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MAX PLANCK INSTITUTE
FOR THE STUDY OF
CRIME, SECURITY AND LAW

Modeling cognitive deficits and enhancements in adversity-exposed youth using Drift Diffusion Modeling

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Developmental Science

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Cognitive deficits and enhancements in youth from adverse conditions: An integrative assessment using Drift Diffusion Modeling in the ABCD study

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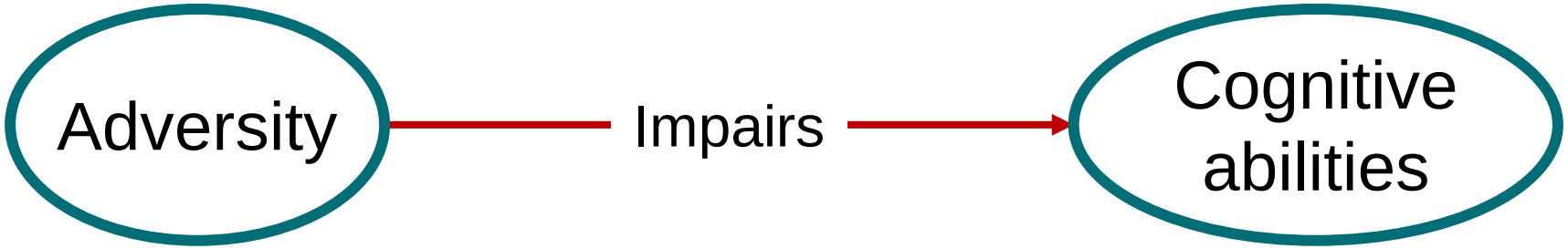
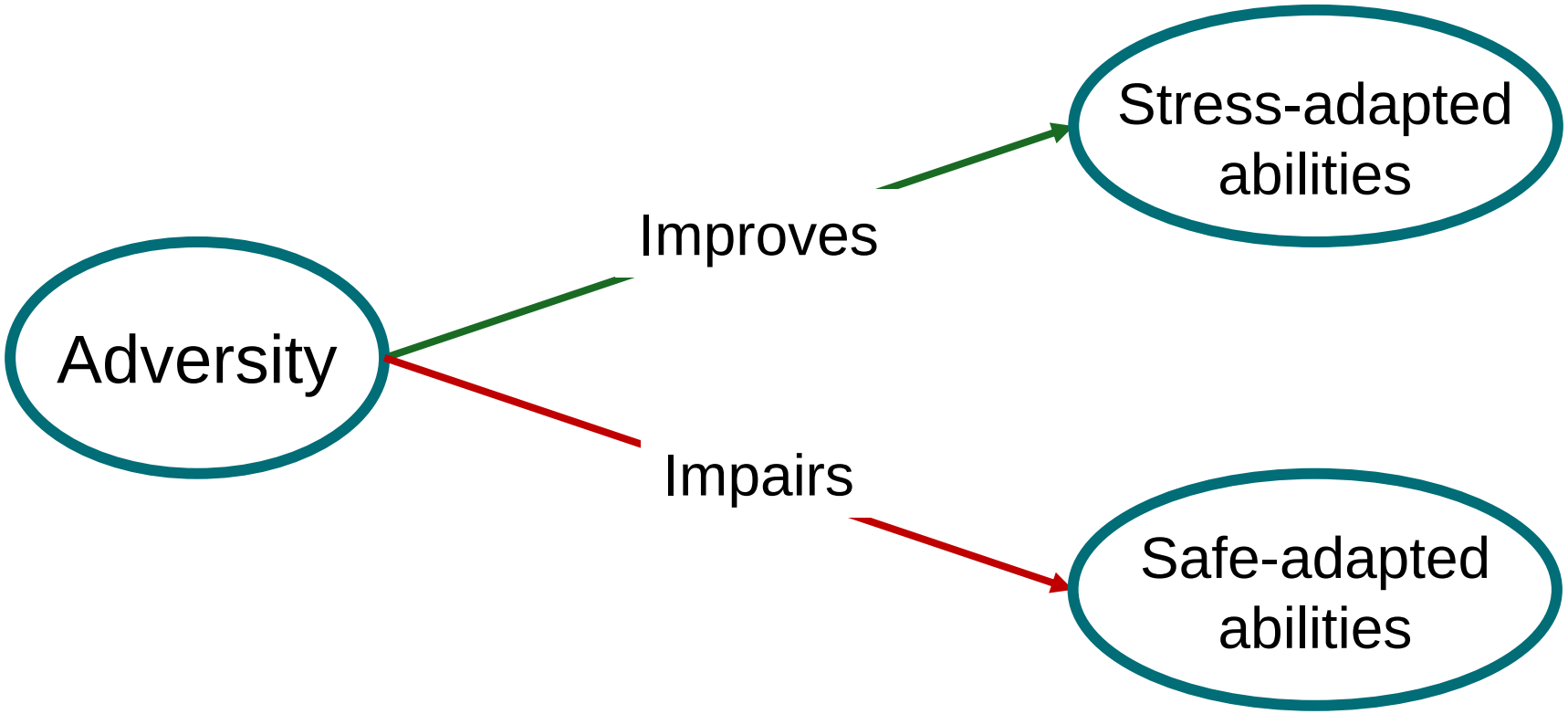
Cognitive deficits



