SUPPLEMENTARY INFORMATION

Accurate Prediction of Momentary Cognition From Intensive Longitudinal Data

Hawks *et al.*

Contents

EMA			
Construct	**Variable**	**Question**	**Response levels**
Positive and Negative Affective Schedule (PANAS) Short Form (1) • **Global prompt (GP):** "For each of the next ten emotion words, indicate to what extent you felt this way **right before** you started this survey." • **Global rating scale (GRS):** [1] Very slightly or not at all; [2] A little; [3] Moderately; [4] Quite a bit; [5] Extremely			
Negative affect (NA)	NA_afraid	GP + afraid	GRS
	NA_distressed	GP + distressed	GRS
	NA_nervous	GP + nervous	GRS
	NA_scared	GP + scared	GRS
	NA_upset	GP + upset	GRS
Positive affect (PA)	PA_alert	GP + alert	GRS
	PA_determined	GP + determined	GRS
	PA_enthusiastic	GP + enthusiastic	GRS
	PA_excited	GP + excited	GRS
	PA_inspired	GP + inspired	GRS
Daily Inventory of Stressful Events (2,3) • **Global prompt (GP):** "Since the last survey…" 1. Did you have an argument or disagreement with someone? 2. Did anything happen to a close friend or relative that turned out to be stressful for you? 3. Did anything stressful happen regarding your personal health? 4. Did anything else happen that you could have argued or disagreed about, but you let it pass? 5. Did anything else happen that most people would consider stressful? 6. How much time did you spend thinking about coronavirus/COVID-19? • **Contingent follow-up (CF)**: If GP is endorsed ("yes" response or indication of time spent engaged in activity), then: "How stressful was this experience?" • **Global rating scale (GRS):** [1] GP not endorsed; [2] GP endorsed, "not at all" to CF; [3] GP endorsed, "a little bit" to CF; [4] GP endorsed, "somewhat" to CF; [5] GP endorsed, "very" to CF			
Stress	stress_argument	GP1 ± CF	GRS
	stress_friend_relative	GP2 ± CF	GRS
	stress_health	GP3 ± CF	GRS
	stress_less_pass	GP4 ± CF	GRS
	stress_other	GP5 ± CF	GRS
	stress_covid	GP6 ± CF	GRS
Social Functioning Scale (4) • **Global prompt (GP):** "Since the last survey, about how many times did you talk or communicate with someone else?" • **Contingent follow-up (CF)**: If GP is endorsed (e.g., one or more social interactions), then: 1. To what extent were these interactions worth the effort it took to have them? 2. How well do you think you communicated? 3. What do you think other people thought of you? • **Modeling note:** Given intercorrelations ≥ 0.9, CF items were replaced by a composite score (socialfunc_comp)			
Social functioning	socialfunc_interactions	GP	[1] 0 interactions [2] 1 interaction [3] 2 or 3 interactions [4] 4 or more interactions
	socialfunc_worth_effort	GP ± CF1	[0] GP not endorsed; [1] Too hard; Not worth trying ↔ [7] Well worth effort
	socialfunc_communicated	GP ± CF2	[0] GP not endorsed; [1] Made mistakes and failed ↔ [7] Did well and succeeded
	socialfunc_others_thought	GP ± CF3	[0] GP not endorsed; [1] Unlikeable, stupid, or weird ↔ [7] Likeable, smart, interesting
	socialfunc_comp	Composite score	Computed as mean of socialfunc_worth_effort, socialfunc_communicated, and socialfunc_others_thought
Anxiety & Depression Scale (5) • **Global prompt (GP):** Since the last survey, how often have you felt…			

• **Global rating scale (GRS):** [1] none of the time; [2] a little of the time; [3] some of the time; [4] most of the time; [5] all the time			
Anxiety and depression	restless_fidgety	GP + restless or fidgety	GRS
	sad_no_cheer	GP + so sad that nothing could cheer you up	GRS
	everything_an_effort	GP + that everything was an effort	GRS
	hopeless	GP + hopeless	GRS
	irritated	GP + irritated	GRS
	worried	GP + worried	GRS
	depressed	GP + depression	GRS
Alertness Item (6)			
Alertness	alert_sleepiness	Please indicate your sleepiness during the 5 minutes before this survey by choosing the appropriate description.	[1] extremely alert ↔ [9] very sleepy, great effort to keep awake, fighting sleep
Contextual Items • **Global rating scale (GRS):** [1] Not at all true; [2] A little bit true; [3] Somewhat true; [4] Very true			
Context	context_going_on	There is a lot going on around me right now.	GRS
	context_diff_concentrating	I am having trouble concentrating right now.	GRS
	context_noisy	I am in a very noisy place right now.	GRS
Attentional Items • **Global prompt (GP):** "On a scale of 1 to 5, with 1 being "not having difficulty at all" and 5 being "extreme difficulty," to what extent are you CURRENTLY having difficulty..." 1. Fidgeting with your hands or feet or squirming in seat? 2. Following through on instructions and failing to finish things? 3. Being forgetful 4. Avoiding, disliking, or reluctantly doing things that require a lot of mental effort? 5. Feeling "on the go" or acting as if you are "driven by a motor"? 6. With organization? • **Global rating scale (GRS):** [1] Not having difficulty at all ↔ [5] Extreme difficulty			
Attention	attention_fidgeting	GP1	GRS
	attention_finish	GP2	GRS
	attention_forgetful	GP3	GRS
	attention_mentaleffort	GP4	GRS
	attention_motor	GP5	GRS
	attention_diff_organization	GP6	GRS
Interruptions Item • **Administration note:** Unlike items above, which were queried pre-cognitive EMA, interruptions were queried post-cognitive EMA			
Interruptions	interruptions	Did anything interrupt you during this assessment?	[0] no, [1] yes
Objectively derived variables			
Assessment timing	study_days	Days elapsed in study	Acceptable values ranged [0-9]
	testPosition	Position of test within battery	Acceptable values ranged [1-4]
	studytime	Time assessment was completed	Measured using 24-hour clock registered to participant's local time-zone and divided by 24. Acceptable values ranged [0, 1]
	sin_studytime	Sine of time, computed as sin(2*pi*studytime)	Acceptable values ranged [-1, 1]
	cos_studytime	Cosine of time, computed as cos(2*pi*studytime)	Acceptable values ranged [-1, 1]
Device characteristics	screenH	Screen height (in pixels)	Observed values ranged [320, 864]
	screenW	Screen width (in pixels)	Observed values ranged [568, 1536]

