Supplementary Information

Domain-general and domain-specific cognitive factors mediating the relationship between math anxiety and mathematical performance in primary school children

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Fig. S1. SEM mediation model tested to investigate the cognitive mediators of the relationship between MA and mathematical outcomes. Latent variables are depicted by ovals and observed variables by squares. Domain-general factors are represented in purple and domain-specific factors in red. Covariates were regressed onto each mediator and dependent variable. Covariances between all mediators were specified in the model, but for clarity are not represented on the present figure. ANS = approximate number system; SES = socioeconomic status.

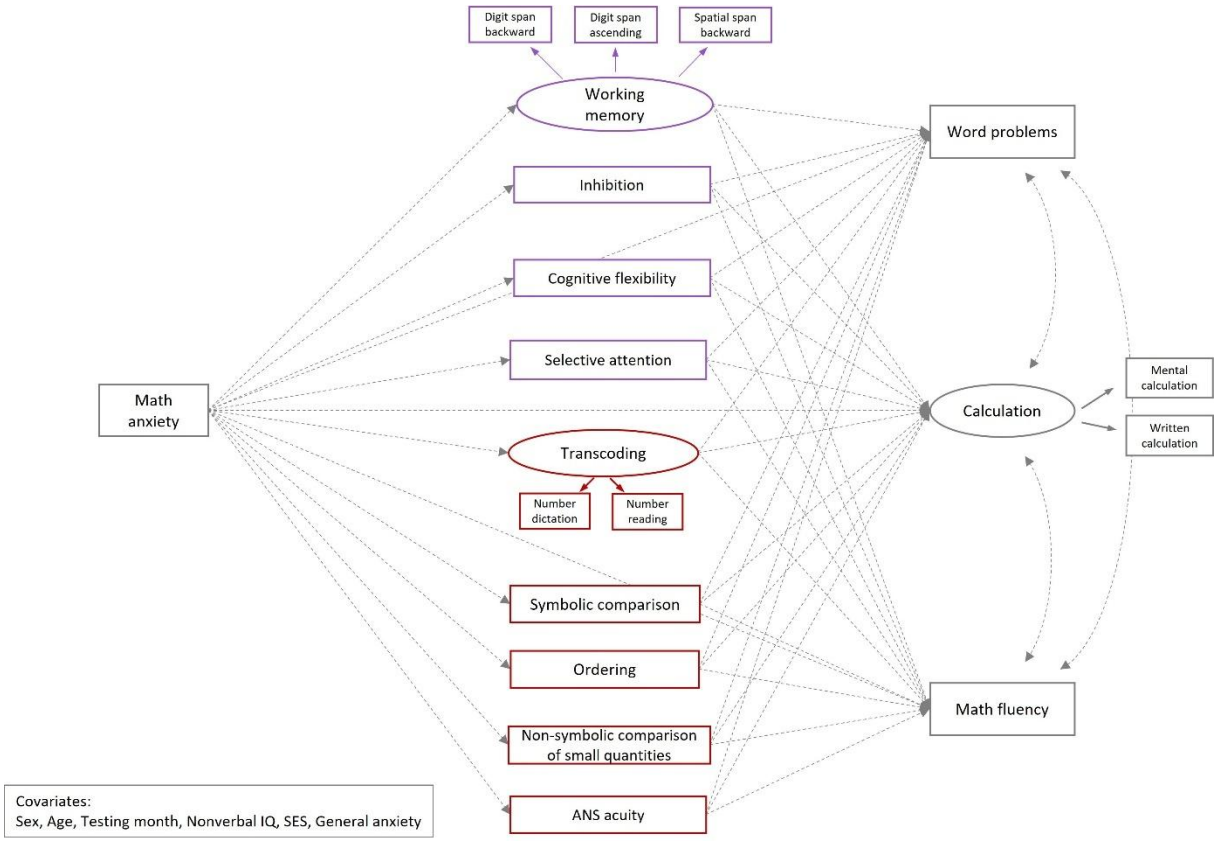

Table S1. **Bivariate correlations among observed variables included in the SEM model.** Zero-order correlations are provided. Sex was dummy coded with boys = –0.5 and girls = 0.5. ANS = approximate number system. SES = socioeconomic status. *p < .05.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1. Math anxiety	_																						
2. Word problems	–.30*	_																					
3. Mental calculation	–.35*	.62*	_																				
4. Written calculation	–.30*	.55*	.67*	_																			
5. Math fluency	–.30*	.51*	.60*	.67*	_																		
6. Digit span backward	–.17*	.37*	.34*	.37*	.32*	_																	
7. Digit span ascending	–.22*	.49*	.41*	.38*	.37*	.34*	_																
8. Spatial span backward	–.22*	.40*	.41*	.35*	.27*	.36*	.30*	_															
9. Inhibition	.05	–.24*	–.25*	–.28*	–.23*	–.21*	–.19*	–.27*	_														
10. Flexibility	.21*	–.32*	–.37*	–.31*	–.34*	–.25*	–.23*	–.20*	.35*	_													
11. Selective attention	–.09	.20*	.19*	.22*	.32*	.18*	.15*	.19*	–.20*	–.25*	_												
12. Number dictation	–.31*	.45*	.50*	.42*	.44*	.25*	.35*	.27*	–.23*	–.29*	.11*	_											
13. Number reading	–.26*	.41*	.47*	.39*	.37*	.22*	.30*	.25*	–.27*	–.30*	.12*	.55*	_										
14. Symbolic comparison	–.19*	.34*	.37*	.38*	.54*	.22*	.28*	.21*	–.26*	–.32*	.40*	.28*	.16*	_									
15. Ordering	–.27*	.44*	.42*	.42*	.59*	.32*	.35*	.33*	–.31*	–.39*	.35*	.26*	.24*	.56*	_								