Cognitive adaptations



Ellis et al. (2022) *Dev. and Psychopath.;* Frankenhuis et al. (2021) *TICS*

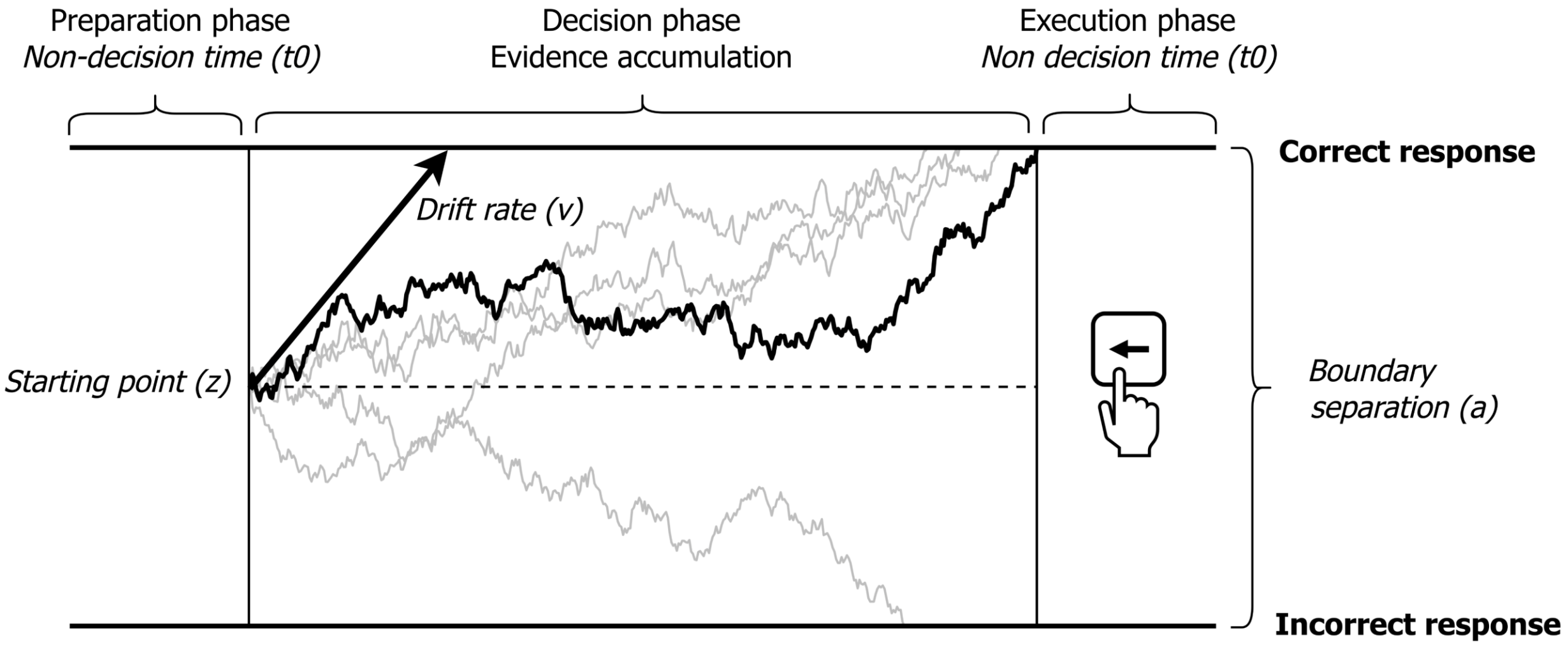
Performance-ability gap

Why is this important?

Theory development

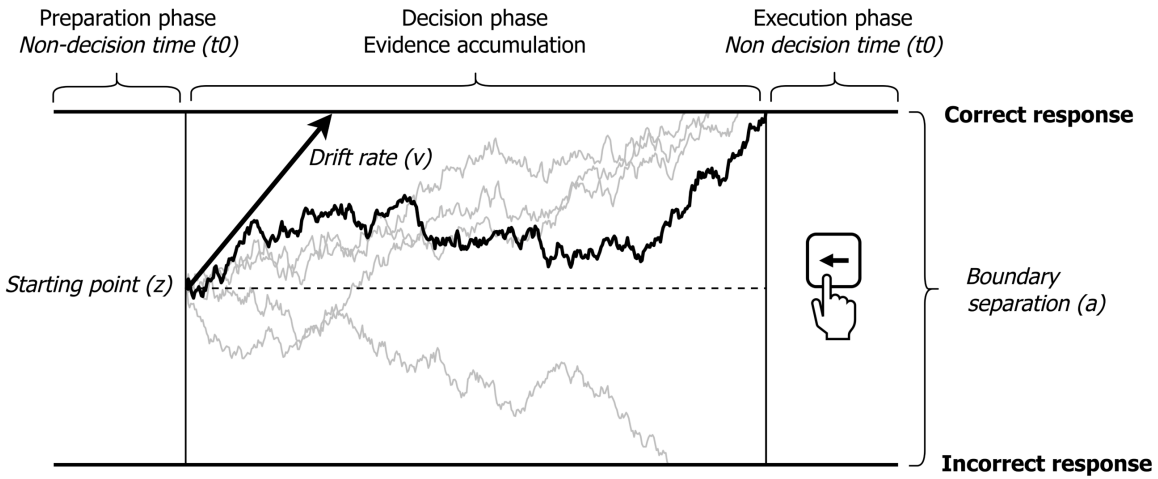
Interventions

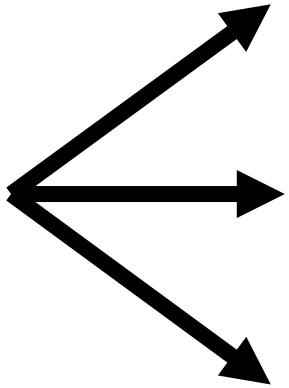
Drift Diffusion Model



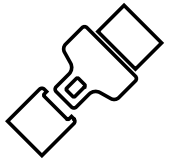
Forstmann et al. (2016) *Ann. Review of Psych.; Ratcliff & McKoon (2008). Neural Comp.*