Baseline			
Construct	**Variable**	**Question**	**Response levels**
Sleep	wakeUpEarliest	In a typical week, what's the earliest you would wake up for the day?	Acceptable values ranged [0-24]
	wakeUpLatest	In a typical week, what's the latest you would wake up for the day?	Acceptable values ranged [0-24]
	wakeUpTypical	In a typical week, what time do you wake up for the day?	Acceptable values ranged [0-24]
	goToSleepEarliest	In a typical week, what's the earliest you would go to bed for the night?	Acceptable values ranged [0-24]
	goToSleepLatest	In a typical week, what's the latest you go to bed for the night?	Acceptable values ranged [0-24]
	goToSleepTypical	In a typical week, what time do you go to bed for the night?	Acceptable values ranged [0-24]
	sleep_dur	Computed as time between wakeUpTypical and goToSleepTypical	Acceptable values ranged (0-24)
Demographics	education	What is the highest level of education you have completed?	[1] High school; [2] Post-high school; [3] Bachelor's degree; [4] Master's degree; [5] Graduate or professional degree, e.g., PhD, MD, JD
	englishPrimary	Is English your primary or native language?	Factor levels: No (reference), yes
	gender	What is your gender?	Factor levels: Female (reference), male, non-binary or genderqueer
	age	What is your age?	Measured in years
	age^2	Quadratic age term	Measured in years^2

Continuous variable distributions

Raw score distributions for continuous variables. Dependent variables visualized in orange.

EMA items borrowed or adapted from:

(1) Mackinnon, A., Jorm, A. F., Christensen, H., Korten, A. E., Jacomb, P. A., & Rodgers, B. (1999). A short form of the Positive and Negative Affect Schedule: Evaluation of factorial validity and invariance across demographic variables in a community sample. Personality and Individual differences, 27(3), 405-416.

(2) Almeida, D. M., Wethington, E., & Kessler, R. C. (2002). The Daily Inventory of Stressful Events - An interview-based approach for measuring daily stressors. Assessment, 9(1), 41-55.

(3) Stawski, R. S., Sliwinski, M. J., Almeida, D. M., & Smyth, J. M. (2008). Reported exposure and emotional reactivity to daily stressors: the roles of adult age and global perceived stress. Psychology and aging, 23(1), 52.

(4) Granholm, E., Ben-Zeev, D., Fulford, D., & Swendsen, J. (2013). Ecological momentary assessment of social functioning in schizophrenia: impact of performance appraisals and affect on social interactions. Schizophrenia research, 145(1), 120-124.

(5) Sliwinski, M. J., Almeida, D. M., Smyth, J., & Stawski, R. S. (2009). Intraindividual change and variability in daily stress processes: Findings from two measurement-burst diary studies. Psychology and Aging, 24(4), 828.

(6) Akerstedt, T., Anund, A., Axelsson, J. and Kecklund, G. Subjective sleepiness is a sensitive indicator of insufficient sleep and impaired waking function. Journal of Sleep Research, 2014, 23: 240-52.

S2.1. Extended task descriptions. Links to tasks are available on GitHub. Refer to *CogEMA_tasks.txt.*

Choice Reaction Time. Choice Reaction Time (CRT) (1,2) is an executive functioning task with demands on processing speed, cognitive inhibition, and cognitive control. CRT for EMA consisted of twenty-four trials. At the outset of each trial, three vertically aligned squares appeared. Squares were colored yellow and blue in a 2:1 ratio, such that one color only appeared one time, and each square contained an arrow pointing left (<) or right (>). At left and right, respectively, of the central square were buttons labeled "L" and "R." Participants were instructed to press the button that matched the direction of the arrow in the off-colored square. Responses were to be made as quickly as possible. RT (CRT_medianRTc) was recorded as median reaction time on correct responses.

Gradual Onset Continuous Performance Test. The Gradual Onset Continuous Performance Test (GCPT) (3,4) is an executive functioning task with demands on sustained attention, cognitive control, and response inhibition. GCPT for EMA consisted of 75 *x* 800 millisecond trials (total duration = 60 seconds). In each trial, participants viewed a circular, grayscale image of a city or mountain. They were instructed to press their device touchpad if the image depicted a city (80% of trials) and withhold a response if the image depicted a mountain (20% of trials). Images faded in and out between trials. Accuracy (GCPT_dprime) was computed as d-prime (d'), which indexes participants' ability to discriminate targets from distractors (5).

Multiple Object Tracking. Multiple Object Tracking (MOT) (6,7) is a visuospatial task with demands on selective attention, cognitive control, and working memory. MOT for EMA consisted of six trials. At the outset of each trial, ten black dots appeared, five of which briefly flashed green (target probes). Once target probes returned to black, all dots moved around the screen for five seconds. Difficulty increased across trials as the speed of dot motion increased. After motion terminated, participants were asked to recall target probes using their device touchpad.

Accuracy (MOT_percent_correct) was computed across trials as number of correctly identified targets divided by the total number of targets (n = 30).

Digit-Symbol Matching. Digit-Symbol Matching (DS), adapted for remote administration from the Wechsler Adult Intelligence Scale (8), is a visuospatial task with demands on processing speed and short-term memory (9,10). In each EMA sitting, six symbols were sampled from a larger set of thirty. These symbols were paired with digits numbering 1, 2, or 3 in a 2:1 ratio. More specifically, digit-symbol pairings were oriented in a 3 x 3 grid, with digits in the bottom row. Symbol probes appeared sequentially above the grid for 30 seconds. Participants were instructed to use their device touchpad to identify the digit corresponding to the symbol probe, as reflected in digit-symbol pairings. After response selection, the next symbol probe appeared. RT (DS_medianRTc) was recorded as median reaction time on correct responses.

S2.2. Within- and between-person reliability statistics. Between-person reliability reflects the proportion of variance in scores attributable to differences between individuals; within-person reliability reflects systematic, within-person variation across assessments (i.e., variation that may be explained by time-varying predictors).

Outcome	Between-person reliability	Within-person reliability
MOT (percent correct)	0.97	0.27
DSM (median RTc)	0.99	0.70
GCPT (dprime)	0.94	0.54
CRT (medianRTc)	0.98	0.75

S2.3. Data cleaning.

Data cleaning maximized signal to noise by excluding observations that were strongly suggestive of careless responding. First, we excluded internally inconsistent EMA sittings (*n*=23) in which participants (*n*=11) selected extreme, contradictory values (i.e., both maxima or both minima) on self-report items assessing alertness and sleepiness (refer to S1). Next, we excluded cognitive data (at the level of task rather than sitting) in which performance was comparable to chance or unlikely to occur with effort. To this end, we excluded data with mean RT below the 1st or above the 99th percentile, CRT data with accuracy < 50%, DS data with accuracy < 50%, and GCPT data with omission errors > 50%. We also excluded MOT data from devices in power save mode (frame time > 30 ms) and required cognitive responses to be registered using a touchpad (11).

Cognitive exclusions are itemized below. N sittings=number of EMA sittings (sessions) that were flagged for a given category; N users=number of unique participants who were flagged for a given category. By definition, N users ≤ N sittings. In secondary analyses, conditional models were re-estimated with counts of careless and missing responses among between-person predictors. These variables were neither significant nor trending. Data and results are available on GitHub.

