Online Supplement

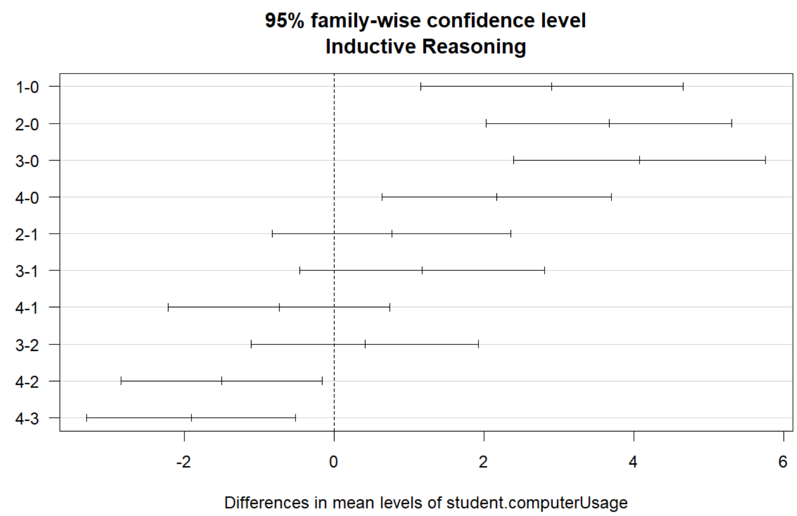

Figure 1 Post hoc contrasts between groups (0 no PC use, 4 daily use) for Inductive Reasoning.

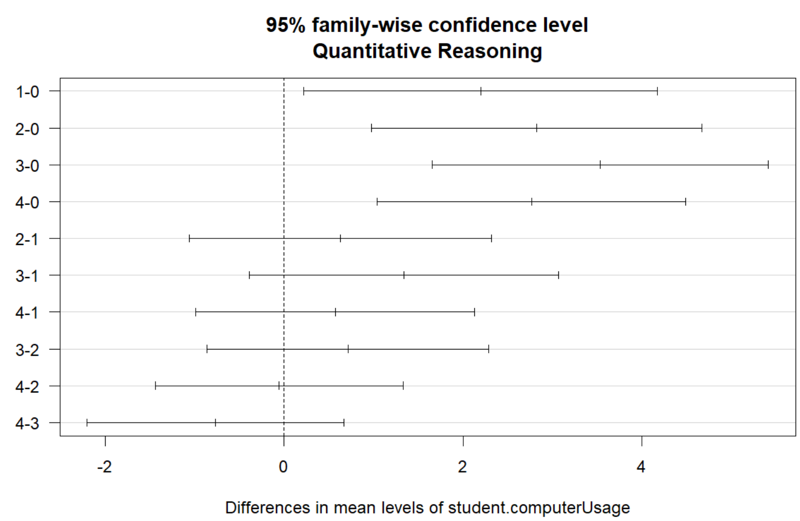

Figure 2 Post hoc contrasts between groups (0 no PC use, 4 daily use) for Quantitative reasoning.

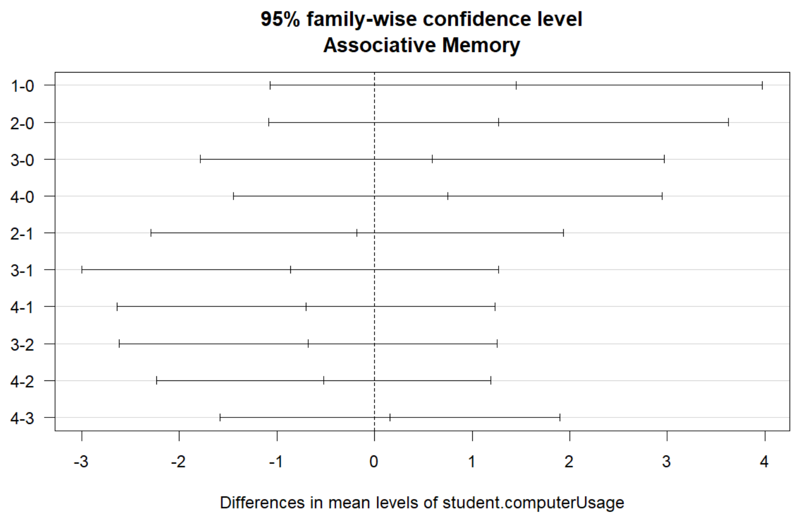

Figure 3 Post hoc contrasts between groups (0 no PC use, 4 daily use) for Associative Memory.