Drift Diffusion Model

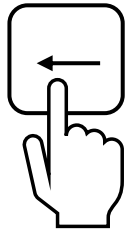




Drift rate
Information processing



Boundary separation
Response caution



Non-decision time
encoding/
response execution

Implementation

More trials needed / Less susceptible to outliers

Option 1. Fit to *individual participants*

Maximum likelihood

Kolmogorov-Smirnov

Chi-square

Software/packages

Fast-dm

Option 2. Fit to *group*

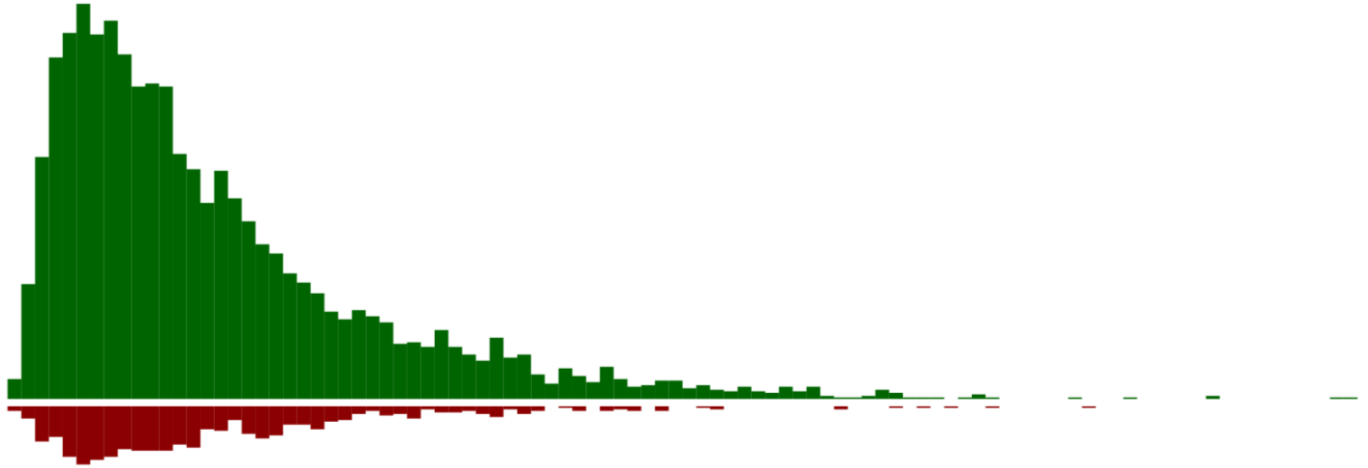
Hierarchical Bayesian

Software/packages

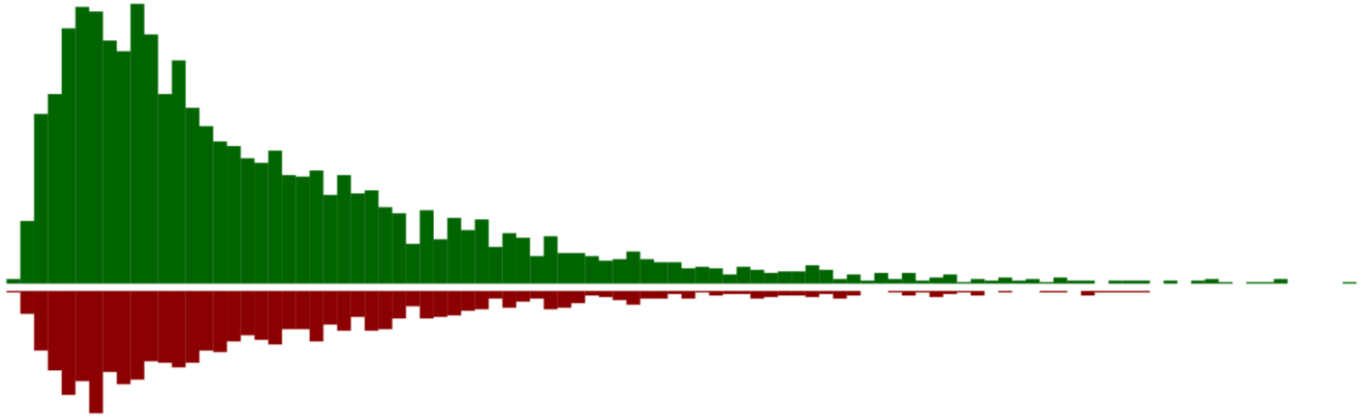
HDDM (python module)
hBayesDM (R package)
runjags (R package; with wiener module)