16. Non-symbolic comparison of small quantities	–.07	.23*	.26*	.26*	.36*	.12*	.16*	.15*	–.20*	–.24*	.35*	.15*	.05	.76*	.43*	_							
17. ANS acuity	.09	–.16*	–.16*	–.23*	–.15*	–.15*	–.15*	–.12*	.13*	.14*	–.11*	–.13*	–.14*	–.15*	–.17*	–.10*	_						
18. Sex	.12*	–.13*	–.16*	–.10*	–.18*	–.05	–.11*	–.07	.04	.18*	.03	–.10*	–.12*	–.04	–.02	.01	–.13*	_					
19. Age	–.07	.15*	.17*	.25*	.21*	.08	.07	.06	–.04	–.09	.21*	.06	.10*	.22*	.24*	.24*	–.06	.00	_				
20. Testing month	–.01	.15*	.12*	.25*	.22*	.07	.06	.00	.03	–.05	.16*	.07	.08	.16*	.22*	.15*	–.13*	.07	.68*	_			
21. Nonverbal IQ	–.21*	.32*	.29*	.29*	.17*	.21*	.18*	.23*	–.18*	–.21*	.24*	.21*	.19*	.14*	.19*	.14*	–.17*	.14*	.17*	.14*	_		
22. SES composite	–.18*	.38*	.35*	.28*	.14*	.26*	.26*	.28*	–.26*	–.15*	.13*	.24*	.24*	.13*	.12*	.06	–.07	–.01	–.02	–.01	.31*	_	
23. General anxiety	.41*	–.15*	–.13*	–.11*	–.10*	–.16*	–.17*	–.11*	.01	.15*	–.04	–.16*	–.13*	–.11*	–.13*	–.06	–.04	.21*	–.04	.08	–.11*	–.14*	_

Table S2. Complete SEM model with all parameter estimates. Both standardized (β) and unstandardized (*b*) estimates are reported. SE = standard error; MA = math anxiety; ANS = approximate number system; SES = socioeconomic status.

A. Paths from MA and covariates to cognitive variables.

Paths	**β**	***b***	**SE**	***p***
MA → Working memory	–0.18	–0.22	0.08	.005
MA → Inhibition	–0.01	–0.01	0.05	.853
MA → Flexibility	0.12	0.12	0.06	.030
MA → Selective attention	–0.03	–0.03	0.05	.576
MA → Transcoding	–0.29	–0.33	0.08	< .001
MA → Symbolic comparison	–0.14	–0.14	0.05	.007
MA → Ordering	–0.22	–0.22	0.05	< .001
MA → Non-symbolic comparison of small quantities	–0.02	–0.02	0.05	.711
MA → ANS acuity	0.10	0.11	0.06	.062
Sex → Working memory	–0.11	–0.28	0.14	.047
Sex → Inhibition	0.05	0.11	0.09	.225
Sex → Flexibility	0.18	0.37	0.09	< .001
Sex → Selective attention	0.01	0.02	0.09	.796
Sex → Transcoding	–0.13	–0.31	0.12	.008
Sex → Symbolic comparison	–0.02	–0.05	0.09	.602
Sex → Ordering	–0.03	–0.06	0.10	.557
Sex → Non-symbolic comparison of small quantities	0.01	0.02	0.09	.828
Sex → ANS acuity	–0.09	–0.19	0.08	.024
Age → Working memory	0.06	0.07	0.10	.434
Age → Inhibition	–0.11	–0.11	0.06	.072
Age → Flexibility	–0.04	–0.04	0.06	.512
Age → Selective attention	0.18	0.18	0.06	.001