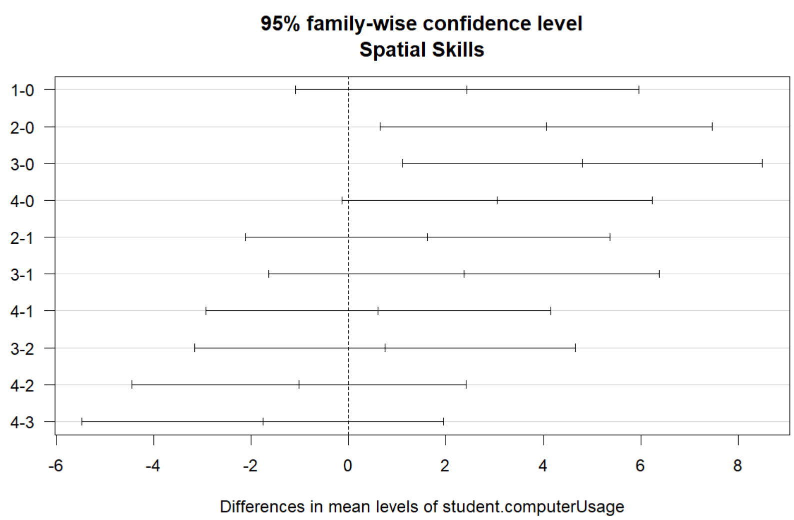

Figure 4 Post hoc contrasts between groups (0 no PC use, 4 daily use) for Spatial Skills.

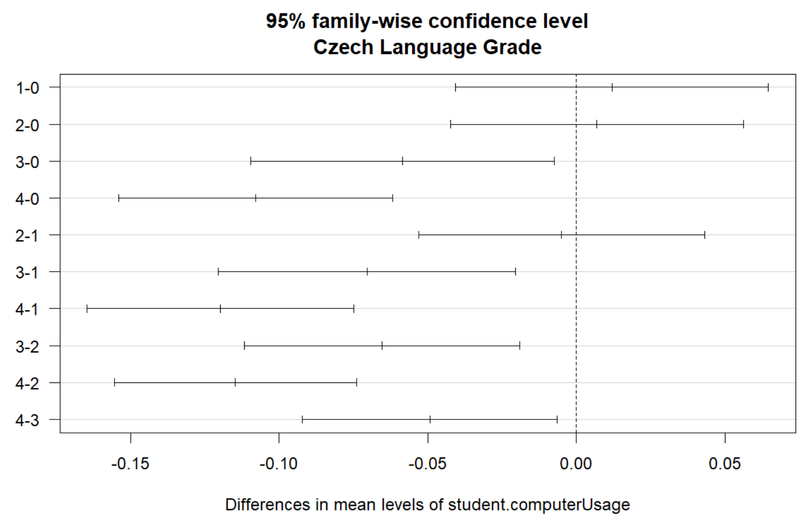

Figure 5 Post hoc contrasts between groups (0 no PC use, 4 daily use) for Czech.