Lerche et al. (2017). *Behav. Res.; Ratcliff & Childers (2015). Decision*

Slower evidence accumulation

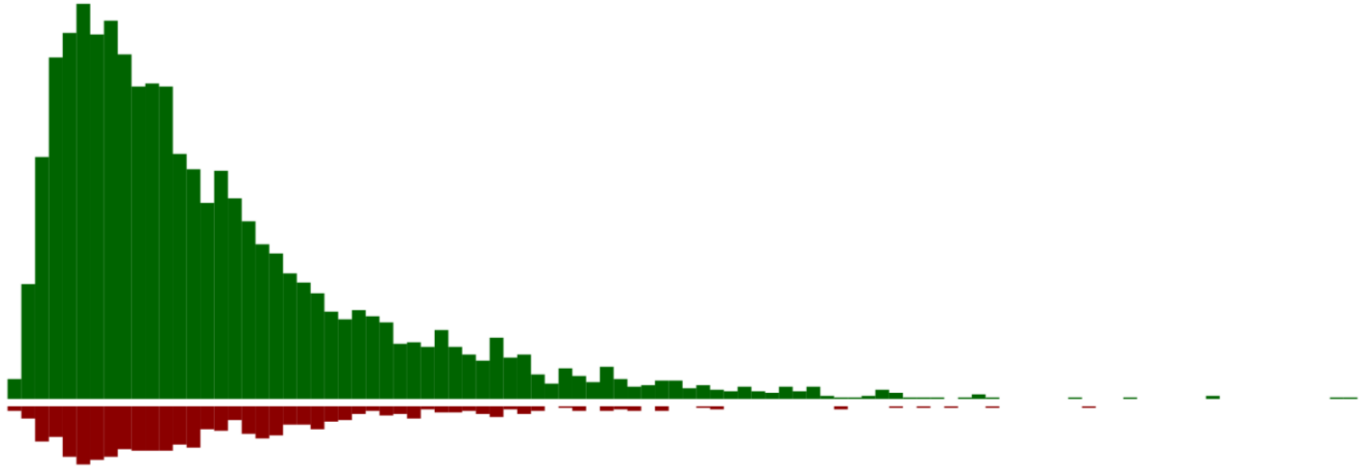


Drift rate: *2*
Boundary separation: 1
Non-decision time: 0.3
Bias: 0.5

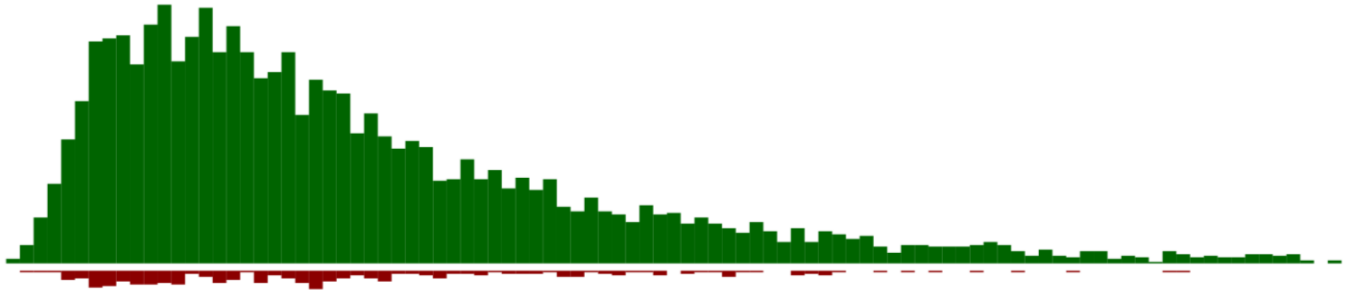


Drift rate: *1*
Boundary separation: 1
Non-decision time: 0.3
Bias: 0.5

Increased response caution

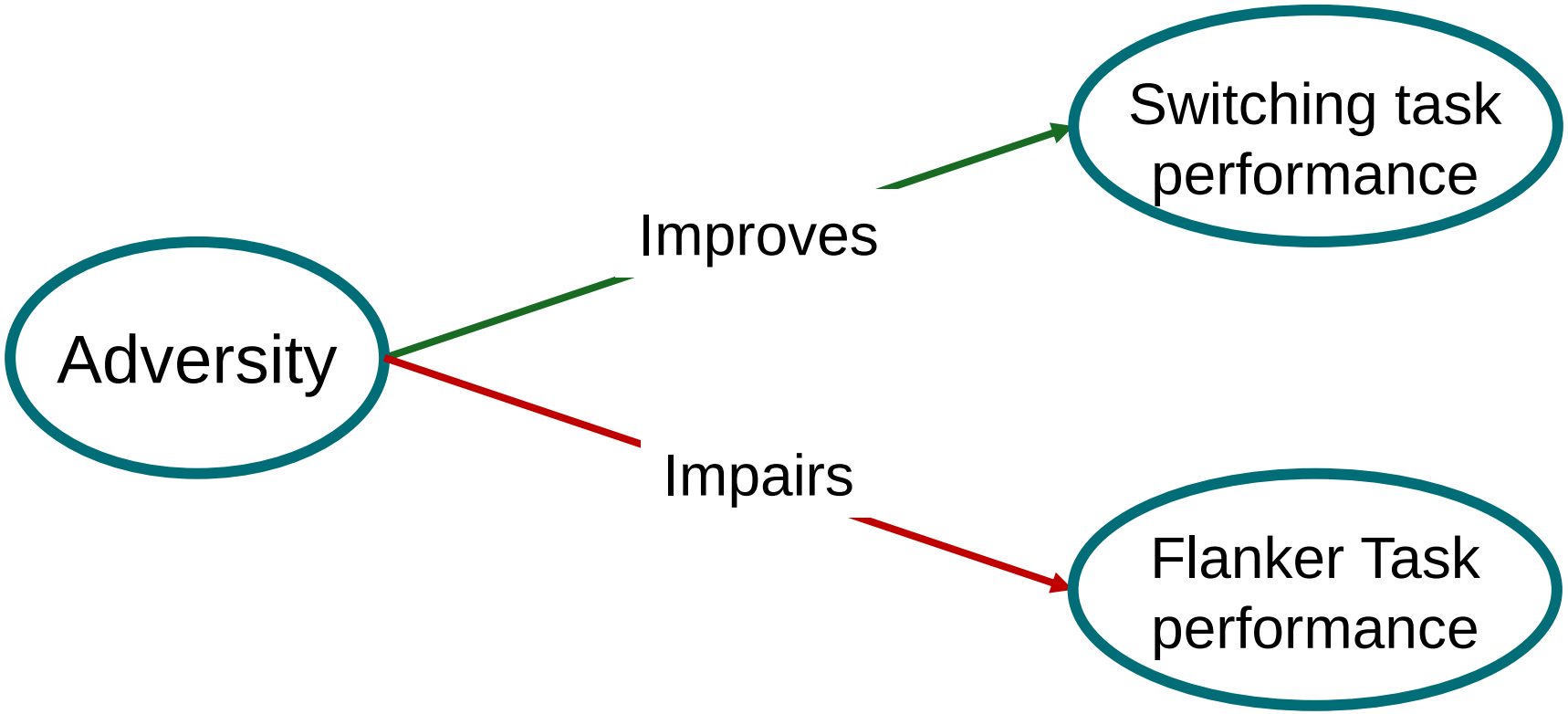


Drift rate: 2
Boundary separation: *1*
Non-decision time: 0.3
Bias: 0.5



Drift rate: 2
Boundary separation: *1.5*
Non-decision time: 0.3
Bias: 0.5

Cognitive adaptations