Exclusion category	**N sittings**	**N users**
CRT (accuracy)	6	3
CRT (accuracy + meanRTc)	4	4
CRT (meanRTc)	67	32
DS (accuracy + meanRTc)	6	4
DS (meanRTc)	64	31
GCPT (meanRTc)	60	20
GCPT (omission errors)	17	10
GCPT (omission errors + meanRTc)	3	2
MOT (frametime)	124	28
MOT (frametime + meanRTc)	9	2
MOT (meanRTc)	65	28
Not touchpad	34	15
Not touchpad + CRT (accuracy + meanRTc)	1	1
Not touchpad + CRT (meanRTc)	2	2
Not touchpad + DS (meanRTc)	4	3
Not touchpad + GCPT (meanRTc)	2	2
Not touchpad + GCPT (omission_errors + meanRTc)	9	6

S2.4. Model formulas:

(1) Unconditional model (*n* = 4 chains *x* 10,000 iterations; 5,000 warm-up):

$$Y_j = \beta_{0j} + r_j$$

(2) Conditional model (*n* = 4 chains *x* 5,000 iterations; 2,500 warm-up):

$$Y_j = \beta_{0j} + \mathbf{X_j}\boldsymbol{\beta_j} + r_j$$

For EMA sittings $i = 1 \ldots n$ in participant *j*, Y_j is the $n \times 1$ vector of cognitive scores, β_{0j} is the uniform $(n \times 1)$ vector of intercepts, X_j is the $n \times m$ design matrix for fixed effects $1 \ldots m$, β_j is the $m \times 1$ vector of fixed coefficients, and r_j is the $n \times 1$ vector of errors. Models were estimated using Gaussian family response distributions and included random intercepts for each participant. Random slopes were not estimated. Horseshoe priors on β were used to shrink coefficients to zero, with manual tuning on degrees of freedom (*df* = 4) to eliminate divergent transitions. Akin to regularized regression, horseshoe priors enable estimation of fixed effects in high-dimensional space (12,13). Residual and random effect standard deviation estimates were estimated using Cauchy ($\lambda = 0, x_0 = 1$) and normal ($\mu = 0, \sigma = 1$) prior distributions, respectively. All models converged with $\hat{R}s \leq 1.01$ (14,15). Mean point estimates and equal-tail credible intervals (CIs) provide information about the strength and robustness of predictors.

S2.5. *Brms* model syntax in black, with comments in gray.

```
# Conditional model formula
df_all <- train %>% select(-value, -user_id, -study_time, -sitting_id)
formula_all <- paste0(names(df_all), collapse=" + ")
formula <- as.formula(paste0("value ~ 1 + ", formula_all,
                             " + age:cos_studytime + age:sin_studytime +
                               I(age^2) + (1 | user_id)"))

# Conditional model specification
fit_bayes_horse <- brm(formula, data = train, family = 'gaussian',
                       prior = c(
                               prior(horseshoe(df = 4), class = "b"),
                               prior(cauchy(0, 1), class = "sigma"),
                               prior(normal(0, 1), class = "sd"),
                               prior(normal(0, 1), class = "Intercept")),
                       chains = chain_num, iter = iter_num,
                       control = list(adapt_delta = .99, max_treedepth = 15),
                       cores = 4, file = paste0(path, key, "_re"))

# Unconditional model formula
formula <- as.formula(paste0("value ~ 1 + (1 | user_id)"))

# Unconditional model specification
fit_bayes_horse <- brm(formula, data = train, family = 'gaussian',
                       prior = c(
                               prior(cauchy(0, 1), class = "sigma"),
                               prior(normal(0, 1), class = "sd"),
                               prior(normal(0, 1), class = "Intercept")),
                       chains = chain_num, iter = iter_num,
                       control = list(adapt_delta = .99, max_treedepth = 15),
                       cores = 4, file = paste0(path, key, "_int"))
```

S2.6. Expected log-pointwise predictive density (elpd) and elpd standard error (e_se) for participant mean and conditional models, estimated in grouped and stratified cross-validation folds. Elpd indexes out-of-sample predictive fit and can be used to compare nested models (16). Conditional models were considered significantly stronger than participant mean models when $elpd_{Full} - elpd_{Intercept} > 4(e\_se_{Full} - e\_se_{Intercept})$. Asterisks denotes significant model comparisons.

Outcome variable	Elpd (PM)	Elpd (Con)	SE (PM)	SE (Con)	Elpd (diff)	SE (diff)	
Grouped							
CRT_medianRTc	-4215.417	-3835.028	50.027	47.619	-380.389	2.408	*
DS_medianRTc	-4202.511	-3459.376	55.628	55.693	-743.135	-0.065	*
GCPT_dprime	-4342.815	-4300.849	38.936	38.602	-41.967	0.334	*
MOT_percent_correct	-4216.704	-4053.565	35.510	38.330	-163.139	-2.819	*
Stratified							
CRT_medianRTc	-2727.383	-2474.634	66.504	71.621	-252.750	-5.117	*
DS_medianRTc	-2574.878	-2385.993	81.243	87.826	-188.884	-6.583	*
GCPT_dprime	-3756.897	-3673.261	43.150	41.562	-83.636	1.588	*
MOT_percent_correct	-3089.677	-3006.955	41.985	42.326	-82.722	-0.342	*

PM = participant mean model; Con = conditional model

S2.7. Estimates, standard errors (std.error), 95% credible intervals (conf.low, conf.high), and probability of direction (pd) for conditional and participant mean models predicting variation in cognitive performance. For each model, terms are sorted by the magnitude of their estimates. Gray shading identifies significant terms, i.e., those for which the 95% credible interval (CI) did not include zero. Pd reflects the probability that an estimate is positive or negative, and pd values > 0.95 (shaded in red) may be interpreted much like p-values < 0.05. CI and pd provide complementary information about uncertainty around model estimates.

