Computational Mechanisms of Effort and Reward Decisions in Patients With Depression and Their Association With Relapse After Antidepressant Discontinuation

Isabel M. Berwian, MSc; Julia G. Wenzel, Dipl Psych; Anne G. E. Collins, PhD; Erich Seifritz, MD; Klaas E. Stephan, MD, PhD; Henrik Walter, MD, PhD; Quentin J. M. Huys, MD, PhD

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Soyeon Kim

Antidepressant

- Selective Serotonin Reuptake Inhibitors (SSRIs)
- tricyclic antidepressants (TCAs)

Psychotherapy

- Cognitive behavioral Therapy (CBT)
- Interpersonal psychotherapy

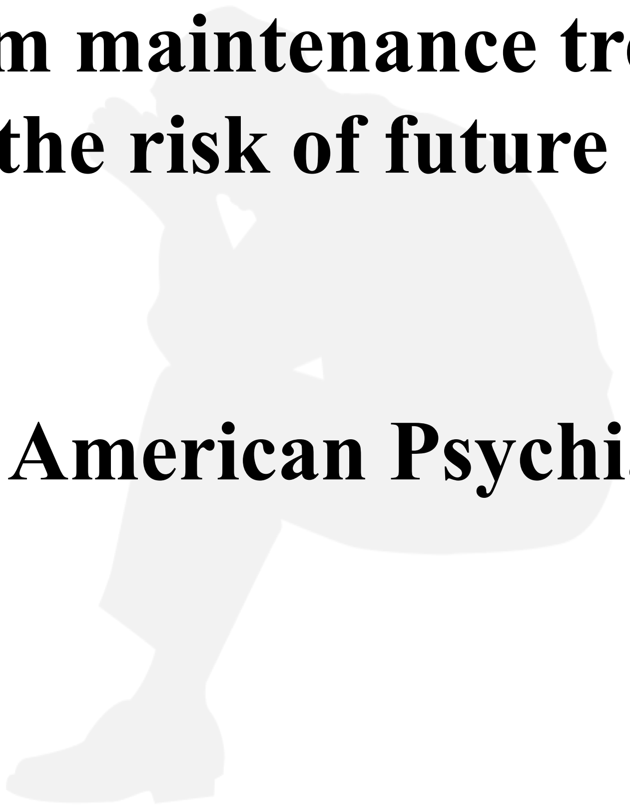
Electroconvulsive Therapy (ECT)

Antidepressant

- Selective Serotonin Reuptake Inhibitors (SSRIs)

“Psychiatrists usually recommend that patients <u>continue to take medication for six or more months after symptoms have improved</u>. Longer-term maintenance treatment may be suggested to decrease the risk of future episodes for certain people at high risk.”