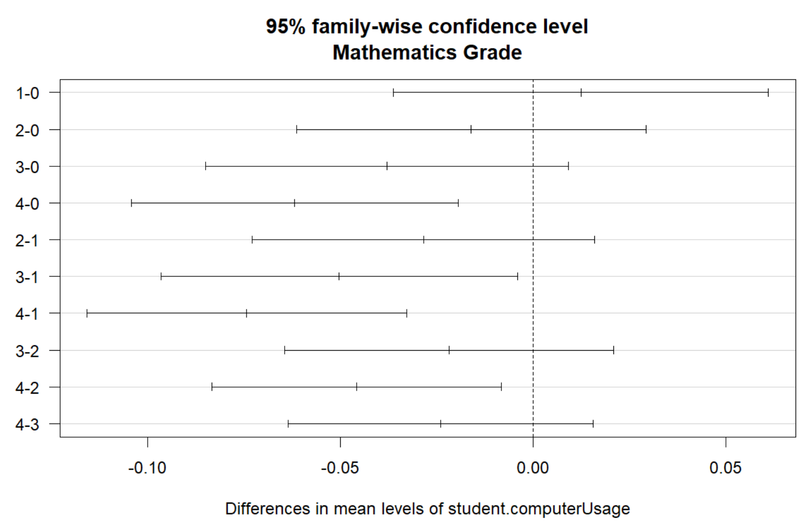

Figure 6 Post hoc contrasts between groups (0 no PC use, 4 daily use) for math.

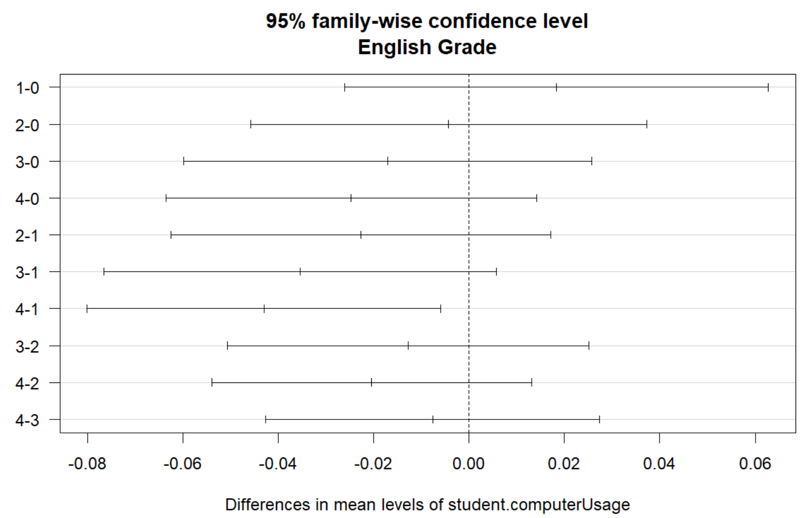

Figure 7 Post hoc contrasts between groups (0 no PC use, 4 daily use) for English.

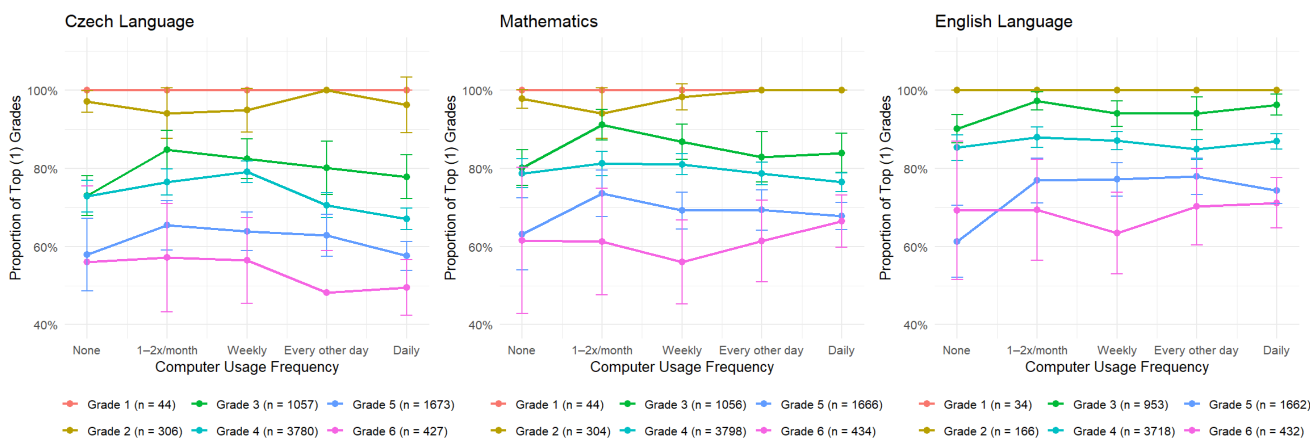

Figure 8 The proportion of students with top grades by computer use and student grade level.