Effect	Group	Term	estimate	std.error	conf.low	conf.high	pd
CRT_medianRTc_Conditional							
fixed	NA	(Intercept)	-0.233	0.119	-0.473	-0.001	0.975
fixed	NA	study_days	-0.182	0.010	-0.201	-0.162	1.000
fixed	NA	gendermale	-0.057	0.096	-0.328	0.043	0.741
fixed	NA	testPosition	-0.047	0.011	-0.068	-0.025	1.000
fixed	NA	education	-0.044	0.055	-0.182	0.026	0.802
fixed	NA	age:sin_studytime	-0.027	0.012	-0.050	-0.002	0.988
fixed	NA	PA_alert	-0.024	0.017	-0.059	0.005	0.926
fixed	NA	screenH	-0.019	0.024	-0.073	0.019	0.808
fixed	NA	everything_an_effort	-0.018	0.016	-0.051	0.007	0.879
fixed	NA	screenW	-0.016	0.027	-0.079	0.031	0.723
fixed	NA	restless_fidgety	-0.011	0.014	-0.044	0.013	0.782
fixed	NA	goToSleepTypical	-0.011	0.032	-0.094	0.047	0.614
fixed	NA	depressed	-0.010	0.015	-0.046	0.014	0.736
fixed	NA	NA_scared	-0.008	0.012	-0.036	0.013	0.727
fixed	NA	goToSleepEarliest	-0.007	0.030	-0.079	0.049	0.581
fixed	NA	NA_nervous	-0.007	0.012	-0.034	0.014	0.714
fixed	NA	irritated	-0.006	0.011	-0.032	0.014	0.705
fixed	NA	attention_mentaleffort	-0.005	0.013	-0.035	0.019	0.641
fixed	NA	stress_covid	-0.005	0.010	-0.028	0.015	0.659
fixed	NA	goToSleepLatest	-0.004	0.030	-0.075	0.058	0.549
fixed	NA	PA_excited	-0.004	0.013	-0.032	0.021	0.606
fixed	NA	attention_finish	-0.004	0.013	-0.034	0.022	0.590
fixed	NA	PA_determined	-0.003	0.012	-0.030	0.020	0.596
fixed	NA	attention_fidgeting	-0.002	0.013	-0.031	0.025	0.568
fixed	NA	wakeUpEarliest	-0.002	0.030	-0.071	0.060	0.517
fixed	NA	age:cos_studytime	-0.001	0.010	-0.022	0.019	0.535
fixed	NA	sad_no_cheer	-0.001	0.012	-0.027	0.025	0.516

Effect	Group	Term	estimate	std.error	conf.low	conf.high	pd
fixed	NA	context_going_on	0.000	0.012	-0.025	0.025	0.502
fixed	NA	stress_health	0.000	0.008	-0.015	0.017	0.516
fixed	NA	stress_argument	0.000	0.008	-0.016	0.018	0.519
fixed	NA	wakeUpLatest	0.001	0.031	-0.068	0.070	0.515
fixed	NA	socialfunc_interactions	0.001	0.010	-0.020	0.024	0.543
fixed	NA	PA_enthusiastic	0.001	0.013	-0.025	0.030	0.541
fixed	NA	stress_friend_relative	0.002	0.008	-0.014	0.020	0.594
fixed	NA	stress_let_pass	0.002	0.008	-0.013	0.020	0.604
fixed	NA	socialfunc_comp	0.003	0.010	-0.017	0.026	0.600
fixed	NA	NA_distressed	0.003	0.012	-0.021	0.029	0.586
fixed	NA	wakeUpTypical	0.003	0.032	-0.063	0.078	0.528
fixed	NA	gendernonMbinary	0.003	0.048	-0.091	0.111	0.523
fixed	NA	interruptions	0.004	0.009	-0.013	0.023	0.660
fixed	NA	NA_afraid	0.006	0.012	-0.016	0.034	0.680
fixed	NA	worried	0.008	0.013	-0.014	0.036	0.717
fixed	NA	stress_other	0.008	0.010	-0.009	0.031	0.798
fixed	NA	context_diff_concentrating	0.010	0.012	-0.011	0.037	0.795
fixed	NA	sleep_dur	0.013	0.033	-0.041	0.095	0.627
fixed	NA	hopeless	0.013	0.016	-0.012	0.049	0.798
fixed	NA	attention_motor	0.014	0.015	-0.010	0.048	0.833
fixed	NA	englishPrimaryyes	0.014	0.060	-0.074	0.163	0.580
fixed	NA	NA_upset	0.018	0.014	-0.006	0.047	0.901
fixed	NA	context_noisy	0.022	0.015	-0.003	0.052	0.938
fixed	NA	attention_diff_organization	0.028	0.019	-0.004	0.068	0.936
fixed	NA	PA_inspired	0.036	0.019	0.000	0.072	0.974
fixed	NA	attention_forgetful	0.038	0.021	0.000	0.080	0.976
fixed	NA	sin_studytime	0.075	0.014	0.048	0.102	1.000
fixed	NA	cos_studytime	0.076	0.013	0.049	0.102	1.000
fixed	NA	alert_sleepiness	0.104	0.015	0.074	0.134	1.000
fixed	NA	age^2	0.243	0.087	0.066	0.408	0.998
fixed	NA	age	0.258	0.108	0.030	0.461	0.995
ran_pars	Residual	sd__Observation	0.526	0.007	0.513	0.540	NA
ran_pars	user_id	sd__(Intercept)	0.662	0.046	0.578	0.760	NA
CRT_medianRTc_ParticipantMean							
fixed	NA	(Intercept)	0.014	0.075	-0.132	0.165	0.575
ran_pars	Residual	sd__Observation	0.577	0.007	0.562	0.592	NA
ran_pars	user_id	sd__(Intercept)	0.834	0.054	0.737	0.947	NA
DS_medianRTc_Conditional							
fixed	NA	study_days	-0.159	0.010	-0.178	-0.139	1.000
fixed	NA	(Intercept)	-0.123	0.094	-0.305	0.056	0.902