Ellis et al. (2022) *Dev. and Psychopath.;* Frankenhuis et al. (2021) *TICS*

Task-general factors

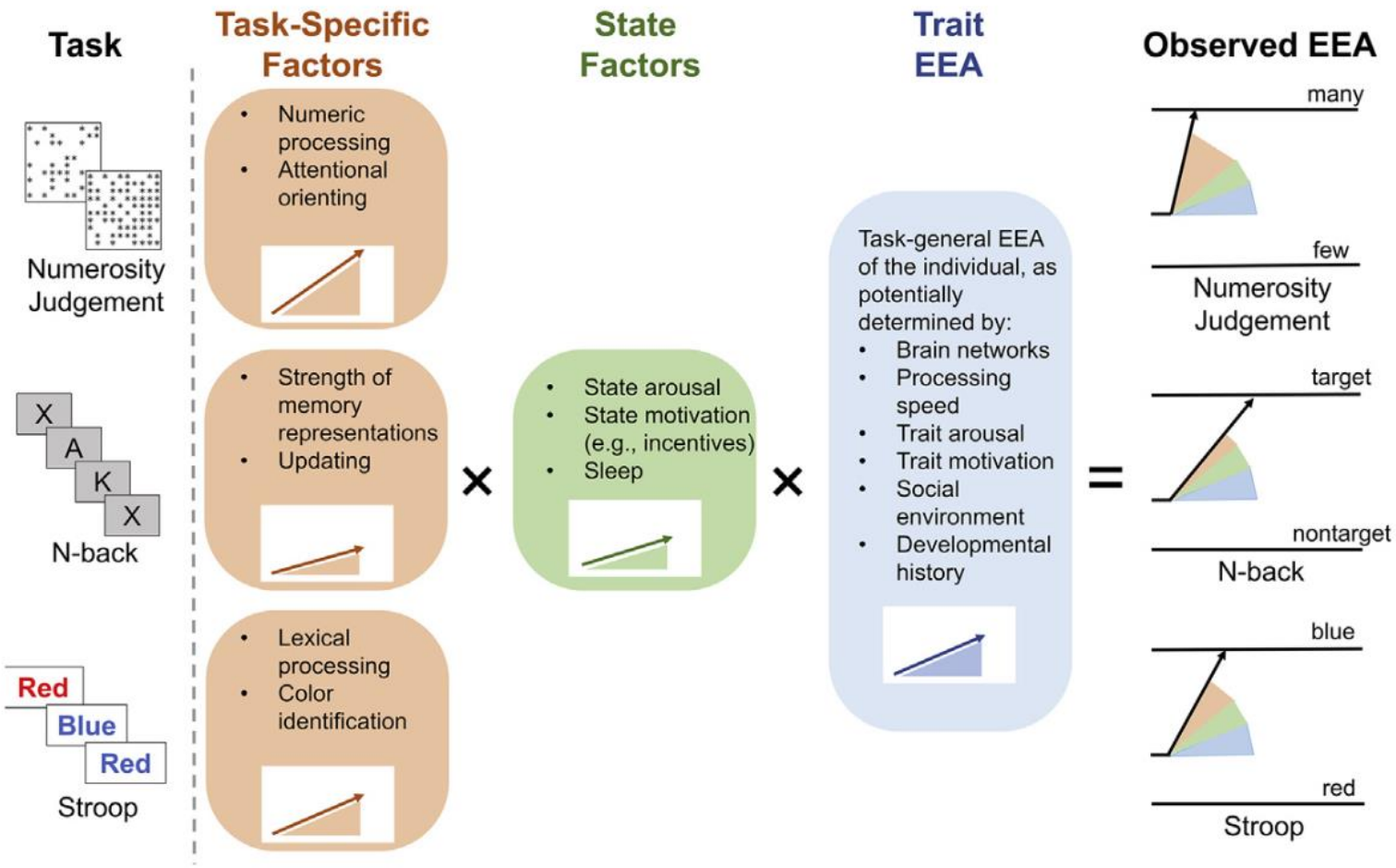


Figure adopted from Weigard & Sripada (2021). *Biological Psychiatry GOS*

Task-general factors

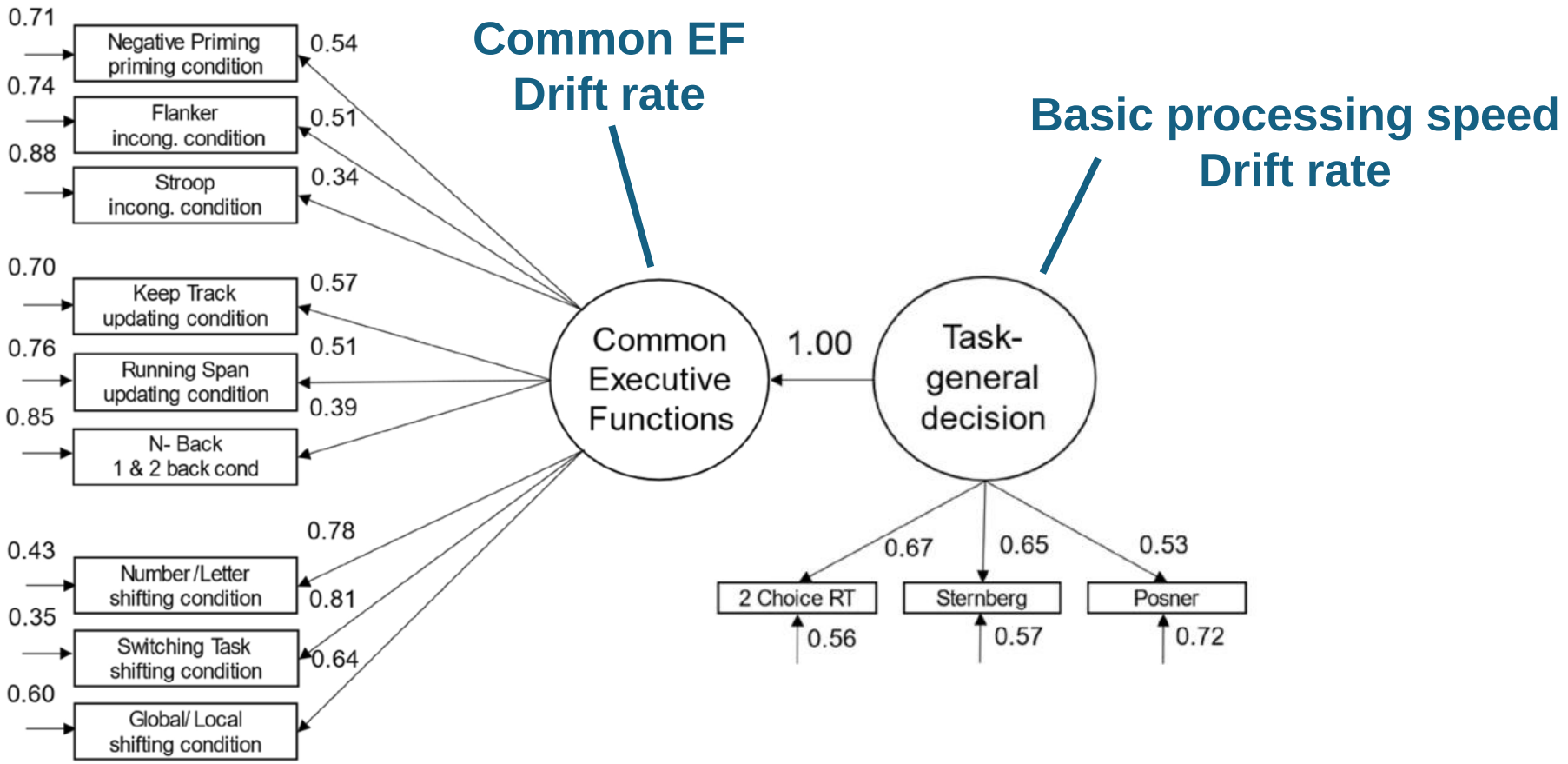


Figure adopted from Löffler et al. (2024). *Psychological Research*

ABCD Data

N = 10,563 US children aged 9-10

Training set: 1,500
Test set: 9,063

Household Threat (9 items)
"*We fight a lot in our family*"

Material deprivation (7 items)
"*Needed food but couldn't afford to buy it or couldn't afford to go out to get it*"

