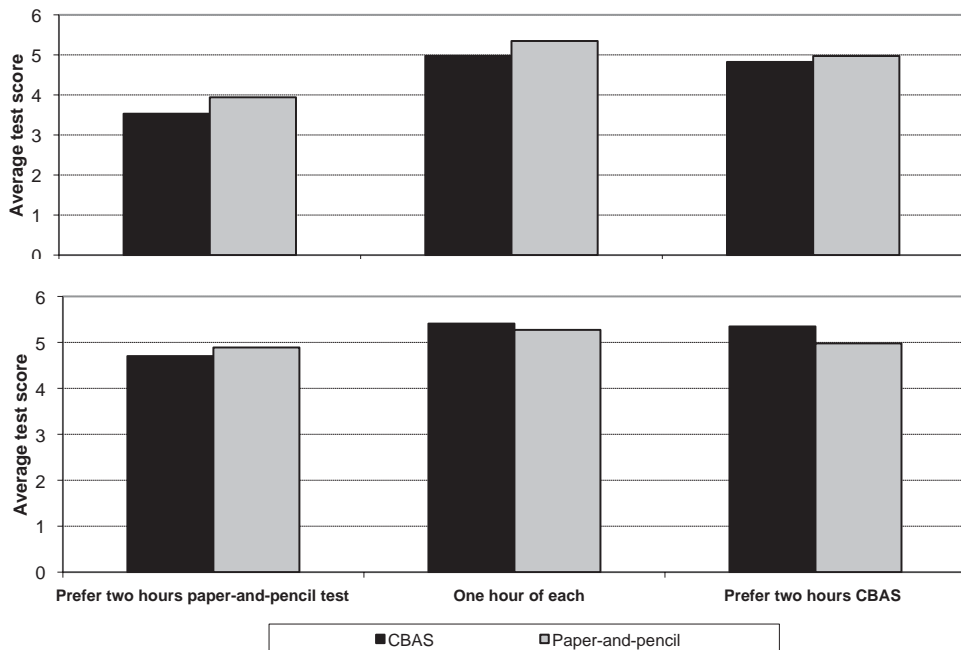




Figure 43.
Average CBAS and paper-and-pencil science achievement and relative effort on tests for Danish females (top) and males (bottom)