- American Psychiatric Association



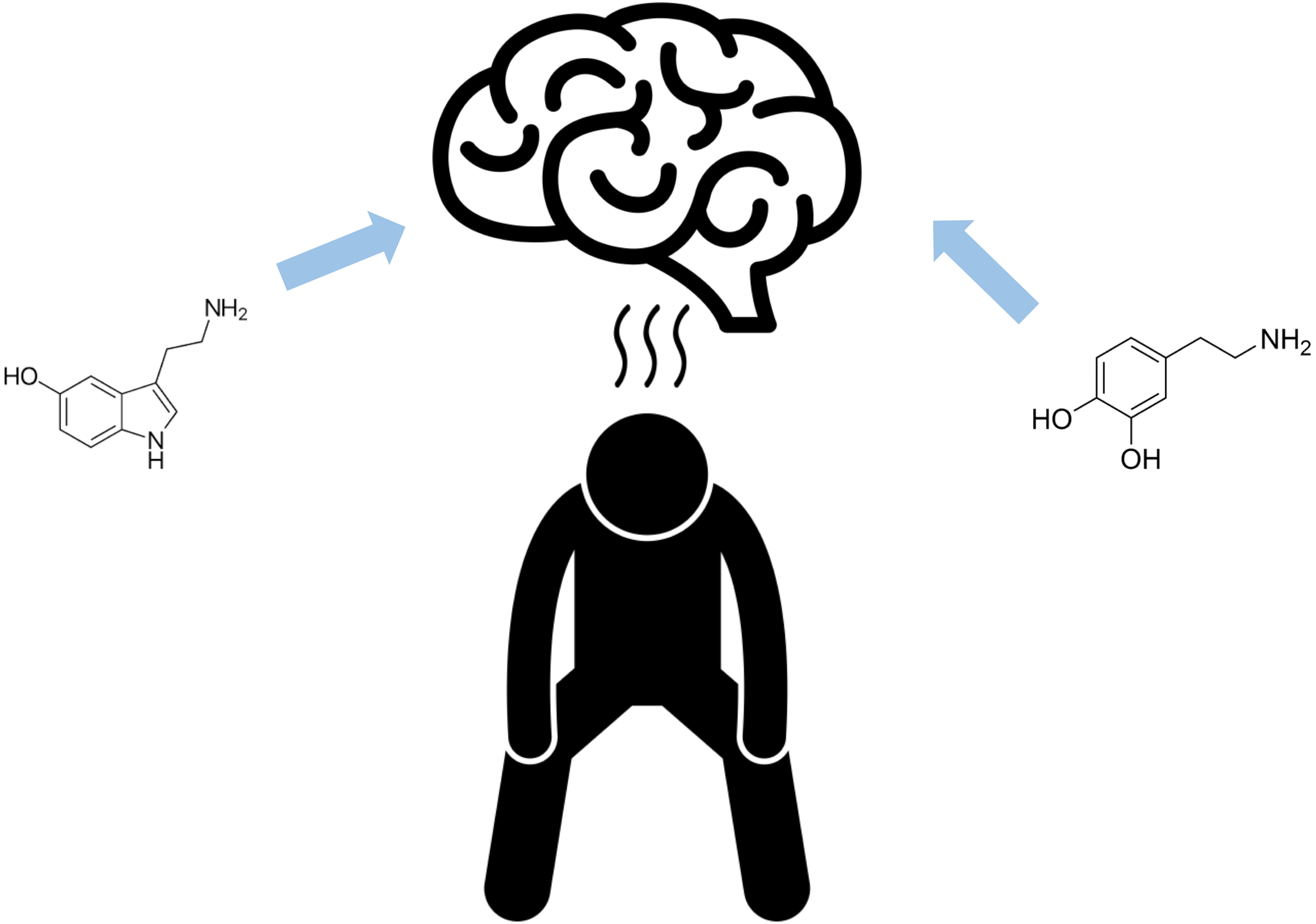
Electroconvulsive Therapy (ECT)

- Cognitive behavioral Therapy (CBT)
- Interpersonal psychotherapy

https://www.psychiatry.org/patients-families/depression/what-is-depression

However..

- No predictors of relapse