Age → Transcoding	–0.00	–0.00	0.07	.956
Age → Symbolic comparison	0.18	0.18	0.06	.005
Age → Ordering	0.11	0.11	0.07	.080
Age → Non-symbolic comparison of small quantities	0.25	0.25	0.06	< .001
Age → ANS acuity	0.07	0.07	0.08	.376
Testing month → Working memory	0.02	0.03	0.09	.791
Testing month → Inhibition	0.11	0.11	0.06	.070
Testing month → Flexibility	–0.02	–0.02	0.06	.790
Testing month → Selective attention	0.01	0.01	0.06	.904
Testing month → Transcoding	0.09	0.11	0.08	.184
Testing month → Symbolic comparison	0.05	0.05	0.06	.438
Testing month → Ordering	0.15	0.15	0.07	.020
Testing month → Non-symbolic comparison of small quantities	–0.02	–0.02	0.06	.741
Testing month → ANS acuity	–0.15	–0.15	0.09	.074
Nonverbal IQ → Working memory	0.20	0.25	0.07	.001
Nonverbal IQ → Inhibition	–0.12	–0.12	0.05	.007
Nonverbal IQ → Flexibility	–0.17	–0.17	0.04	< .001
Nonverbal IQ → Selective attention	0.17	0.17	0.05	< .001
Nonverbal IQ → Transcoding	0.15	0.17	0.07	.012
Nonverbal IQ → Symbolic comparison	0.05	0.05	0.05	.249
Nonverbal IQ → Ordering	0.09	0.09	0.05	.089
Nonverbal IQ → Non-symbolic comparison of small quantities	0.09	0.09	0.05	.059
Nonverbal IQ → ANS acuity	–0.13	–0.13	0.06	.039
SES → Working memory	0.34	0.42	0.09	< .001
SES → Inhibition	–0.24	–0.24	0.05	< .001
SES → Flexibility	–0.08	–0.08	0.05	.090

SES → Selective attention	0.09	0.09	0.05	.094
SES → Transcoding	0.23	0.26	0.06	< .001
SES → Symbolic comparison	0.09	0.09	0.05	.085
SES → Ordering	0.06	0.06	0.05	.269
SES → Non-symbolic comparison of small quantities	0.03	0.03	0.05	.511
SES → ANS acuity	–0.02	–0.02	0.05	.666
General anxiety → Working memory	–0.09	–0.11	0.08	.161
General anxiety → Inhibition	–0.05	–0.05	0.05	.278
General anxiety → Flexibility	0.04	0.04	0.06	.556
General anxiety → Selective attention	0.01	0.01	0.05	.925
General anxiety → Transcoding	–0.02	–0.02	0.07	.797
General anxiety → Symbolic comparison	–0.03	–0.03	0.05	.562
General anxiety → Ordering	–0.02	–0.02	0.05	.749
General anxiety → Non-symbolic comparison of small quantities	–0.03	–0.03	0.05	.484
General anxiety → ANS acuity	–0.07	–0.07	0.05	.164

B. Paths from cognitive variables and covariates to mathematics outcomes.

Paths	Word problems				Calculation				Math fluency			
	β	***b***	**SE**	***p***	**β**	***b***	**SE**	***p***	**β**	***b***	**SE**	***p***
MA → Math (total effect c)	–0.19	–0.19	0.05	< .001	–0.30	–0.65	0.13	< .001	–0.26	–0.26	0.05	< .001
MA → Math (direct effect c')	–0.03	–0.03	0.04	.442	–0.10	–0.22	0.10	.022	–0.06	–0.06	0.04	.139
Working memory → Math	0.62	0.50	0.10	< .001	0.49	0.87	0.26	.001	0.17	0.14	0.08	.073
Inhibition → Math	0.09	0.09	0.04	.051	0.04	0.09	0.10	.337	0.05	0.05	0.04	.208
Flexibility → Math	–0.01	–0.01	0.06	.869	–0.04	–0.07	0.10	.449	0.03	0.03	0.04	.504
Selective attention → Math	–0.05	–0.05	0.04	.222	–0.05	–0.10	0.11	.326	0.06	0.06	0.04	.148
Transcoding → Math	0.16	0.14	0.07	.064	0.32	0.59	0.18	.001	0.29	0.25	0.06	< .001