Effect	Group	Term	estimate	std.error	conf.low	conf.high	pd
fixed	NA	testPosition	-0.048	0.010	-0.068	-0.029	1.000
fixed	NA	PA_alert	-0.036	0.018	-0.072	-0.001	0.982
fixed	NA	everything_an_effort	-0.035	0.017	-0.068	-0.001	0.980
fixed	NA	education	-0.031	0.043	-0.140	0.026	0.773
fixed	NA	NA_nervous	-0.021	0.015	-0.052	0.003	0.930
fixed	NA	PA_excited	-0.020	0.017	-0.055	0.006	0.898
fixed	NA	goToSleepLatest	-0.020	0.034	-0.107	0.032	0.714
fixed	NA	irritated	-0.015	0.013	-0.043	0.006	0.880
fixed	NA	NA_scared	-0.015	0.015	-0.047	0.009	0.849
fixed	NA	worried	-0.013	0.014	-0.044	0.009	0.829
fixed	NA	age:sin_studytime	-0.012	0.010	-0.034	0.005	0.885
fixed	NA	screenH	-0.009	0.019	-0.054	0.023	0.683
fixed	NA	gendermale	-0.009	0.039	-0.111	0.061	0.568
fixed	NA	attention_fidgeting	-0.008	0.014	-0.040	0.015	0.715
fixed	NA	stress_other	-0.005	0.009	-0.025	0.010	0.718
fixed	NA	stress_friend_relative	-0.005	0.008	-0.023	0.010	0.704
fixed	NA	NA_distressed	-0.004	0.011	-0.030	0.017	0.628
fixed	NA	screenW	-0.003	0.020	-0.047	0.040	0.566
fixed	NA	goToSleepEarliest	-0.003	0.025	-0.061	0.048	0.544
fixed	NA	PA_determined	-0.003	0.012	-0.028	0.020	0.578
fixed	NA	attention_motor	-0.002	0.011	-0.027	0.020	0.568
fixed	NA	wakeUpEarliest	-0.001	0.026	-0.063	0.054	0.512
fixed	NA	stress_health	-0.001	0.007	-0.017	0.014	0.575
fixed	NA	attention_finish	-0.001	0.012	-0.029	0.024	0.537
fixed	NA	PA_enthusiastic	0.000	0.013	-0.028	0.028	0.503
fixed	NA	stress_let_pass	0.000	0.008	-0.016	0.017	0.506
fixed	NA	context_noisy	0.000	0.011	-0.022	0.024	0.516
fixed	NA	restless_fidgety	0.000	0.011	-0.024	0.025	0.515
fixed	NA	NA_upset	0.001	0.010	-0.021	0.024	0.511
fixed	NA	stress_argument	0.001	0.008	-0.015	0.018	0.540
fixed	NA	interruptions	0.001	0.008	-0.016	0.019	0.548
fixed	NA	stress_covid	0.002	0.010	-0.017	0.023	0.569
fixed	NA	socialfunc_comp	0.002	0.010	-0.017	0.024	0.574
fixed	NA	depressed	0.004	0.013	-0.022	0.035	0.607
fixed	NA	socialfunc_interactions	0.004	0.010	-0.016	0.027	0.646
fixed	NA	englishPrimaryyes	0.004	0.043	-0.079	0.104	0.526
fixed	NA	age:cos_studytime	0.004	0.009	-0.012	0.024	0.676
fixed	NA	gendernonMbinary	0.005	0.046	-0.082	0.111	0.537
fixed	NA	hopeless	0.005	0.013	-0.019	0.036	0.644
fixed	NA	PA_inspired	0.006	0.013	-0.018	0.036	0.657

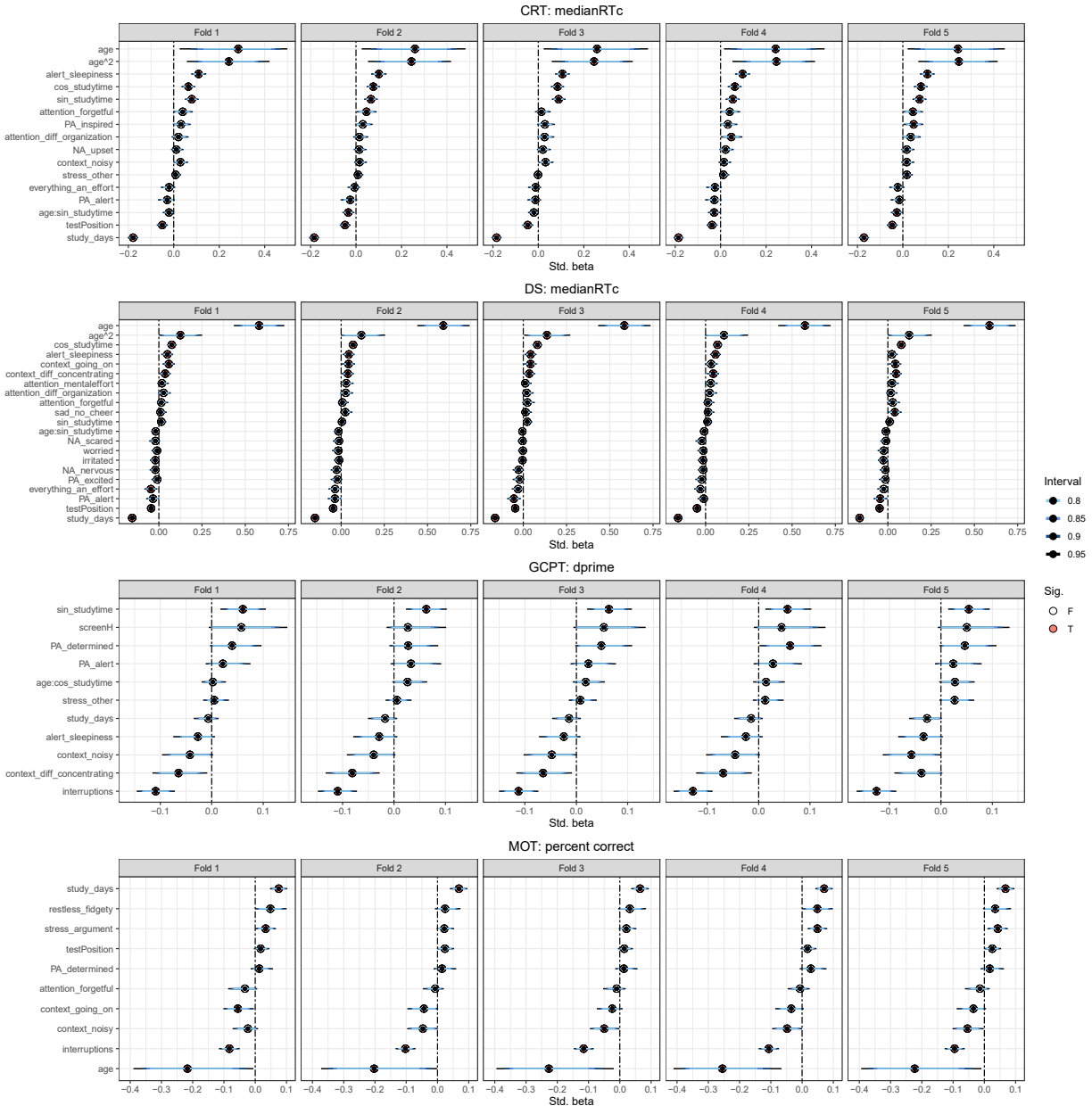
Effect	Group	Term	estimate	std.error	conf.low	conf.high	pd
fixed	NA	goToSleepTypical	0.006	0.027	-0.047	0.071	0.572
fixed	NA	wakeUpTypical	0.010	0.030	-0.040	0.089	0.616
fixed	NA	sin_studytime	0.013	0.012	-0.006	0.039	0.883
fixed	NA	wakeUpLatest	0.014	0.032	-0.037	0.096	0.665
fixed	NA	attention_forgetful	0.016	0.016	-0.009	0.052	0.839
fixed	NA	NA_afraid	0.020	0.016	-0.006	0.054	0.904
fixed	NA	sad_no_cheer	0.020	0.017	-0.007	0.055	0.892
fixed	NA	attention_diff_organization	0.024	0.018	-0.005	0.062	0.919
fixed	NA	attention_mentaleffort	0.025	0.018	-0.004	0.061	0.931
fixed	NA	sleep_dur	0.030	0.038	-0.023	0.123	0.784
fixed	NA	context_diff_concentrating	0.041	0.016	0.009	0.071	0.994
fixed	NA	alert_sleepiness	0.044	0.015	0.013	0.074	0.997
fixed	NA	context_going_on	0.046	0.016	0.013	0.077	0.998
fixed	NA	cos_studytime	0.076	0.013	0.052	0.102	1.000
fixed	NA	age^2	0.123	0.069	-0.001	0.257	0.972
ran_pars	Residual	sd__Observation	0.509	0.007	0.496	0.523	NA
ran_pars	user_id	sd__(Intercept)	0.547	0.039	0.475	0.630	NA
fixed	NA	age	0.584	0.079	0.431	0.739	1.000
DS_medianRTc_ParticipantMean							
fixed	NA	(Intercept)	0.010	0.080	-0.148	0.170	0.556
ran_pars	Residual	sd__Observation	0.546	0.007	0.532	0.560	NA
ran_pars	user_id	sd__(Intercept)	0.851	0.057	0.749	0.972	NA
GCPT_dprime_Conditional							
fixed	NA	interruptions	-0.118	0.017	-0.152	-0.085	1.000
fixed	NA	context_diff_concentrating	-0.065	0.024	-0.111	-0.017	0.998
fixed	NA	context_noisy	-0.050	0.025	-0.098	-0.002	0.984
fixed	NA	alert_sleepiness	-0.031	0.022	-0.076	0.004	0.933
fixed	NA	PA_excited	-0.024	0.024	-0.077	0.010	0.855
fixed	NA	age^2	-0.022	0.033	-0.106	0.022	0.744
fixed	NA	context_going_on	-0.021	0.022	-0.072	0.011	0.842
fixed	NA	goToSleepTypical	-0.021	0.036	-0.119	0.024	0.717
fixed	NA	study_days	-0.017	0.014	-0.047	0.005	0.898
fixed	NA	gendernonMbinary	-0.008	0.041	-0.108	0.056	0.559
fixed	NA	attention_finish	-0.008	0.016	-0.048	0.020	0.685
fixed	NA	stress_friend_relative	-0.006	0.011	-0.032	0.013	0.692
fixed	NA	depressed	-0.006	0.016	-0.045	0.023	0.628
fixed	NA	wakeUpLatest	-0.006	0.026	-0.070	0.042	0.577
fixed	NA	attention_mentaleffort	-0.005	0.015	-0.040	0.024	0.604
fixed	NA	attention_fidgeting	-0.005	0.016	-0.042	0.025	0.597
fixed	NA	sad_no_cheer	-0.004	0.015	-0.041	0.024	0.603