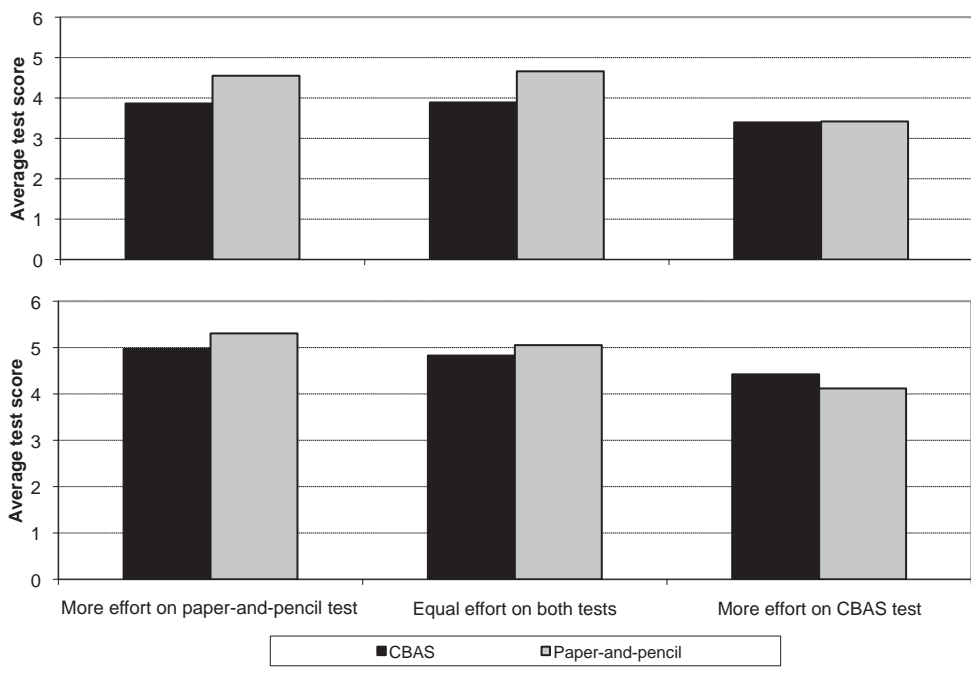


Figure 44.
Average CBAS and paper-and-pencil science achievement and relative effort on tests for Icelandic females (top) and males (bottom)

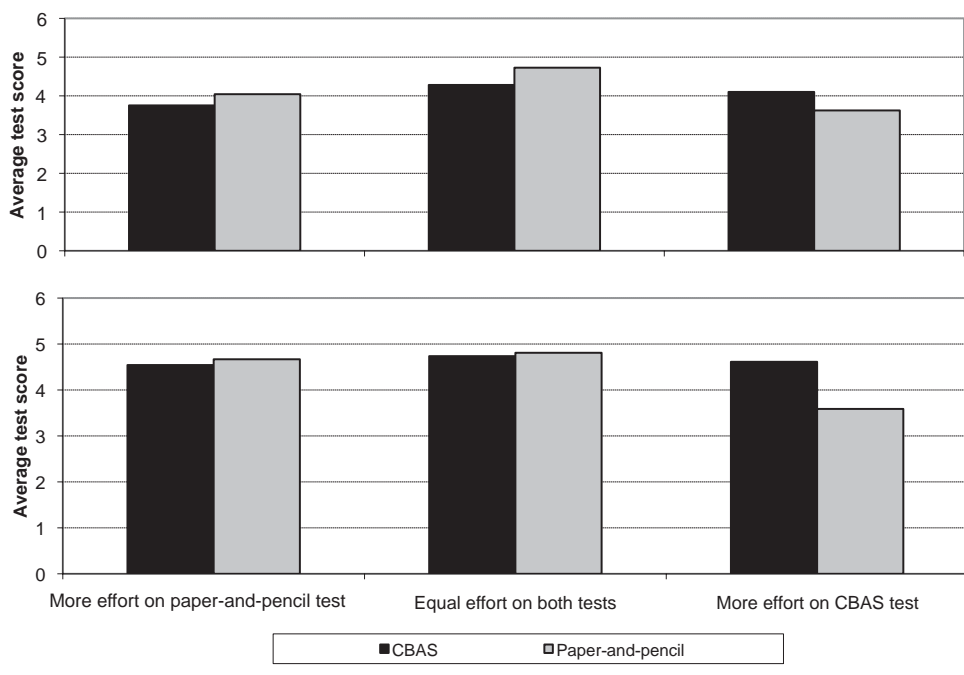
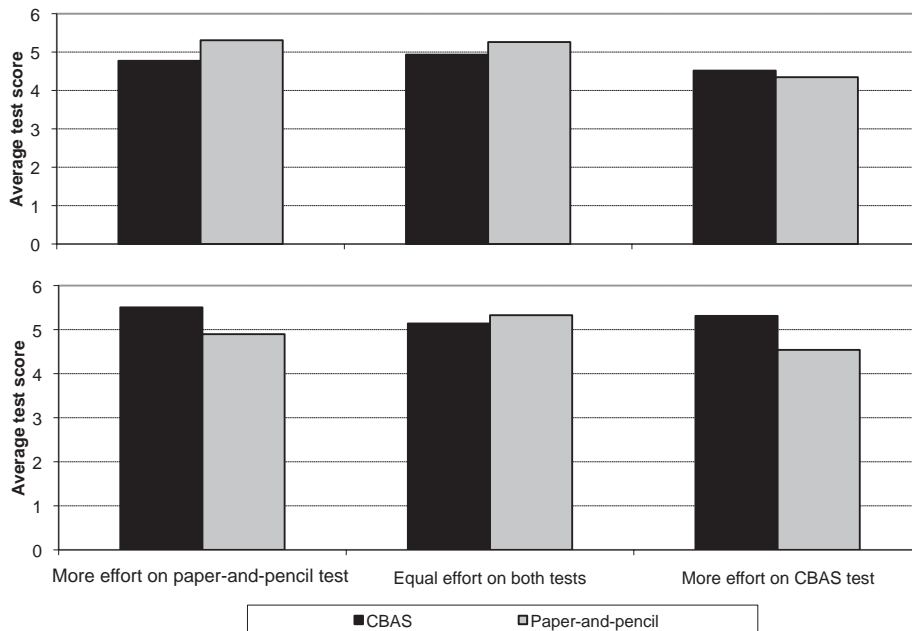