- Mechanisms underlying discontinuation
- Studies based on the depressive episodes, not treatment
- Evidence about longer treatment’s benefit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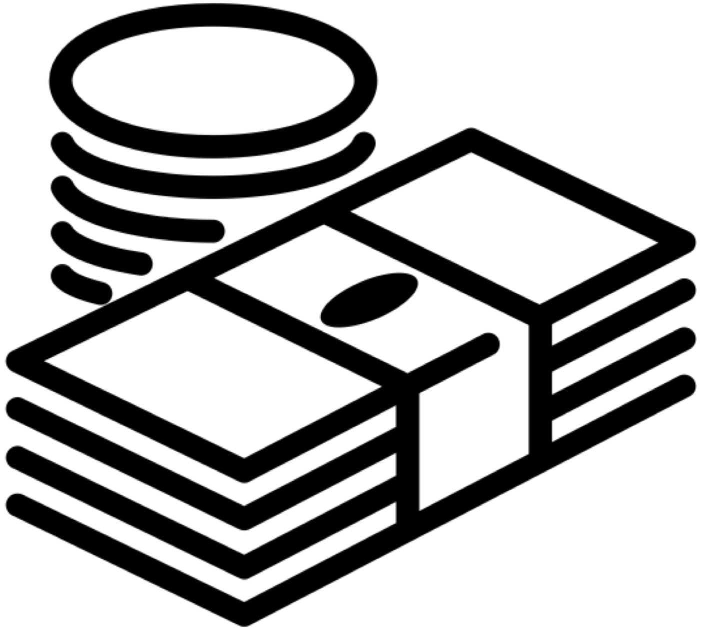
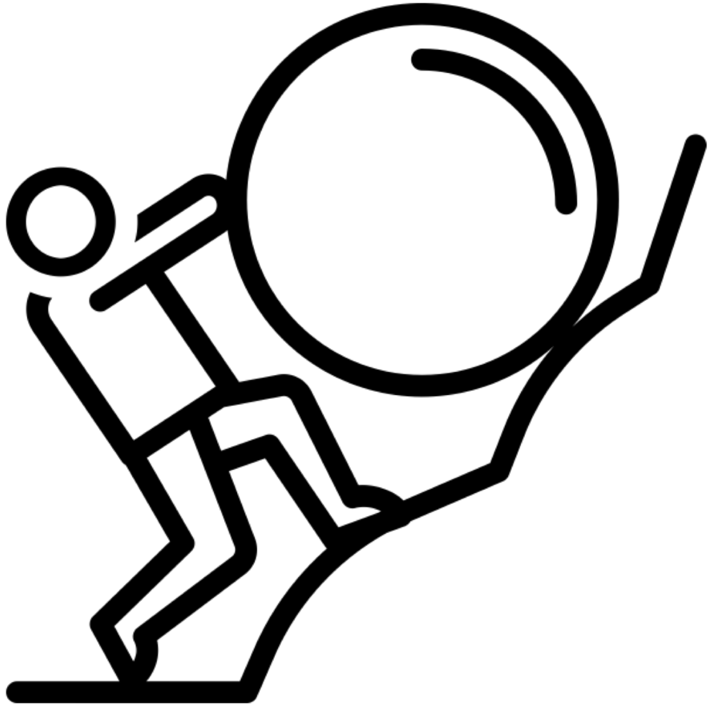