ABCD Data

N = 10,563 US children aged 9-10

Training set: 1,500
Test set: 9,063

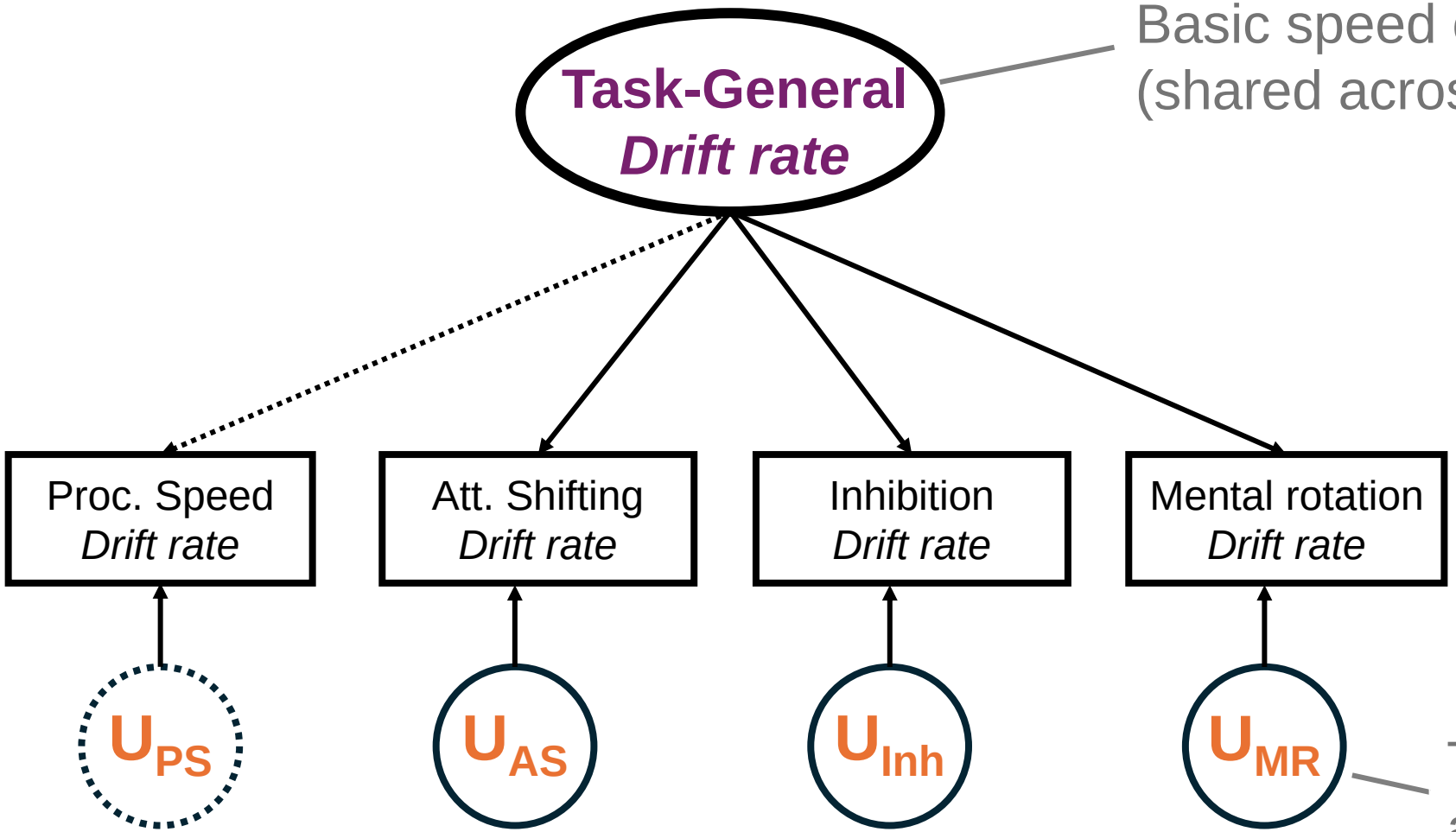
Processing Speed Task
Visual processing

Flanker Task
Inhibition / cognitive control

Dimensional Change Card Sort Task
Attention Shifting

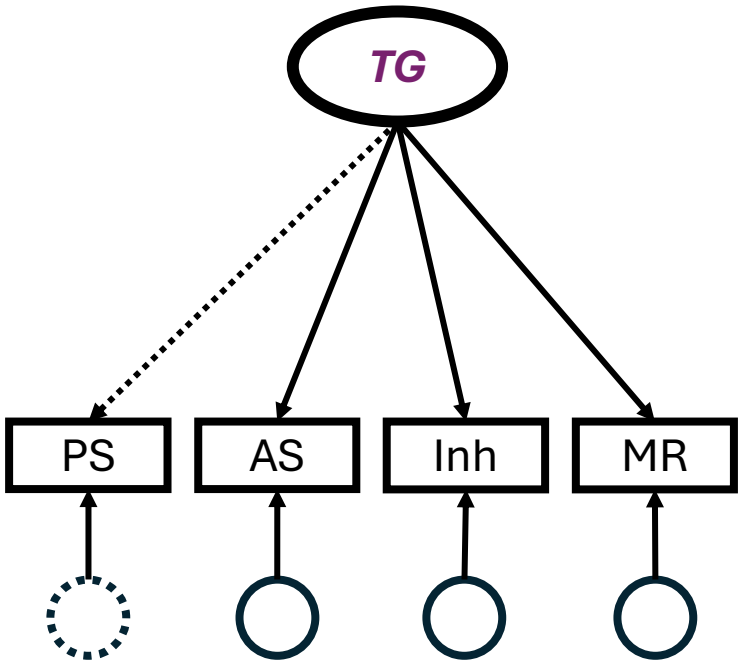
Mental Rotation Task
Visual-spatial processing

SEM

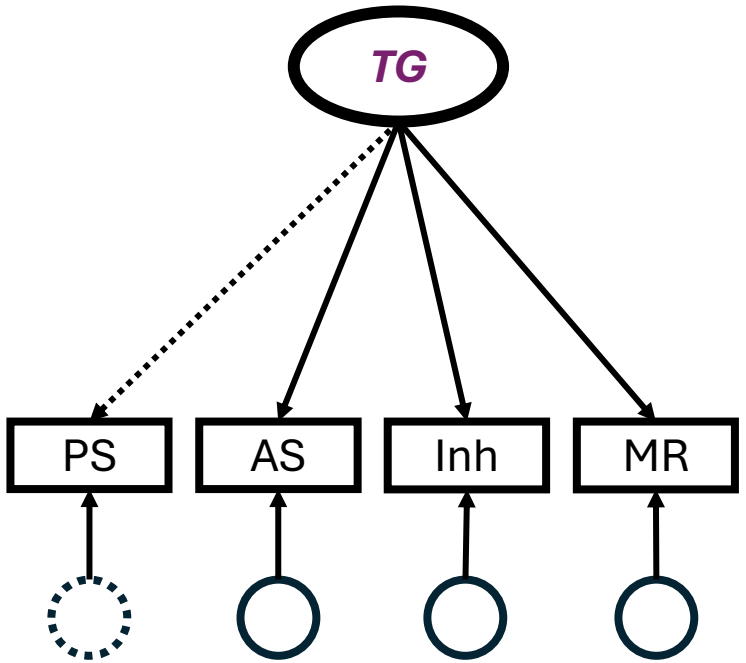

Task-General
Drift rate
Basic speed of processing
(shared across all tasks)
Proc. Speed
Drift rate
Att. Shifting
Drift rate
Inhibition
Drift rate
Mental rotation
Drift rate
U_PS
U_AS
U_Inh
U_MR
Task-specific
ability