Figure 45.
Average CBAS and paper-and-pencil science achievement and relative effort on tests for Korean females (top) and males (bottom)



As Figure 43 and Figure 44 show, there does not appear to be an association in any country between whether a student worked harder on CBAS or the paper-and-pencil science test and achievement on either test.

STUDENTS' REPORTED EFFORT ON PISA AND CBAS: WHAT THE EFFORT THERMOMETER SHOWS

This section examines reported effort from the PISA effort thermometer across tests, countries and genders, looking at the differences between effort employed in the test and conditional effort reported if the test would have counted for school marks. These findings are considered in relation to the achievement results.

On average, students reported that they put more effort into the computer-based test than on the paper-and-pencil test.

The difference between actual effort reported and conditional effort reported if the test would have counted for school marks was greater on the paper-and-pencil test than on the computer-based test, particularly for males.

Greater reported effort was associated with higher achievement on the paper-and-pencil test but not on the CBAS test.

On average, students reported that they tried 5% harder on the CBAS test than on the paper-and-pencil test of science. Considering that the vast majority of student responses were in top 40% of the scale (between 6 and 10 on the thermometer), a 5% increase in effort within this range is considerable. As displayed in Table 22, females in Denmark and Iceland on average reported that they put in more effort than males on both the paper-and-pencil and the computer-based test, whereas the reverse was true in Korea. The amount of effort reported in Iceland overall was inferior to the amounts reported in Denmark and Korea.

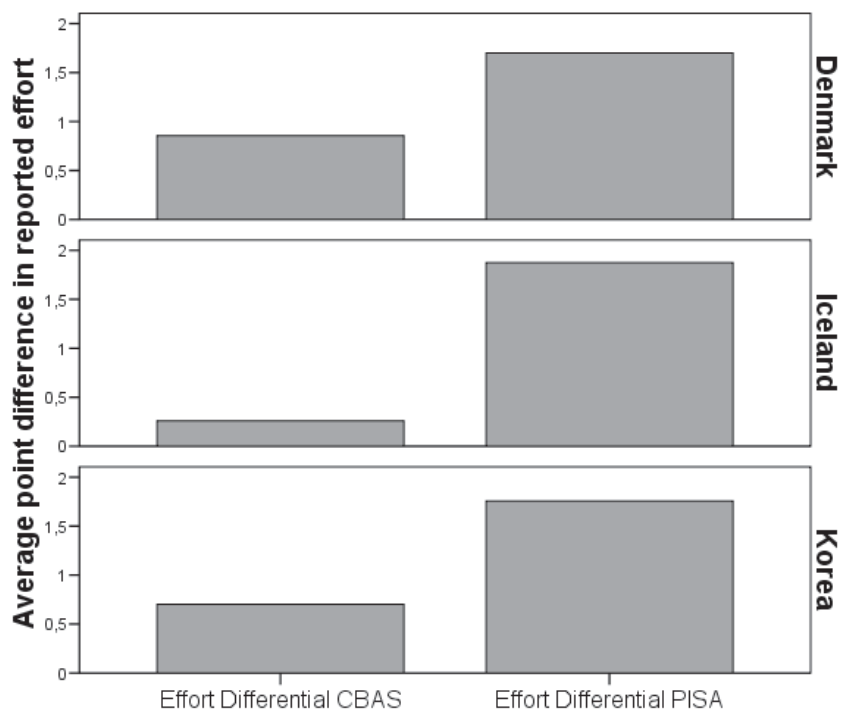


Table 22.
Average reported effort per country for the CBAS and the paper-and-pencil tests