Symbolic comparison → Math	–0.02	–0.02	0.06	.770	0.04	0.09	0.16	.591	0.25	0.25	0.06	< .001
Ordering → Math	0.02	0.02	0.08	.822	0.03	0.06	0.17	.735	0.27	0.27	0.07	< .001
Non-symbolic comparison of small quantities → Math	0.08	0.08	0.06	.137	0.10	0.20	0.13	.128	–0.02	–0.02	0.05	.659
ANS acuity → Math	0.03	0.03	0.04	.404	–0.01	–0.03	0.10	.751	0.02	0.02	0.03	.493
Sex → Math	–0.04	–0.09	0.08	.313	–0.07	–0.29	0.19	.117	–0.11	–0.23	0.07	.002
Age → Math	0.01	0.01	0.05	.931	0.09	0.20	0.12	.097	–0.03	–0.03	0.05	.508
Testing month → Math	0.07	0.07	0.06	.226	0.06	0.13	0.12	.317	0.10	0.10	0.05	.047
Nonverbal IQ → Math	0.05	0.05	0.05	.233	0.05	0.10	0.10	.304	–0.02	–0.02	0.04	.652
SES → Math	0.06	0.06	0.05	.230	0.04	0.08	0.12	.515	–0.09	–0.09	0.05	.054
General anxiety → Math	0.08	0.08	0.04	.051	0.13	0.27	0.10	.008	0.09	0.09	0.04	.017

C. Variances.

Variances	**β**	***b***	**SE**	***p***
MA	1.00	1.00	0.07	< .001
Working memory	0.66	1.00	_	_
Inhibition	0.91	0.91	0.09	< .001
Flexibility	0.89	0.88	0.15	< .001
Selective attention	0.90	0.90	0.06	< .001
Transcoding	0.74	1.00	_	_
Symbolic comparison	0.90	0.91	0.06	< .001
Ordering	0.85	0.85	0.07	< .001
Non-symbolic comparison of small quantities	0.92	0.93	0.07	< .001
ANS acuity	0.94	0.94	0.32	.003
Word problems	0.41	0.41	0.05	< .001
Calculation	0.22	1.00	_	_
Math fluency	0.43	0.43	0.04	< .001
Sex	1.00	0.25	0.00	< .001
Age	1.00	1.00	0.05	< .001
Testing month	1.00	1.00	0.03	< .001
Nonverbal IQ	1.00	1.00	0.06	< .001

SES	1.00	1.00	0.06	< .001
General anxiety	1.00	1.00	0.06	< .001

D. Covariances.

Covariances	**β**	***b***	**SE**	***p***
Working memory ↔ Inhibition	–0.31	–0.30	0.06	< .001
Working memory ↔ Flexibility	–0.28	–0.27	0.06	< .001
Working memory ↔ Selective attention	0.22	0.21	0.07	.002
Working memory ↔ Transcoding	0.52	0.52	0.07	< .001
Working memory ↔ Symbolic comparison	0.34	0.32	0.06	< .001
Working memory ↔ Ordering	0.55	0.51	0.07	< .001
Working memory ↔ Non-symbolic comparison of small quantities	0.19	0.19	0.06	.003
Working memory ↔ ANS acuity	–0.23	–0.23	0.05	< .001
Inhibition ↔ Flexibility	0.32	0.28	0.06	< .001
Inhibition ↔ Selective attention	–0.15	–0.14	0.04	.001
Inhibition ↔ Transcoding	–0.27	–0.26	0.06	< .001
Inhibition ↔ Symbolic comparison	–0.23	–0.21	0.05	< .001
Inhibition ↔ Ordering	–0.30	–0.26	0.05	< .001
Inhibition ↔ Non-symbolic comparison of small quantities	–0.18	–0.16	0.04	< .001
Inhibition ↔ ANS acuity	0.12	0.11	0.03	.001
Flexibility ↔ Selective attention	–0.21	–0.19	0.05	< .001
Flexibility ↔ Transcoding	–0.29	–0.28	0.07	< .001
Flexibility ↔ Symbolic comparison	–0.27	–0.24	0.05	< .001
Flexibility ↔ Ordering	–0.34	–0.30	0.05	< .001
Flexibility ↔ Non-symbolic comparison of small quantities	–0.22	–0.20	0.05	< .001
Flexibility ↔ ANS acuity	0.14	0.13	0.04	< .001
Selective attention ↔ Transcoding	0.07	0.07	0.05	.198
Selective attention ↔ Symbolic comparison	0.36	0.32	0.05	< .001
Selective attention ↔ Ordering	0.30	0.26	0.05	< .001