Robustness checks: Analyses of a subsample of fourth-grade students

To rule out age as a potential confounder, analyses were repeated separately for fourth-grade students (N = 5,844). The pattern of means is shown in Figure 9 below.

For inductive reasoning, the subsample replicates the main pattern, with a significant effect of computer use frequency, $F(4, 3940) = 5.20$, $p < .001$. Quantitative reasoning shows the same convergence, again yielding a significant effect, $F(4, 3874) = 6.24$, $p < .001$. Associative memory also aligns with the main analyses, showing no meaningful differences across computer-use groups, $F(4, 3253) = 0.62$, $p = .65$.

For spatial skills, the descriptive pattern follows the same ordering as in the full sample, but the effect is not statistically significant in the subsample, $F(4, 255) = 2.05$, $p = .088$. This is likely due to the smaller number of observations (260 test score and usage non-missing pairs), which limits statistical power, even though the group means show the same, indeed even more pronounced, trend.

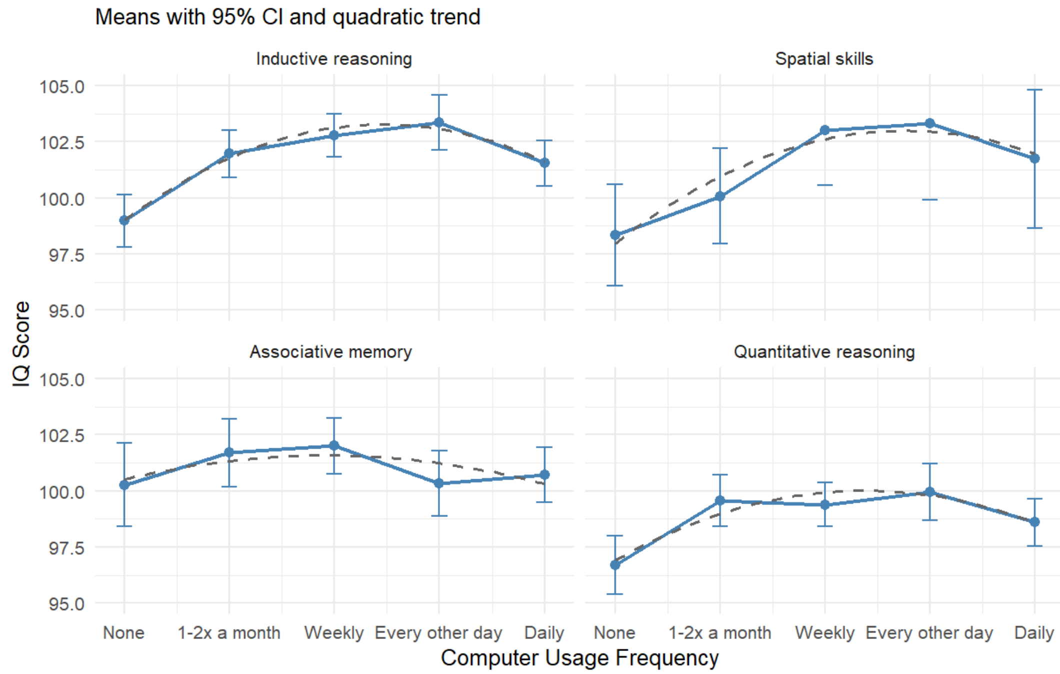

Figure 9 The distribution of IQ means by computer use for a subsample of fourth-grade students.