Effort thermometer results		Average reported effort on CBAS (out of 10)	S.E. of mean	Average reported effort on PISA (out of 10)	S.E. of mean
Denmark	Females	8.42	0.06	8.18	0.07
	Males	8.01	0.09	7.90	0.08
Iceland	Females	7.78	0.08	7.71	0.09
	Males	7.68	0.10	7.37	0.12
Korea	Females	8.03	0.06	7.41	0.07
	Males	8.12	0.06	7.54	0.07
Total		8.09	0.003	7.54	0.002

The reported effort scores were converted to differential scores which reflect the difference between the real effort and the student’s estimate of conditional effort if the test had counted for school marks (as covered in the methodology section). Overall, 73% of students across countries said that they would not have tried any harder if the CBAS test had counted for school marks. This is a very different pattern from the pattern one can observe on the paper-and-pencil effort thermometer scores where only 23% of students said that they would not have put any more effort in if the paper-and-pencil test counted for school marks. A further 23% said they would have tried 1 degree harder on the effort thermometer and an additional 23% said they would have tried 2 degrees harder. As Figure 46 illustrates, on average, PISA effort differential scores were higher

Figure 46.
Effort differential for CBAS and PISA across countries





than CBAS differential scores. Given that the CBAS effort scores were higher than the paper-and-pencil effort scores, this indicates either that students were trying close to their maximum on the CBAS test, (perhaps due to greater enjoyment of the test), and thus the scale did not allow them to report a significant increase in effort employed if the test had counted. Another explanation is that due to the novelty of the computer-based testing situation, students found it more difficult to imagine that a computer-based test would really count for final academic marks and as a result their responses do not reflect as accurately the effort they would have manifested. This theory is supported by the higher reported effort in Denmark and Iceland if the CBAS test had counted compared to if the paper-and-pencil test had counted as shown in Table 23 below.

Table 23.

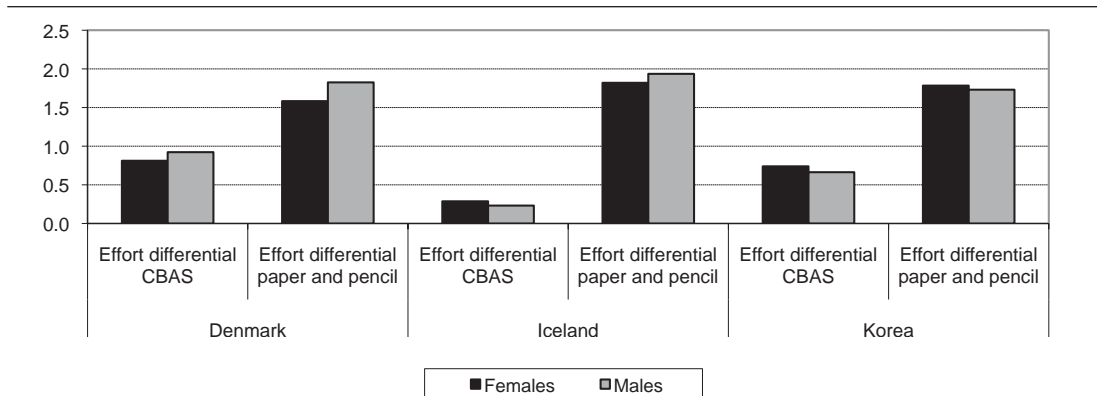
Average reported effort if the CBAS and the paper-and-pencil tests had counted for school marks