Selective attention ↔ Non-symbolic comparison of small quantities	0.30	0.28	0.05	< .001
Selective attention ↔ ANS acuity	–0.07	–0.07	0.04	.059
Transcoding ↔ Symbolic comparison	0.22	0.20	0.06	< .001
Transcoding ↔ Ordering	0.21	0.20	0.07	.003
Transcoding ↔ Non-symbolic comparison of small quantities	0.09	0.09	0.06	.149
Transcoding ↔ ANS acuity	–0.15	–0.15	0.05	.006
Symbolic comparison ↔ Ordering	0.50	0.44	0.05	< .001
Symbolic comparison ↔ Non-symbolic comparison of small quantities	0.75	0.69	0.06	< .001
Symbolic comparison ↔ ANS acuity	–0.13	–0.12	0.03	< .001
Ordering ↔ Non-symbolic comparison of small quantities	0.38	0.34	0.05	< .001
Ordering ↔ ANS acuity	–0.15	–0.13	0.04	.001
Non-symbolic comparison of small quantities ↔ ANS acuity	–0.09	–0.08	0.04	.020
Word problems ↔ Calculation	0.20	0.13	0.07	.058
Word problems ↔ Math fluency	0.10	0.04	0.03	.125
Calculation ↔ Math fluency	0.63	0.41	0.06	< .001

Table S3. SEMA questionnaire translated in French.

Instructions: « Je vais te lire quelques questions de mathématiques. Pour chaque question, je veux que tu t'imagines en train d'y répondre. Ensuite, montre-moi comment tu te sens à l'idée de répondre à cette question. Par exemple, tu peux te sentir *(montrer en même temps)* : Pas du tout nerveux, Un peu nerveux, Moyennement nerveux, Très nerveux ou Très très neveux. Attention, tu ne dois pas réellement répondre à la question, tu dois juste t'imaginer en train de répondre et me montrer comment tu te sens. Voici un exemple. »	
Exemple 1.	Qui est le président de la France ?
Item 1.	Thomas a acheté 2 pizzas de 6 parts chacune. Combien de parts au total Thomas a-t-il dû partager avec ses amis ?
Item 2.	L'opération suivante est-elle juste : 9 + 7 = 18 ?
Item 3.	Combien d'argent a Anne si elle possède 2 pièces de 1 euro et 4 pièces de 1 centime ?
Item 4.	Comment écris-tu le nombre *quatre cent quatre-vingt-deux* ?
Item 5.	Dessine-moi les aiguilles d'une horloge pour qu'on puisse lire 15h15.
Item 6.	Dessine-moi un carré et un triangle au tableau.
Item 7.	Compte de 5 en 5 à partir de 10 jusqu'à 55.
Item 8.	Quelle heure sera-t-il dans 20 minutes ?
Item 9.	L'opération suivante est-elle juste : 15 – 7 = 8 ?
Item 10.	Léa a plus d'argent que Marie. Marie a plus d'argent que Julie. Qui a le plus d'argent entre Léa et Julie ?
Instructions : « Maintenant, je vais te montrer des phrases sur des situations qui impliquent les maths. Pour chaque phrase, imagine-toi que la situation est en train d'arriver et montre-moi comment tu te sens, comme on vient de faire. Voici un exemple. »	
Exemple 2.	Tu es sur le point de faire un tour de montagnes russes.
Item 11.	Tu es en classe en train de faire des maths et ton professeur est sur le point d'enseigner quelque chose de nouveau.
Item 12.	Tu dois t'asseoir pour commencer tes devoirs de maths.
Item 13.	Tu comptes tout l'argent que tu as dans ta tirelire.
Item 14.	Quelqu'un te demande de couper une tarte aux pommes en quatre parts égales.
Item 15.	Tu es sur le point de faire une évaluation de maths.

Item 16.	Tu ne comprends pas quelque chose en maths. Tu demandes à ton professeur de t'aider.
Item 17.	Ton professeur te donne un tas de problèmes d'addition à résoudre.
Item 18.	Ton professeur te donne un tas de problèmes de soustraction à résoudre.
Item 19.	Tu es en classe en train de résoudre un problème de maths au tableau.
Item 20.	Tu es en train d'écouter ton professeur qui t'explique comment résoudre un problème de maths.