When it comes to confirming the nonlinear trends using multiple regression, across the three domains, the fourth-grade subsample largely reproduces the patterns observed in the full sample.
For inductive reasoning, the fourth-grade models closely match the main results. The quadratic term remains negative and significant in all adjusted models, and both parental education and solving time show strong positive effects. The size of the nonlinear component is slightly smaller than in the full sample, but the overall pattern and explanatory power (adjusted R^2 = .100) are nearly identical, supporting the robustness of the inverted-U trend.
For spatial skills, the subsample does not replicate the main nonlinear effect. Neither the linear nor the quadratic term reaches significance in any model, and parental education also shows no reliable association, reflecting the limited statistical power due to a smaller sample (n = 240). The descriptive pattern still follows the same trend as in the main sample, however.
For quantitative reasoning, the fourth-grade results align closely with the main findings. Both computer-use terms remain significant across all models, and the quadratic term retains its negative direction and significance even after adjusting for parental education and solving time. The effect sizes are slightly smaller than in the full sample but remain robust, and the full model explains a similar proportion of variance (adjusted R^2 = .106).
Overall, the nonlinear pattern is replicated for inductive and quantitative reasoning but not for spatial skills, where the reduced sample size limits statistical power despite similar trends.

Table 1 *Coefficients for regression models predicting inductive reasoning*

N = 3,672	**Model 0**	**Model 1**	**Model 2: + Par. Education**	**Model 3: + Solving Time**
Computer use (linear)	1.18	1.18	1.13	2.20*
Computer use (quadratic)		-4.27***	-3.39***	-3.17***
Parental highest education			0.23***	0.24***
Solving time				0.23***

R²	.000	.005	.058	.102
Adj. R²	.000	.005	.057	.100

Note. The outcome and covariates (parental education, solving time) were standardized. Computer-use predictors are orthogonal polynomial components derived from the standardized computer-use variable and, therefore, are not on a standardized scale. R^2 represents the proportion of variance explained; Adjusted R^2 accounts for model complexity.
** p < .01; *** p < .001

Table 2 *Coefficients for regression models predicting spatial skills*

N = 240	**Model 0**	**Model 1**	**Model 2: + Par. Education**	**Model 3: + Solving Time**
Computer use (linear)	1.53	1.53	1.47	1.65
Computer use (quadratic)		-1.62	-1.46	-1.31
Parental highest education			0.07	0.06
Solving time				0.14*
R²	.010	.021	.025	.050
Adj. R²	.006	.013	.013	.033

Note. The outcome and covariates (parental education, solving time) were standardized. Computer-use predictors are orthogonal polynomial components derived from the standardized computer-use variable and, therefore, are not on a standardized scale. R^2 represents the proportion of variance explained; Adjusted R^2 accounts for model complexity.
** p < .01; *** p < .001

Table 3 *Coefficients for regression models predicting quantitative reasoning.*

N = 3,613	**Model 0**	**Model 1**	**Model 2: + Par. Education**	**Model 3: + Solving Time**
Computer use (linear)	2.41*	2.41*	2.50*	3.19***
Computer use (quadratic)		-3.53***	-2.61**	-2.22*
Parental highest education			0.25***	0.22***
Solving time				0.22***
R²	.002	.005	.063	.107
Adj. R²	.001	.004	.063	.106

Note. The outcome and covariates (parental education, solving time) were standardized. Computer-use predictors are orthogonal polynomial components derived from the standardized computer-use variable and, therefore, are not on a standardized scale. R^2 represents the proportion of variance explained; Adjusted R^2 accounts for model complexity.
** p < .01; *** p < .001

Robustness checks: Analyses by gender

To assess whether the findings hold across gender subgroups, analyses were repeated separately for boys (N = 5,852) and girls (N = 5,477). The pattern of means is shown in Figure 10.
For inductive reasoning, both boys and girls show significant effects of computer use, $F(4, 3686) = 8.31$, $p < .001$, and $F(4, 3412) = 14.52$, $p < .001$, respectively, reproducing the main inverted-U pattern. Quantitative reasoning also shows the same U-shaped pattern in both groups, with performance peaking at moderate use and declining at the extremes; however, the effect reaches significance only for girls, $F(4, 3287) = 2.62$, $p = .033$, while the boys' test remains non-significant, $F(4, 3544) = 1.32$, $p = .26$, reflecting the small effect size rather than a different trend. For associative memory, the subgroup analyses diverge from the full-sample result (which showed no differences across usage groups), with boys showing a clear effect, $F(4, 2627) = 22.14$, $p < .001$, and girls showing a smaller but still significant effect, $F(4, 2427) = 10.15$, $p < .001$. Spatial skills show no significant effects in either subgroup, $F(4, 652) = 0.50$, $p = .74$ for boys and $F(4, 582) = 0.77$, $p = .55$ for girls, likely due to the limited number of available observations despite the descriptive means following the same ordering as in the full sample.