	CBAS effort if counted	S.E. of mean	Paper-and-pencil effort if counted	S.E. of mean
Denmark	9.5	0.05	9.7	0.03
Iceland	9.0	0.05	9.3	0.02
Korea	9.4	0.04	9.2	0.03

Figure 47 below shows the gender differences in the gap between reported effort and predicted effort. The gap between reported effort and conditional effort for males was greater than for females in Denmark. In Iceland, the differences are small but show a reversal in that the gap in females' reported effort and conditional effort is greater on CBAS but inferior on paper-and-pencil. In Korea, again the differences are too small to be noteworthy. Overall, only in Denmark it can be confidently said that males report that they would have increased their effort more than females do if the test (either computer-based or paper-and-pencil) had counted.

Figure 47.

How much harder students would have tried if the results of CBAS and the paper-and-pencil test counted for school marks



RELATIONSHIP BETWEEN REPORTED EFFORT AND ACHIEVEMENT

Figure 48 and Figure 49 below display the relationship between effort reported on the effort thermometer and achievement for males and females across countries. Only effort thermometer scores with at least five percent of overall responses are displayed. The figures only a slight tendency towards higher achievement as reported effort increases across all three countries. In contrast, the relationship between paper-and-pencil reported effort and PISA science achievement is clearly shown as a positive relationship; achievement increases with reported effort for both males and females across all three countries.



Figure 48.
CBAS reported effort and achievement across countries

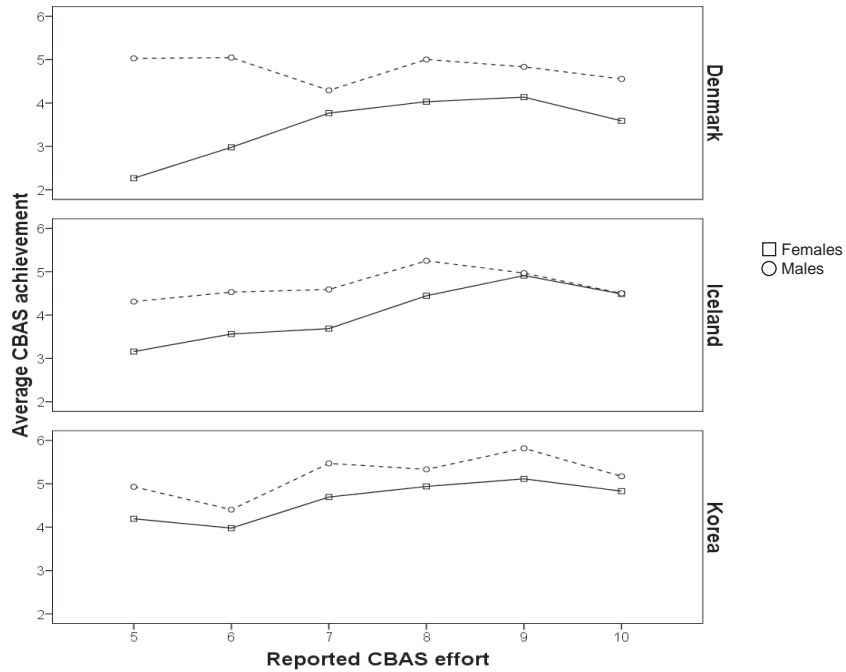
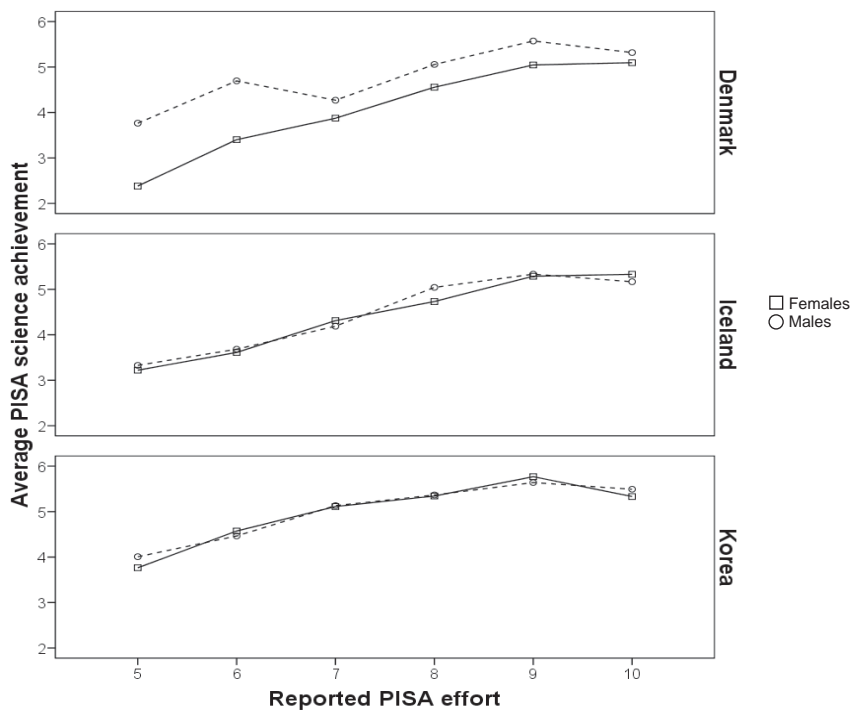


