Automaticity as an Independent Trait in Predicting Reading Outcomes in Middle-School

- Online Supplementary Material -

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**S1.	Contributions of Each Task**

Question 4 addressed the contributions of masked versions of different individual tasks. These analyses could not be reported in the main manuscript due to space restrictions but are included here for completeness. To do so, we asked which tasks individually reached significance in each regression on Step 3 when all factors were entered. As pointed out in the manuscript, we concentrated on fluency and decoding, as neither unmasked nor masked task/versions consistently predicted comprehension. For fluency, we looked at the model where masked task/versions were entered on the third step, thus evaluating individual contributions of masked task/versions. For decoding, we used the model where unmasked tasks were entered on the step three. This was done separately for monosyllabic tasks, nonword trials of monosyllabic tasks, and multisyllabic tasks. For each individual task, we extracted both η_p^2 to measure effect size, and its significance (by a t-test on the coefficient). Results are in Table S1; η_p^2 for all tasks and outcomes are in Tables S2-S4).

Monosyllabic tasks. For fluency, in Wave 1, only the masked version of *Verify* was significant ($\eta_p^2 = 0.019$, $p = 0.038$). Masked versions of *Find the Picture* ($\eta_p^2 = 0.015$, $p = 0.071$) and *Find the Rhyme* ($\eta_p^2 = 0.014$, $p = 0.078$) were not. In Wave 2, the pattern differed: Masked *Find the Picture* ($\eta_p^2 = 0.069$, $p < 0.001$) and *Find the Rhyme* ($\eta_p^2 = 0.029$, $p = 0.015$) predicted unique variance in fluency, whereas masked *Verify* did not ($\eta_p^2 = 0.001$, $p = 0.67$).

For decoding unmasked *Find the Rhyme* ($\eta_p^2 = 0.029$, $p = 0.010$) and *Verify* ($\eta_p^2 = 0.076$, $p < 0.001$) in Wave 1 as well as *Find the Rhyme* ($\eta_p^2 = 0.056$, $p = 0.001$) in Wave 2 all predicted unique variance on Step 3. This is consistent with the idea that decoding requires participants' activation of phonological representations as needed to identify a rhyme.

Nonword trials (monosyllabic tasks). For fluency, analysis of the individual coefficients showed that masked versions of *Find the Rhyme* and *Verify* reached significance on the third regression step in both waves (all $\eta_p^2 > 0.025$, all $p < 0.02$). Consistent with the combined analyses, the only unmasked version that reached significance when predicting decoding in both waves was unmasked *Find the Rhyme* (Wave 1: $\eta_p^2 = 0.54$, $p < 0.001$; Wave 2: $\eta_p^2 = 0.74$, $p < 0.001$), supporting the need of phonological information during decoding. In addition, unmasked *Verify* also reached significance in Wave 1 ($\eta_p^2 = 0.71$, $p < 0.001$).

Multisyllabic tasks. Both the masked versions of *Find the Picture* and *Verify* reached significance on the final regression step in both waves (Wave 1 and 2: all $\eta_p^2 > 0.025$, all $p < 0.03$) for fluency. However, effect sizes were higher for *Find the Picture* in both waves (Table S1). For decoding, unmasked *Verify* reached significance on the third step in both waves (all $\eta_p^2 > 0.032$, all $p < 0.011$), whereas *Find the Picture* did not contribute significantly in either wave.

Table S1

Overview of partial eta-squared for each task version at the final level of the hierarchical regression model when either masked or unmasked task versions were entered on the final step. P<.05 is marked with *; p<.001 is marked with **. The complete list of all partial eta-squared values for each task is presented in Tables S2-S4.