Effect	Group	Term	estimate	std.error	conf.low	conf.high	pd
fixed	NA	hopeless	-0.004	0.015	-0.040	0.026	0.597
fixed	NA	age:sin_studytime	-0.004	0.012	-0.031	0.019	0.615
fixed	NA	irritated	-0.004	0.013	-0.034	0.021	0.599
fixed	NA	attention_diff_organization	-0.003	0.016	-0.039	0.028	0.581
fixed	NA	gendermale	-0.003	0.033	-0.083	0.061	0.523
fixed	NA	stress_health	-0.003	0.010	-0.027	0.016	0.615
fixed	NA	englishPrimaryyes	-0.003	0.037	-0.085	0.069	0.518
fixed	NA	NA_scared	-0.001	0.013	-0.031	0.025	0.538
fixed	NA	PA_inspired	-0.001	0.016	-0.036	0.031	0.529
fixed	NA	testPosition	-0.001	0.010	-0.024	0.019	0.551
fixed	NA	goToSleepLatest	-0.001	0.024	-0.055	0.052	0.512
fixed	NA	wakeUpEarliest	-0.001	0.025	-0.056	0.053	0.503
fixed	NA	attention_forgetful	0.000	0.015	-0.033	0.033	0.501
fixed	NA	sleep_dur	0.000	0.023	-0.049	0.051	0.503
fixed	NA	restless_fidgety	0.001	0.014	-0.028	0.032	0.528
fixed	NA	NA_nervous	0.001	0.013	-0.026	0.030	0.529
fixed	NA	stress_argument	0.002	0.010	-0.019	0.025	0.557
fixed	NA	age	0.002	0.024	-0.048	0.058	0.532
fixed	NA	attention_motor	0.003	0.014	-0.025	0.036	0.574
fixed	NA	socialfunc_interactions	0.003	0.013	-0.022	0.033	0.581
fixed	NA	stress_covid	0.003	0.012	-0.020	0.032	0.588
fixed	NA	NA_upset	0.003	0.014	-0.024	0.035	0.579
fixed	NA	worried	0.004	0.014	-0.023	0.038	0.602
fixed	NA	socialfunc_comp	0.005	0.013	-0.020	0.035	0.628
fixed	NA	stress_let_pass	0.005	0.011	-0.015	0.032	0.667
fixed	NA	(Intercept)	0.006	0.075	-0.138	0.161	0.520
fixed	NA	PA_enthusiastic	0.008	0.019	-0.023	0.054	0.650
fixed	NA	wakeUpTypical	0.009	0.028	-0.039	0.081	0.619
fixed	NA	stress_other	0.010	0.014	-0.010	0.042	0.779
fixed	NA	NA_distressed	0.011	0.017	-0.015	0.050	0.744
fixed	NA	goToSleepEarliest	0.012	0.029	-0.033	0.086	0.645
fixed	NA	everything_an_effort	0.012	0.018	-0.015	0.054	0.755
fixed	NA	screenW	0.013	0.031	-0.041	0.089	0.664
fixed	NA	NA_afraid	0.013	0.017	-0.013	0.055	0.771
fixed	NA	cos_studytime	0.016	0.018	-0.010	0.056	0.824
fixed	NA	age:cos_studytime	0.018	0.015	-0.006	0.051	0.895
fixed	NA	PA_alert	0.025	0.023	-0.008	0.076	0.880
fixed	NA	education	0.027	0.040	-0.022	0.131	0.760
fixed	NA	PA_determined	0.053	0.027	0.001	0.106	0.981
fixed	NA	screenH	0.057	0.039	-0.005	0.136	0.941