SEM

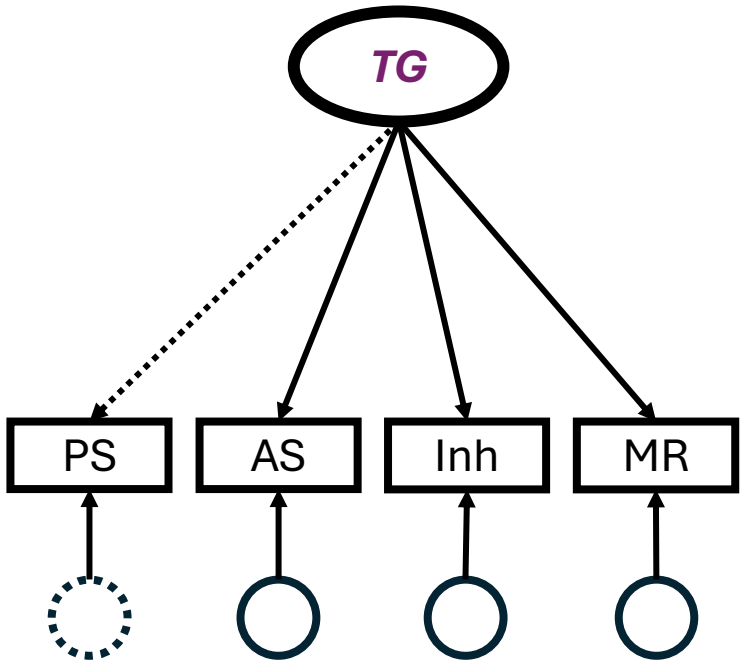
Drift rate



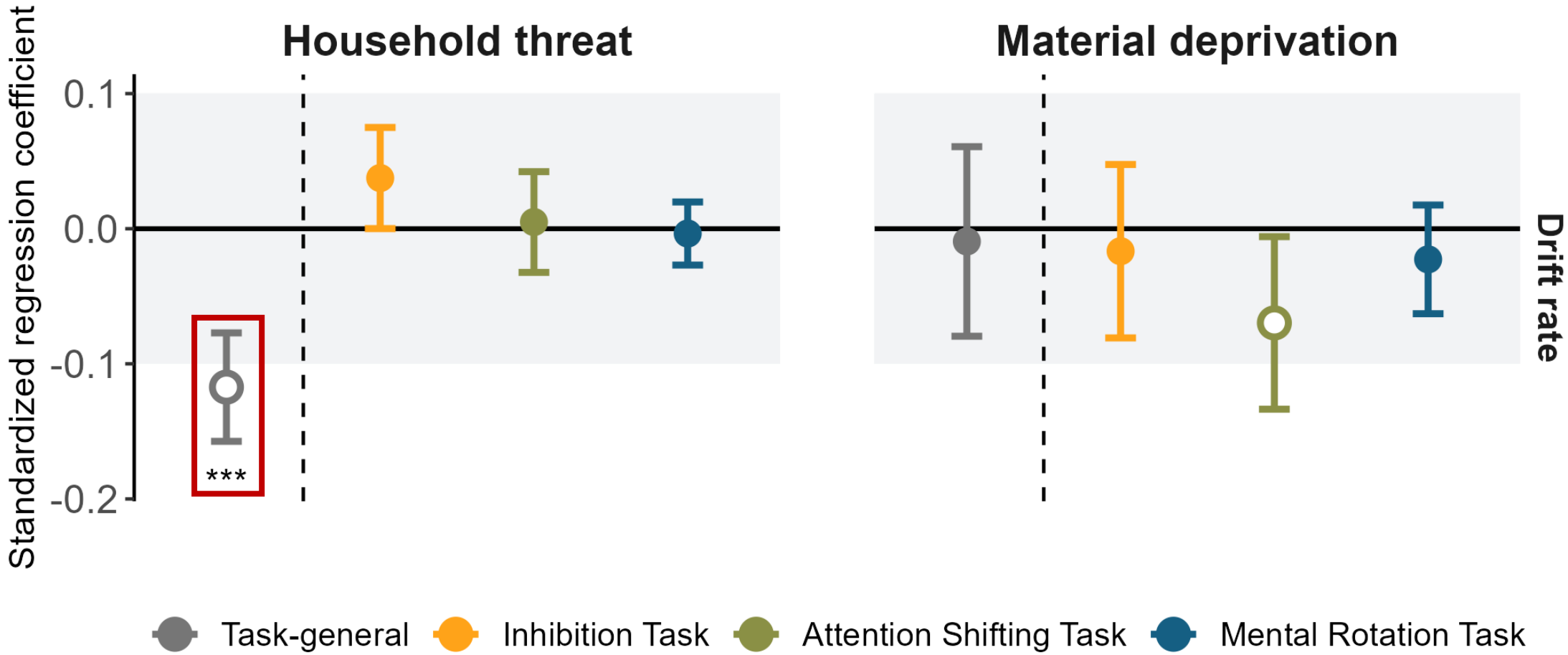
Boundary separation



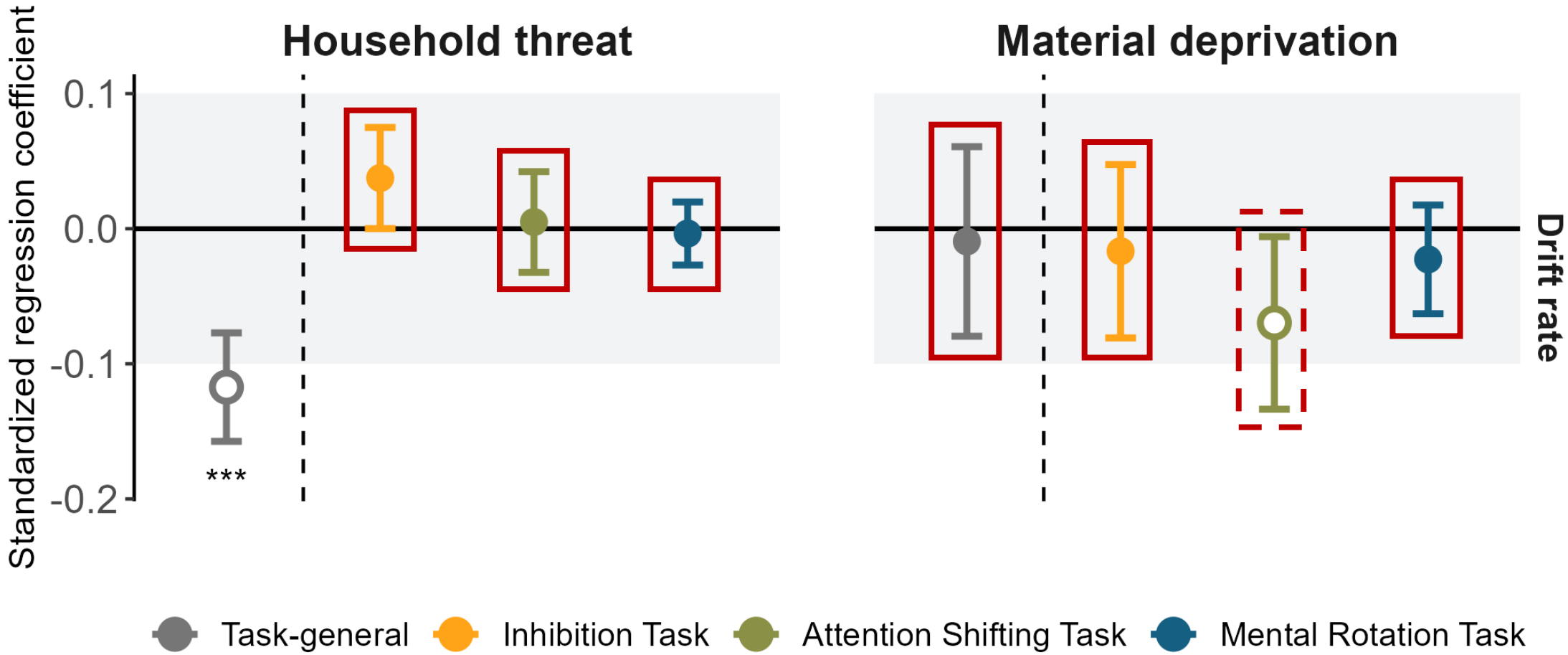
Non-decision time



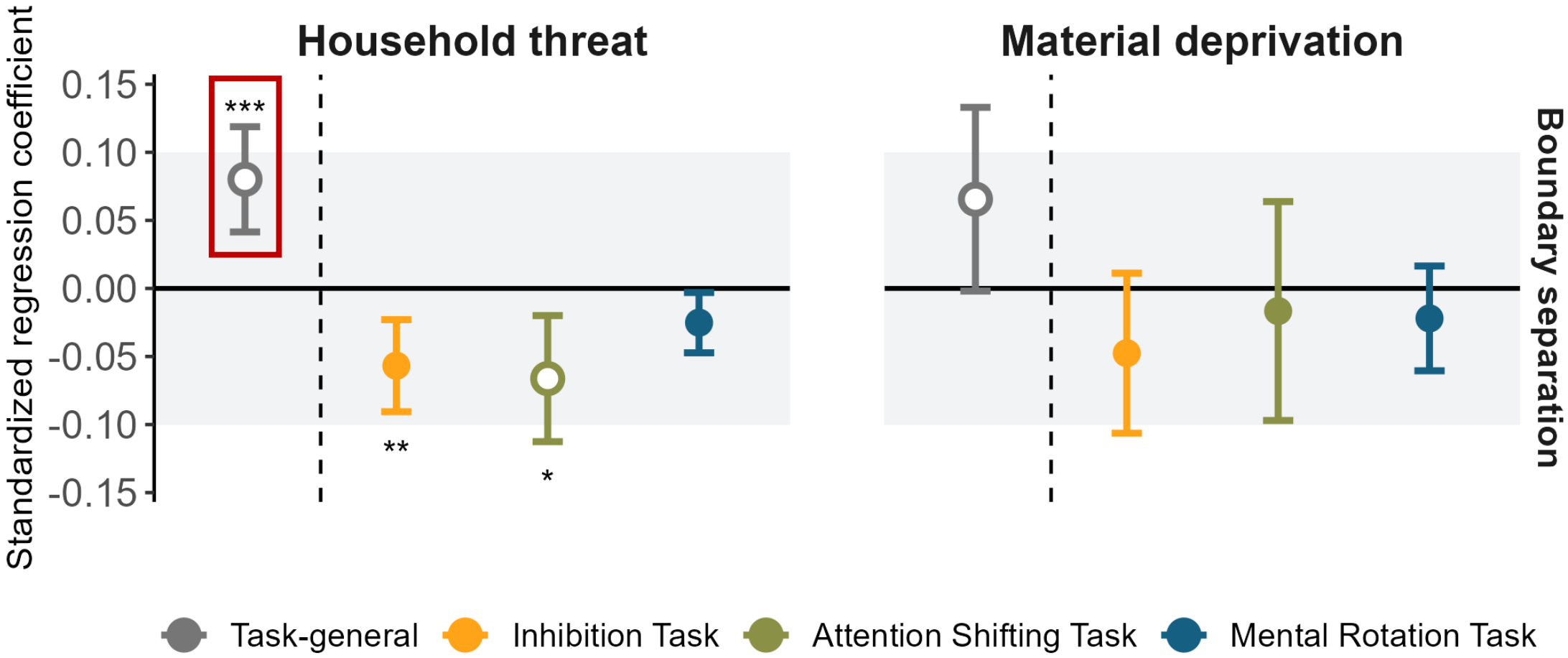
** Not shown: covariances between task-general factors and task-specific factors within tasks*



Lowered performance due to task-general speed of processing



Many instances of practical equivalence for task-specific effects



HIGHER task-general response caution,
But LOWER response caution for the shifting task

Conclusions

Mostly task-general, not task-specific effects

Support for deficit framework, but also strategy differences

Open question: what does the task-general drift rate factor represent, and why is it lowered in children from adverse conditions?

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Thank you!

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