Task type	Outcome (task version)	Wave	Picture	Rhyme	Verify
Mono-syllabic	Fluency (masked)	1	0.015	0.014	0.019*
		2	0.069**	0.029*	0.001
	Decoding (unmasked)	1	0.003	0.029*	0.076*
		2	0.016	0.056*	0.003
Mono-syllabic, nonword trials	Fluency (masked)	1	-	0.044*	0.041*
		2	-	0.044**	0.027*
	Decoding (unmasked)	1	-	0.054**	0.071**
		2	-	0.074**	<0.001
Multi-syllabic	Fluency (masked)	1	0.077**	-	0.026*
		2	0.186**	-	0.025*
	Decoding (unmasked)	1	0.016	-	0.084**
		2	0.005	-	0.032*

Table S2

Overview of partial eta-squared for each task version at the final level of the hierarchical regression model when either masked or unmasked monosyllabic task versions were entered on the final step. P<.05 is marked with *; p<.001 is marked with **.

Task version (entered last)	Outcome	Wave	Picture	Rhyme	Verify
masked	Fluency	1	0.015	0.014	0.019*
		2	0.069**	0.029*	0.001
	Decoding	1	< 0.001	0.003	0.005
		2	< 0.001	0.022*	0.004
	Comprehension	1	0.046*	0.005	< 0.001
		2	0.020*	0.003	< 0.001
unmasked	Fluency	1	0.020*	0.003	0.013
		2	0.043*	0.028*	0.006
	Decoding	1	0.003	0.029*	0.076*
		2	0.016	0.056*	0.003
	Comprehension	1	< 0.001	0.003	0.018*
		2	< 0.001	0.035*	0.001

Table S3

Overview of partial eta-squared for each task version including only nonword trials at the final level of the hierarchical regression model when either masked or unmasked monosyllabic task versions were entered on the final step. P<.05 is marked with *; p<.001 is marked with **.

Task version (entered last)	Outcome	Rhyme	Verify
masked	Fluency	0.044*	0.041*
		0.044**	0.027*
	Decoding	0.008	0.006
		0.046**	0.001
	Comprehension	0.009	0.005
		0.004	0.008
unmasked	Fluency	0.009	0.008
		0.096**	0.007
	Decoding	0.054**	0.071**
		0.074**	<0.001
	Comprehension	<0.001	0.017*
		0.062**	<0.001

Table S4

Overview of partial eta-squared for each task version at the final level of the hierarchical regression model when either masked or unmasked multisyllabic task versions were entered on the final step. P<.05 is marked with *; p<.001 is marked with **.

Task version (entered last)	Outcome	Picture	Verify
	Fluency	0.077**	0.026*
		0.186**	0.025*
masked	Decoding	< 0.001	0.010
		0.067**	0.005
	Comprehension	0.034*	0.015
		0.039*	0.019*
	Fluency	0.032*	0.014
		0.002	0.002
unmasked	Decoding	0.016	0.084**
		0.005	0.032*
	Comprehension	0.001	0.001
		0.003	0.004

S2. Ceiling Effects

As discussed in the main manuscript, the monosyllabic task version of *Find the Picture* was the task with the highest number of children that performed at ceiling. To investigate the influence of potential ceiling effects, we replicated our primary analysis of monosyllabic words without either version of *Find the Picture* for Wave 1. The results of this are presented in Table S5; it should be noted that the first line includes the original analysis and the second line the replication without *Find the Picture* (here abbreviated as *FTP*). Importantly, the pattern of results remained the same across analysis, suggesting that the high overall performance in the *Find the Picture* task did not distort our results.

Table S5

Overview of communality analysis including shared and unique variance for masked and unmasked tasks for all monosyllabic tasks and monosyllabic tasks without Find the Picture (termed here "No FTP"). P<.05 is marked with *; p<.001 is marked with **. Overall R^2 includes contribution of oral vocabulary (PPVT).

	Outcome	Tasks	Overall R^2	Shared ΔR^2	Unmasked ΔR^2	Masked ΔR^2
Monosyllabic	Fluency	All	0.399	0.301	0.030*	0.065**
		No FTP	0.397	0.250	0.044**	0.100**
	Decoding	All	0.383	0.262	0.112**	0.008
		No FTP	0.284	0.161	0.112**	0.009
	Comprehension	All	0.194	0.084	0.015	0.059*
		No FTP	0.181	0.079	0.002	0.063**

S3. Correlations Among Tasks

Table S6

Correlations among all task versions for monosyllabic and multisyllabic words in Wave 1. "Multi" is used as an abbreviation for multisyllabic task versions.