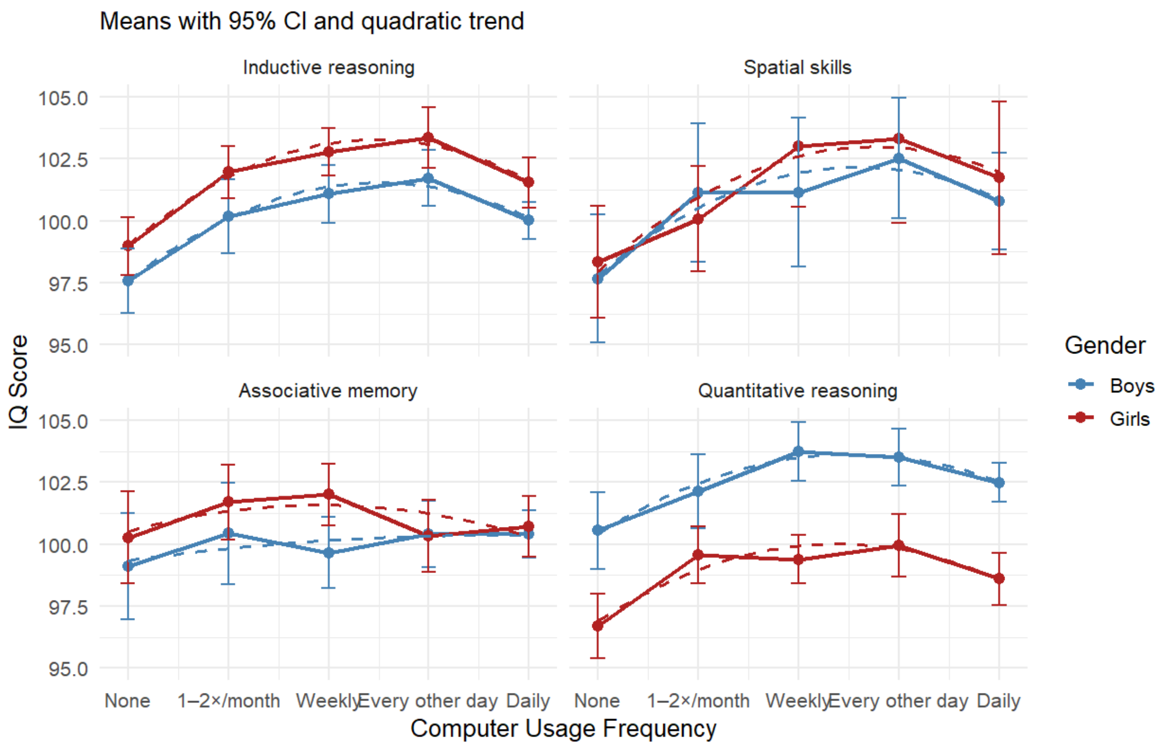

Figure 10 The distribution of IQ means by computer use, split by gender.

Across the four domains, the hierarchical regressions largely reproduced the patterns observed in the full sample. For spatial skills, the regression coefficients for the quadratic term were negative for both boys and girls in all models, matching the inverted-U pattern seen in the full sample, but they did not reach significance levels. Given the reduction in sample size for this test, this pattern is most plausibly interpreted as a power issue rather than a different trend for the two genders.
Associative memory presents a different picture: the ANOVAs showed significant group differences for both boys and girls, yet the regression models did not yield reliable linear or quadratic effects of computer use frequency. This suggests that the significant subgroup differences in associative memory do not indicate a systematic linear or quadratic trend but rather a random or more complex variation.

Taken together, the robustness checks indicate that the inverted-U association is clearly supported for inductive and quantitative reasoning, while spatial skills show a similar but less conclusive pattern due to reduced power, and associative memory does not follow a consistent nonlinear gradient with computer use, consistent with the main findings.