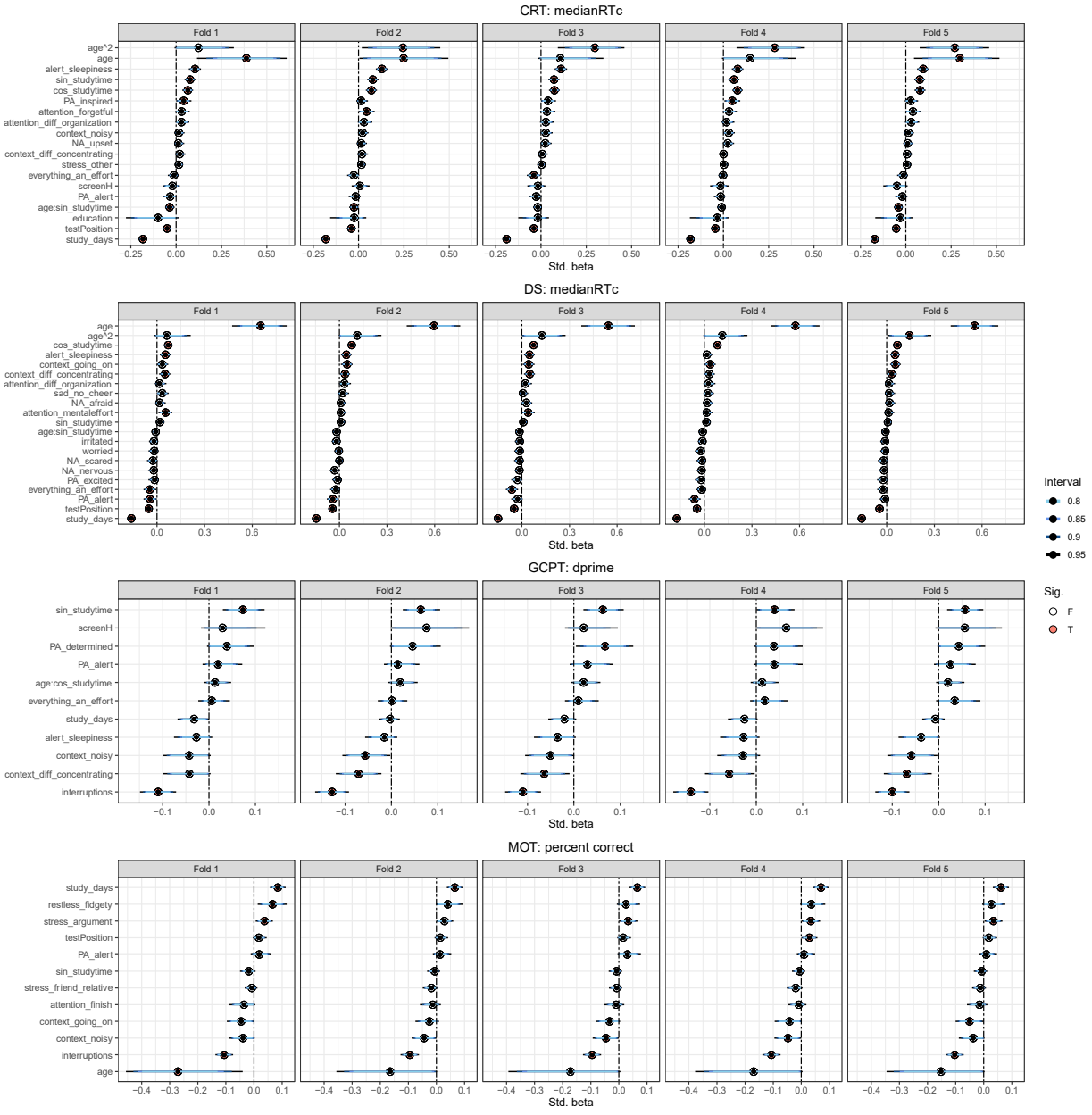
Effect	Group	Term	estimate	std.error	conf.low	conf.high	pd
fixed	NA	sin_studytime	0.063	0.019	0.027	0.102	1.000
ran_pars	user_id	sd__(Intercept)	0.596	0.042	0.519	0.687	NA
ran_pars	Residual	sd__Observation	0.785	0.010	0.765	0.805	NA
GCPT_dprime_ParticipantMean							
fixed	NA	(Intercept)	-0.023	0.057	-0.133	0.089	0.658
ran_pars	user_id	sd__(Intercept)	0.599	0.042	0.523	0.688	NA
ran_pars	Residual	sd__Observation	0.811	0.011	0.790	0.832	NA
MOT_percent_correct_Conditional							
fixed	NA	age	-0.226	0.093	-0.393	-0.016	0.991
fixed	NA	interruptions	-0.102	0.014	-0.130	-0.074	1.000
fixed	NA	context_noisy	-0.045	0.023	-0.089	-0.001	0.980
fixed	NA	context_going_on	-0.040	0.024	-0.086	0.001	0.964
fixed	NA	sleep_dur	-0.035	0.047	-0.155	0.021	0.786
fixed	NA	age^2	-0.034	0.050	-0.167	0.024	0.767
fixed	NA	PA_inspired	-0.022	0.021	-0.069	0.008	0.872
fixed	NA	attention_diff_organization	-0.019	0.020	-0.064	0.012	0.831
fixed	NA	attention_finish	-0.016	0.019	-0.058	0.011	0.811
fixed	NA	stress_friend_relative	-0.014	0.013	-0.041	0.006	0.879
fixed	NA	screenW	-0.013	0.024	-0.074	0.024	0.692
fixed	NA	attention_forgetful	-0.012	0.018	-0.054	0.015	0.749
fixed	NA	hopeless	-0.011	0.017	-0.052	0.016	0.737
fixed	NA	NA_afraid	-0.011	0.015	-0.045	0.012	0.765
fixed	NA	sin_studytime	-0.010	0.012	-0.037	0.009	0.793
fixed	NA	PA_excited	-0.008	0.015	-0.044	0.017	0.696
fixed	NA	wakeUpLatest	-0.007	0.028	-0.075	0.045	0.585
fixed	NA	englishPrimaryyes	-0.006	0.040	-0.104	0.061	0.543
fixed	NA	alert_sleepiness	-0.006	0.012	-0.035	0.016	0.681
fixed	NA	context_diff_concentrating	-0.006	0.013	-0.036	0.017	0.670
fixed	NA	stress_let_pass	-0.005	0.010	-0.028	0.013	0.677
fixed	NA	attention_motor	-0.004	0.014	-0.036	0.021	0.613
fixed	NA	NA_scared	-0.004	0.012	-0.033	0.019	0.617
fixed	NA	depressed	-0.004	0.014	-0.037	0.024	0.595
fixed	NA	attention_fidgeting	-0.004	0.015	-0.038	0.025	0.583
fixed	NA	sad_no_cheer	-0.004	0.014	-0.036	0.023	0.592
fixed	NA	goToSleepLatest	-0.003	0.025	-0.064	0.047	0.546
fixed	NA	everything_an_effort	-0.003	0.013	-0.033	0.022	0.585
fixed	NA	socialfunc_interactions	-0.003	0.012	-0.030	0.020	0.588
fixed	NA	screenH	-0.001	0.019	-0.041	0.039	0.537
fixed	NA	age:sin_studytime	-0.001	0.009	-0.021	0.019	0.519
fixed	NA	PA_enthusiastic	-0.001	0.014	-0.033	0.030	0.510