Figure 49.
PISA reported effort and PISA science achievement





The correlation data in Table 24 confirm these trends, showing us that for the paper-and-pencil test, if a student reported that they had put a lot of effort into the test, this was associated with higher performance across all countries and for both males and females. For the CBAS test this relationship was much weaker, particularly for the males.

Table 24.
Correlations between reported effort and achievement

	Paper-and-pencil effort and achievement			CBAS effort and achievement			CBAS reported effort and paper-and-pencil reported effort		
	Females	Males	Total	Females	Males	Total	Females	Males	Total
Denmark	0.40	0.28	0.32	0.14	-0.05	0.01	0.41	0.48	0.46
Iceland	0.42	0.42	0.42	0.31	0.17	0.23	0.37	0.31	0.34
Korea	0.26	0.25	0.25	0.12	0.11	0.12	0.60	0.52	0.55

The results displayed in Table 24 are surprising and warrant further consideration. While higher reported effort predicts better performance on the paper-and-pencil test in all countries across both genders, one finds that the relationship between reported effort and performance on the computer-based test is much weaker, even though the same instrument for measuring effort was utilised (one presented on screen and one presented on paper). Either, students do not respond to the item in the same way when it is presented on screen as compared to on paper, or there is something different in the way that achievement on a computer-based test is related to effort in comparison to the traditional paper-and-pencil tests. The fact that the effort reported on the paper-and-pencil test is a better predictor of CBAS achievement than the effort that students reported on the CBAS⁵ test, suggests students respond to the effort thermometer in a different manner (more aligned with the way the item was designed to function) when it is presented on paper than when it is presented on computer. One explanation of this may be that perhaps students are more familiar and thus more accurate reporting their actual effort on a paper-and-pencil test than on a computer test.

As we see in Figure 50 and Figure 51 below, both distributions are negatively skewed with the majority of responses occurring in the top 30% of the effort thermometer. However, since the two distributions are skewed in the same way and approximately to the same degree, this alone cannot explain the large differences in the strength of the relationship between reported effort on the test and achievement on the computer-based or on the paper-and-pencil test.