VS

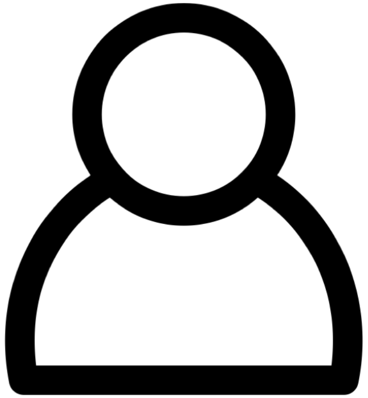


Purpose & Hypotheses

- Knowing the mechanisms underlying the tradeoff between reward and effort
- Patients with relapse would choose
  - less high-effort options
  - Press buttons slowly
  - Take longer time for decisions

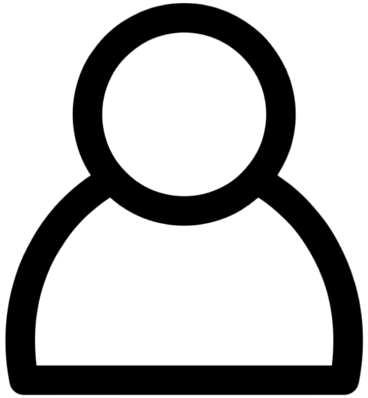
Methods

Participants



Main Sample

- Zurich sample