Table 4 *Coefficients for regression models predicting inductive reasoning, split by gender: boys / girls*

N = 3537 / 3258	Model 0	Model 1	Model 2: + Par. Education	Model 3: + Solving Time
Computer use (linear)	2.07* / 3.07**	2.07* / 3.07**	2.06* / 3.10**	3.30*** / 4.21***
Computer use (quadratic)		-4.22*** / -4.64***	-3.05** / -3.42***	-3.17*** / -3.75***
Parental highest education			0.26*** / 0.25***	0.25*** / 0.24***
Solving time				0.21*** / 0.16***
R^2	.001 / .003	.006 / .010	.073 / .070	.115 / .094
Adj. R^2	.001 / .003	.006 / .009	.072 / .069	.114 / .093

Note. The outcome and covariates (parental education, solving time) were standardized. Computer-use predictors are orthogonal polynomial components derived from the standardized computer-use variable and, therefore, are not on a standardized scale. R^2 represents the proportion of variance explained; Adjusted R^2 accounts for model complexity. ** $p < .01$; *** $p < .001$

Table 5 *Coefficients for regression models predicting spatial skills, split by gender: boys / girls*

N = 629 / 557	Model 0	Model 1	Model 2: + Par. Education	Model 3: + Solving Time
Computer use (linear)	1.46 / 2.21*	1.46 / 2.21*	1.35 / 1.63	1.32 / 1.94*
Computer use (quadratic)		-1.90 / -1.67	-1.42 / -0.50	-1.66 / -0.62
Parental highest education			0.18*** / 0.27***	0.15*** / 0.24***
Solving time				0.25*** / 0.21***
R^2	.003 / .009	.009 / .014	.040 / .081	.103 / .123
Adj. R^2	.002 / .007	.006 / .010	.036 / .076	.097 / .116

Note. The outcome and covariates (parental education, solving time) were standardized. Computer-use predictors are orthogonal polynomial components derived from the standardized computer-use variable and, therefore, are not on a standardized scale. R^2 represents the proportion of variance explained; Adjusted R^2 accounts for model complexity. ** $p < .01$; *** $p < .001$

Table 6 *Coefficients for regression models predicting quantitative reasoning, split by gender: boys / girls*

N = 3078 / 2838	Model 0	Model 1	Model 2: + Par. Education	Model 3: + Solving Time
Computer use (linear)	1.20 / 0.88	1.20 / 0.88	1.56 / 1.23	2.12* / 1.27
Computer use (quadratic)		-2.98** / -3.14**	-2.16* / -2.25*	-2.18* / -2.16*

Parental highest education			0.27*** / 0.26***	0.25*** / 0.22***
Solving time				0.23*** / 0.23***
R^2	.000 / .000	.003 / .004	.078 / .069	.129 / .119
Adj. R^2	.000 / .000	.003 / .003	.077 / .068	.128 / .118

Note. The outcome and covariates (parental education, solving time) were standardized. Computer-use predictors are orthogonal polynomial components derived from the standardized computer-use variable and, therefore, are not on a standardized scale. R^2 represents the proportion of variance explained; Adjusted R^2 accounts for model complexity. ** $p < .01$; *** $p < .001$

Table 7 *Coefficients for regression models predicting associative memory, split by gender: boys / girls*

N = 2080 / 1934	**Model 0**	**Model 1**	**Model 2: + Par. Education**	**Model 3: + Solving Time**
Computer use (linear)	0.64 / -0.62	0.64 / -0.62	0.59 / -0.44	-1.12 / -0.74
Computer use (quadratic)		0.28 / -1.51	0.55 / -0.87	0.24 / -0.59
Parental highest education			0.11*** / 0.17***	0.09*** / 0.16***
Solving time				-0.34*** / -0.28***
R^2	.000 / .000	.000 / .001	.011 /.031	.129 / .111
Adj. R^2	.000 / .000	.000 / .000	.010 / .030	.127 / .109

Note. The outcome and covariates (parental education, solving time) were standardized. Computer-use predictors are orthogonal polynomial components derived from the standardized computer-use variable and, therefore, are not on a standardized scale. R^2 represents the proportion of variance explained; Adjusted R^2 accounts for model complexity. ** $p < .01$; *** $p < .001$