Figure 50.
Distribution of effort thermometer scores in PISA paper-and-pencil test

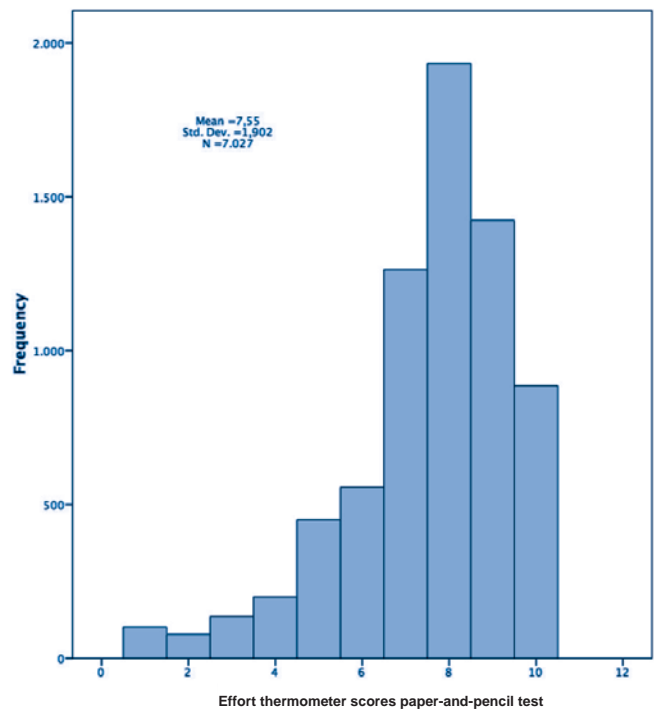
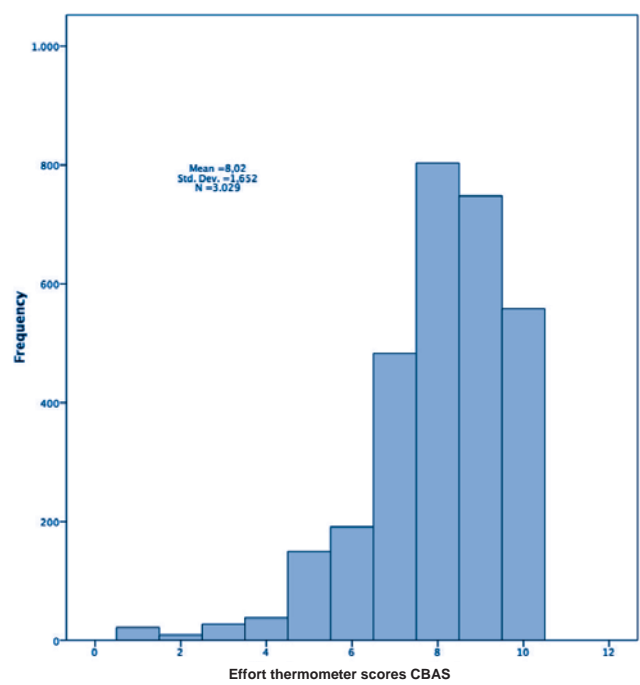


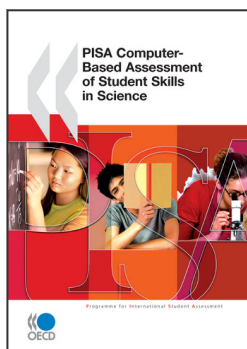
Figure 51.
Distribution of effort thermometer scores in CBAS test





Notes

1. Paper-and-pencil: Denmark (FET =16, $p<0.05$), Iceland (FET =0.9) , $p>0.05$) and Korea (FET =12, $p<0.05$)
2. Denmark (FET =7, $p<0.05$), Iceland (FET =6, $p<0.05$) and Korea (FET =1, $p>0.05$)
3. Denmark (FET =4, $p>0.05$), Iceland (FET =11, $p<0.05$) and Korea (FET=23, $p<0.05$)
4. Denmark (Females: $r=0.33$, Males: $r=0.23$), Iceland (Females: $r=0.30$, Males: $r=0.31$), Korea (Females: $r=0.21$, Males: $r=0.19$)
5. Denmark (Female: $r=0.33$, Male: $r=0.23$), Iceland (Female: $r=0.30$, Male: $r=0.31$), Korea (Female: $r=0.21$, Male: $r=0.19$)



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