- 74 patients and 34 matched healthy controls

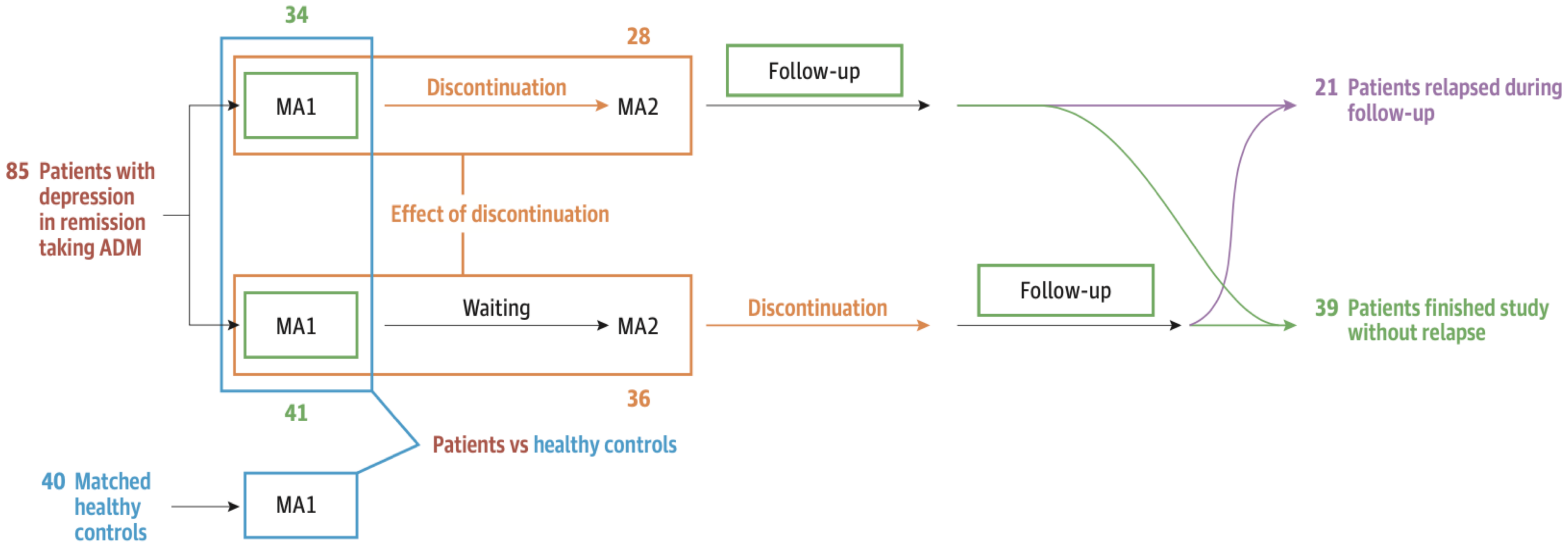


Replication Sample

- Berlin sample
- 27 patients and 21 matched healthy controls

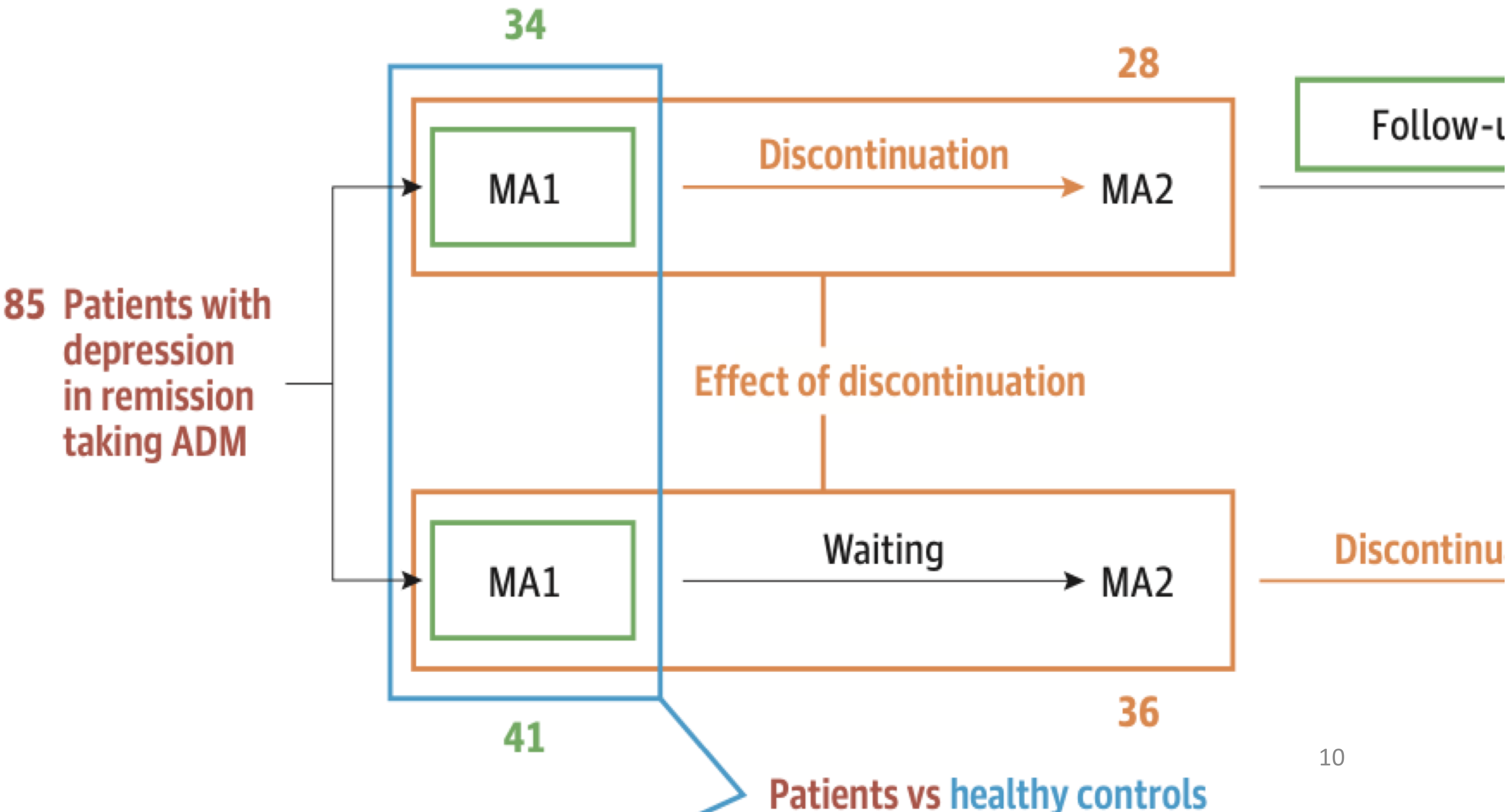