	Picture Multi Unmasked	Picture Multi Masked	Verify Multi Unmasked	Verify Multi Masked	Picture Unmasked	Picture Masked	Rhyme Unmasked	Rhyme Masked	Verify Unmasked	Verify Masked
Picture Multi Unmasked	1.00	0.55	0.54	0.43	0.60	0.57	0.51	0.49	0.47	0.49
Picture Multi Masked	0.55	1.00	0.52	0.59	0.65	0.70	0.49	0.57	0.47	0.62
Verify Multi Unmasked	0.54	0.52	1.00	0.61	0.45	0.49	0.53	0.50	0.66	0.58
Verify Multi Masked	0.43	0.59	0.61	1.00	0.35	0.55	0.51	0.63	0.60	0.71
Picture Unmasked	0.60	0.65	0.45	0.35	1.00	0.56	0.44	0.47	0.36	0.47
Picture Masked	0.57	0.70	0.49	0.55	0.56	1.00	0.53	0.58	0.43	0.63
Rhyme Unmasked	0.51	0.49	0.53	0.51	0.44	0.53	1.00	0.81	0.59	0.47
Rhyme Masked	0.49	0.57	0.50	0.63	0.47	0.58	0.81	1.00	0.52	0.63
Verify Unmasked	0.47	0.47	0.66	0.60	0.36	0.43	0.59	0.52	1.00	0.52
Verify Masked	0.49	0.62	0.58	0.71	0.47	0.63	0.47	0.63	0.52	1.00

Table S7

Correlations among all task versions for monosyllabic and multisyllabic words in Wave 2. "Multi" is used as an abbreviation for multisyllabic task versions.

	Picture Multi Unmasked	Picture Multi Masked	Verify Multi Unmasked	Verify Multi Masked	Picture Unmasked	Picture Masked	Rhyme Unmasked	Rhyme Masked	Verify Unmasked	Verify Masked
Picture Multi Unmasked	1.00	0.69	0.59	0.52	0.70	0.70	0.52	0.48	0.55	0.57
Picture Multi Masked	0.69	1.00	0.55	0.70	0.69	0.81	0.68	0.67	0.54	0.67
Verify Multi Unmasked	0.59	0.55	1.00	0.59	0.54	0.58	0.58	0.53	0.68	0.67
Verify Multi Masked	0.52	0.70	0.59	1.00	0.45	0.70	0.60	0.65	0.55	0.73
Picture Unmasked	0.70	0.69	0.54	0.45	1.00	0.66	0.53	0.51	0.49	0.50
Picture Masked	0.70	0.81	0.58	0.70	0.66	1.00	0.63	0.62	0.57	0.67
Rhyme Unmasked	0.52	0.68	0.58	0.60	0.53	0.63	1.00	0.79	0.55	0.55
Rhyme Masked	0.48	0.67	0.53	0.65	0.51	0.62	0.79	1.00	0.49	0.58
Verify Unmasked	0.55	0.54	0.68	0.55	0.49	0.57	0.55	0.49	1.00	0.65
Verify Masked	0.57	0.67	0.67	0.73	0.50	0.67	0.55	0.58	0.65	1.00

Table S8

Correlations among all task versions for nonwords only in Wave 1.

	Rhyme Unmasked	Rhyme Masked	Verify Unmasked	Verify Masked
Rhyme Unmasked	1.00	0.76	0.54	0.44
Rhyme Masked	0.76	1.00	0.46	0.56
Verify Unmasked	0.54	0.46	1.00	0.45
Verify Masked	0.44	0.56	0.45	1.00

Table S9

Correlations among all task versions for nonwords only in Wave 2.

	Rhyme Unmasked	Rhyme Masked	Verify Unmasked	Verify Masked
Rhyme Unmasked	1.00	0.74	0.53	0.46
Rhyme Masked	0.74	1.00	0.41	0.44
Verify Unmasked	0.53	0.41	1.00	0.50
Verify Masked	0.46	0.44	0.50	1.00