Effect	Group	Term	estimate	std.error	conf.low	conf.high	pd
fixed	NA	age:cos_studytime	0.000	0.009	-0.019	0.021	0.516
fixed	NA	socialfunc_comp	0.001	0.011	-0.022	0.025	0.521
fixed	NA	stress_health	0.001	0.009	-0.018	0.020	0.539
fixed	NA	gendernonMbinary	0.001	0.038	-0.074	0.082	0.513
fixed	NA	goToSleepTypical	0.001	0.027	-0.055	0.062	0.517
fixed	NA	NA_upset	0.002	0.012	-0.022	0.028	0.567
fixed	NA	irritated	0.002	0.012	-0.021	0.029	0.579
fixed	NA	attention_mentaleffort	0.003	0.014	-0.023	0.035	0.576
fixed	NA	cos_studytime	0.003	0.010	-0.017	0.027	0.614
fixed	NA	NA_distressed	0.004	0.013	-0.020	0.034	0.615
fixed	NA	wakeUpEarliest	0.005	0.029	-0.049	0.073	0.548
fixed	NA	education	0.005	0.026	-0.045	0.072	0.565
fixed	NA	NA_nervous	0.005	0.013	-0.017	0.034	0.643
fixed	NA	wakeUpTypical	0.005	0.028	-0.048	0.075	0.562
fixed	NA	stress_other	0.009	0.012	-0.009	0.034	0.771
fixed	NA	stress_covid	0.009	0.014	-0.012	0.041	0.753
fixed	NA	worried	0.010	0.016	-0.014	0.047	0.742
fixed	NA	gendermale	0.017	0.049	-0.047	0.149	0.626
fixed	NA	PA_alert	0.018	0.018	-0.009	0.058	0.842
fixed	NA	PA_determined	0.019	0.020	-0.010	0.062	0.843
fixed	NA	testPosition	0.020	0.013	-0.001	0.046	0.955
fixed	NA	goToSleepEarliest	0.021	0.037	-0.028	0.122	0.718
fixed	NA	stress_argument	0.036	0.014	0.006	0.064	0.995
fixed	NA	(Intercept)	0.038	0.088	-0.122	0.225	0.659
fixed	NA	restless_fidgety	0.042	0.023	0.000	0.087	0.973
fixed	NA	study_days	0.071	0.013	0.046	0.096	1.000
ran_pars	Residual	sd__Observation	0.653	0.009	0.635	0.670	NA
ran_pars	user_id	sd__(Intercept)	0.665	0.047	0.578	0.762	NA
MOT_percent_correct_ParticipantMean							
fixed	NA	(Intercept)	-0.003	0.070	-0.137	0.138	0.515
ran_pars	Residual	sd__Observation	0.674	0.009	0.657	0.692	NA
ran_pars	user_id	sd__(Intercept)	0.748	0.050	0.656	0.852	NA

S2.8. Strong predictors from stratified cross-validation. Predictors are sorted by cognitive outcome (rows), fold number (columns), and coefficient magnitude (within panels, along y-axis). Significant (sig.) predictors, for which 95% CI did not include zero, are identified by a salmon-colored dot. Std. beta = standardized beta.



S2.9. Strong predictors from grouped cross-validation. Predictors are sorted by cognitive outcome (rows), fold number (columns), and coefficient magnitude (within panels, along y-axis). Significant (sig.) predictors, for which 95% CI did not include zero, are identified by a salmon-colored dot. Std. beta = standardized beta.



S2.10. Post-hoc hierarchical linear models evaluating intra- and inter-individual effects on cognitive performance. Gray shading identifies significant and marginal terms ($p < .10$), red text identifies intra-individual predictors, and black text identifies inter-individual predictors.

Term	estimate	std.error	t.value	df	p.value	ci.l	ci.u
CRT_medianRTc							
(Intercept)	711.074	9.113	78.025	118.897	0.000	693.028	729.120
alert_sleepiness_pm	-9.728	9.756	-0.997	118.902	0.321	-29.047	9.591
attention_forgetful_pm	14.394	9.704	1.483	118.953	0.141	-4.822	33.610
alert_sleepiness_cwp	11.344	1.267	8.956	2934.898	0.000	8.861	13.828
attention_forgetful_cwp	6.307	1.400	4.506	2934.898	0.000	3.563	9.052
DS_medianRTc							
(Intercept)	811.563	11.171	72.646	117.955	0.000	789.440	833.685
context_composite_pm	-4.353	11.753	-0.370	117.907	0.712	-27.628	18.922
alert_composite_pm	36.016	11.634	3.096	117.990	0.002	12.979	59.054
everything_an_effort_pm	5.868	12.000	0.489	117.933	0.626	-17.895	29.631
context_composite_cwp	8.865	1.497	5.921	2936.958	0.000	5.929	11.801
alert_composite_cwp	-7.806	1.490	-5.239	2936.958	0.000	-10.728	-4.885
everything_an_effort_cwp	-2.698	1.636	-1.649	2936.958	0.099	-5.907	0.511
GCPT_dprime							
(Intercept)	2.833	0.041	68.707	115.639	0.000	2.751	2.914
PA_determined_pm	-0.044	0.043	-1.037	115.120	0.302	-0.128	0.040
context_noisy_pm	0.017	0.062	0.280	117.795	0.780	-0.106	0.141
context_diff_concentrating_pm	-0.065	0.057	-1.144	116.188	0.255	-0.178	0.048
interruptions_pm	-0.028	0.050	-0.565	116.347	0.573	-0.128	0.071
PA_determined_cwp	0.053	0.011	4.910	2923.035	0.000	0.032	0.075
context_noisy_cwp	-0.042	0.012	-3.451	2923.035	0.001	-0.066	-0.018
context_diff_concentrating_cwp	-0.041	0.012	-3.365	2923.035	0.001	-0.064	-0.017
interruptions_cwp	-0.088	0.011	-7.677	2923.035	0.000	-0.110	-0.065
MOT_percent_correct							
(Intercept)	0.739	0.008	94.638	117.074	0.000	0.723	0.754
stress_argument_pm	-0.002	0.008	-0.227	116.950	0.821	-0.018	0.014
context_noisy_pm	-0.009	0.010	-0.905	117.150	0.367	-0.028	0.010
interruptions_pm	-0.004	0.009	-0.417	116.945	0.677	-0.023	0.015
stress_argument_cwp	0.005	0.002	3.036	2831.105	0.002	0.002	0.008
context_noisy_cwp	-0.007	0.001	-4.960	2831.105	0.000	-0.010	-0.004
interruptions_cwp	-0.012	0.001	-7.906	2831.105	0.000	-0.015	-0.009

Df = degrees of freedom; _pm = participant mean; _cwp = centered within participants; ci.l = lower bound of 95% confidence interval; ci.u = upper bound of 95% confidence interval

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