Methods

Study design



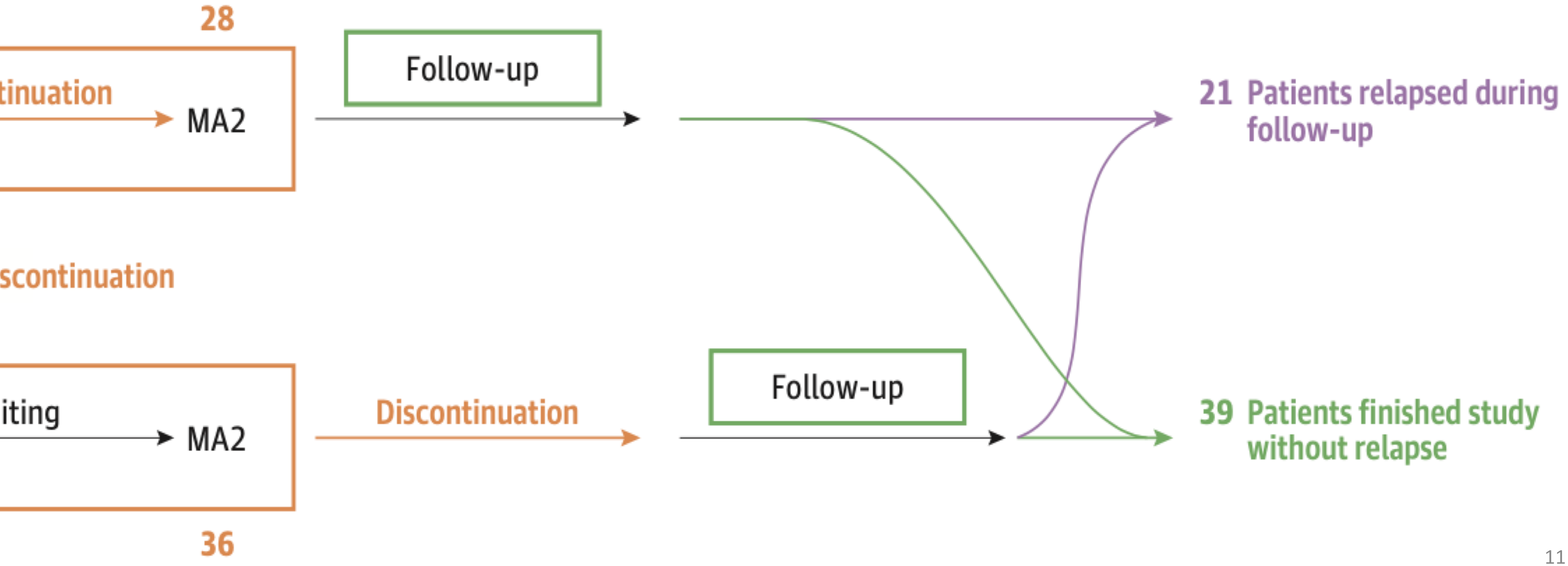
Methods

Study design



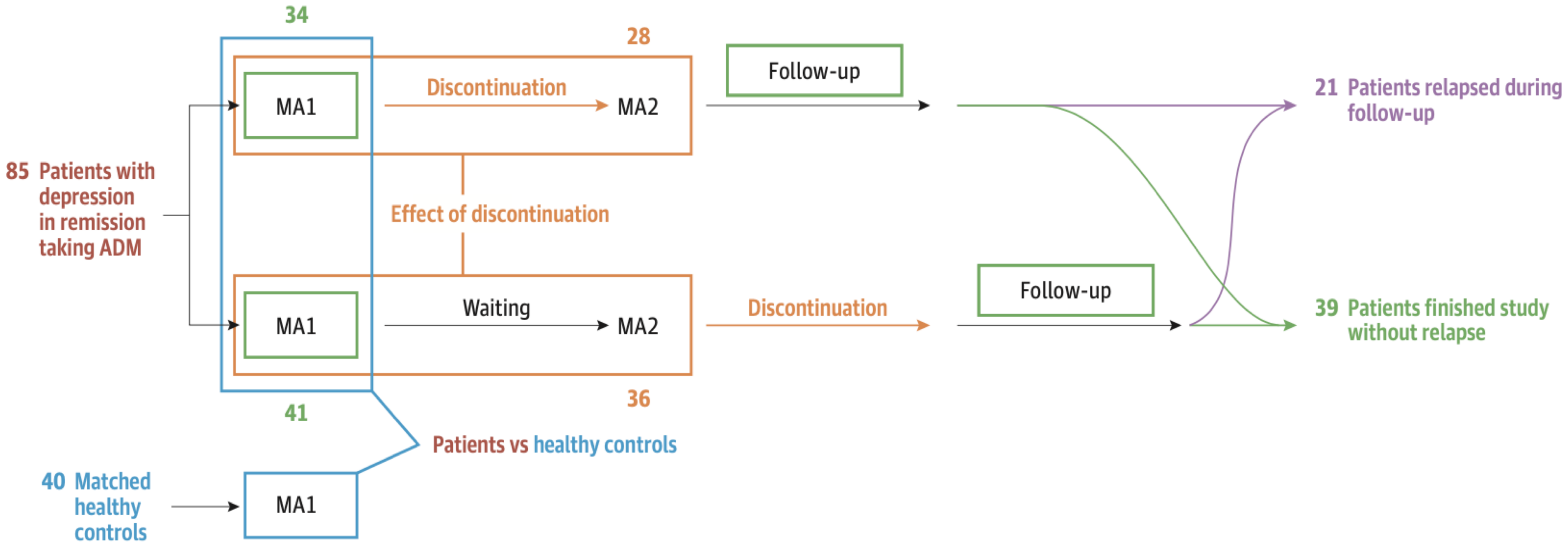
Methods

Study design



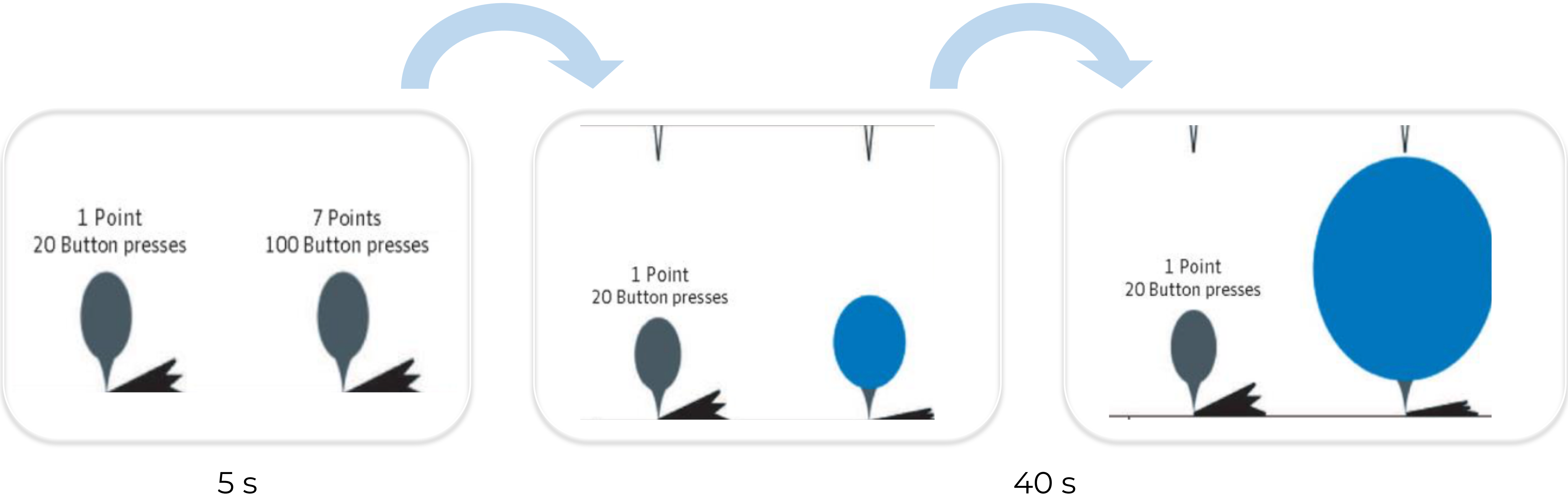
Methods

Study design



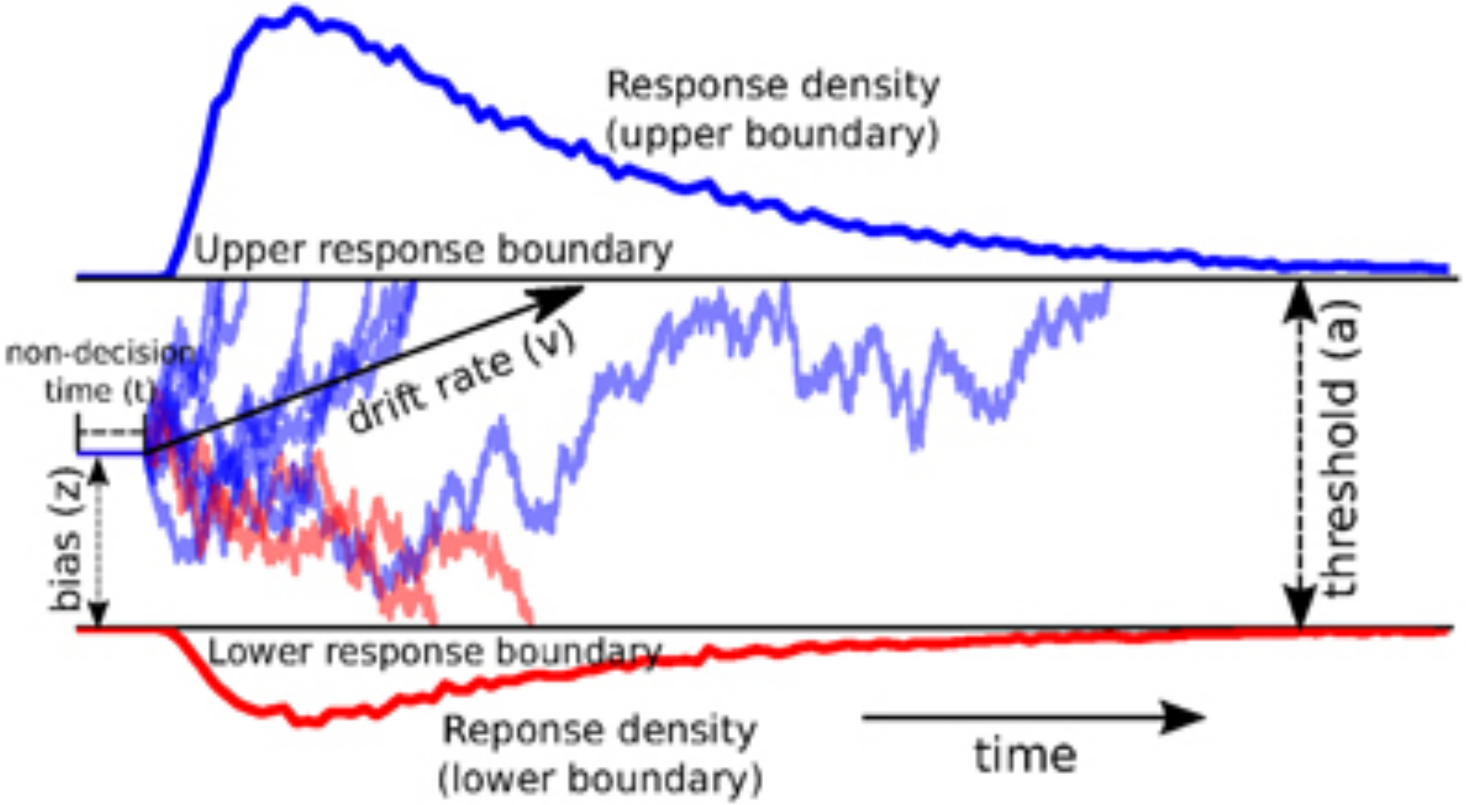
Methods

Physical Effort Task



Methods

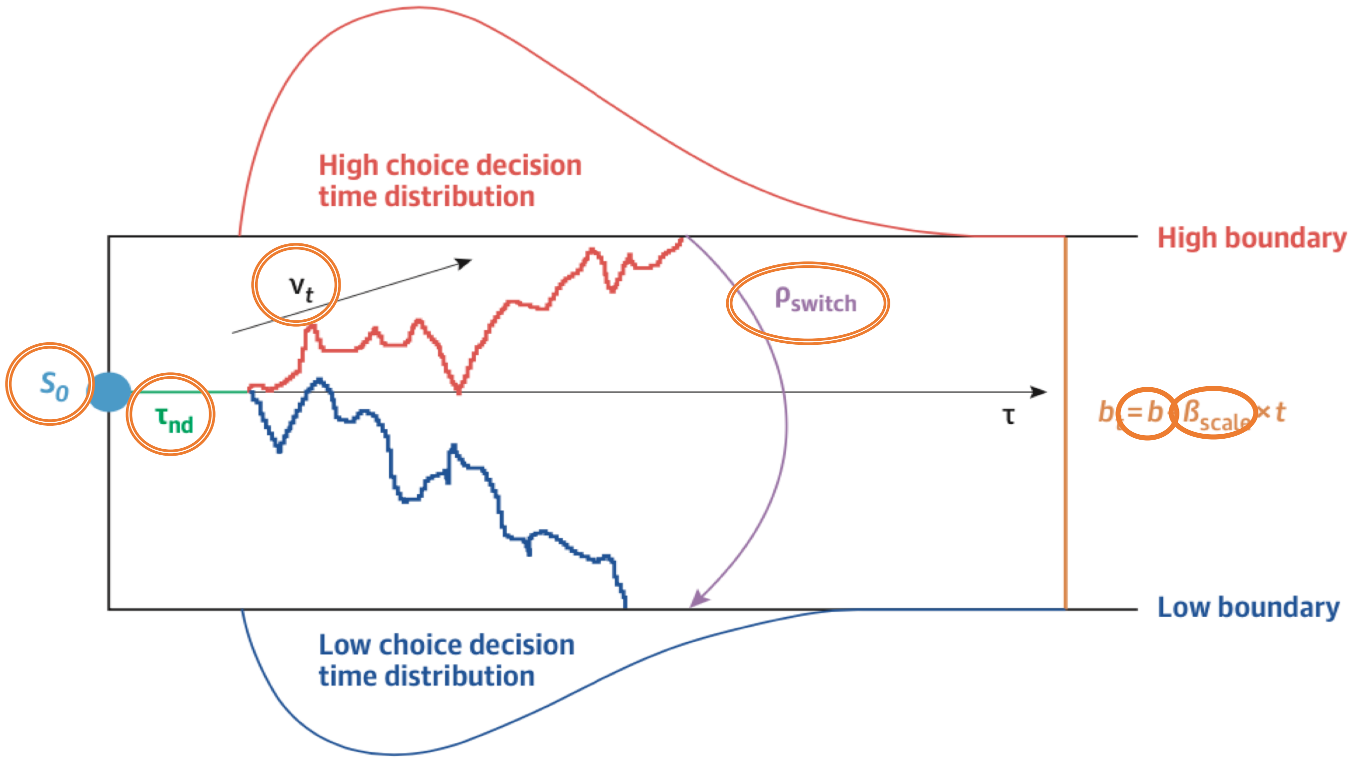
Drift-diffusion model



Wiecki et al., 2013

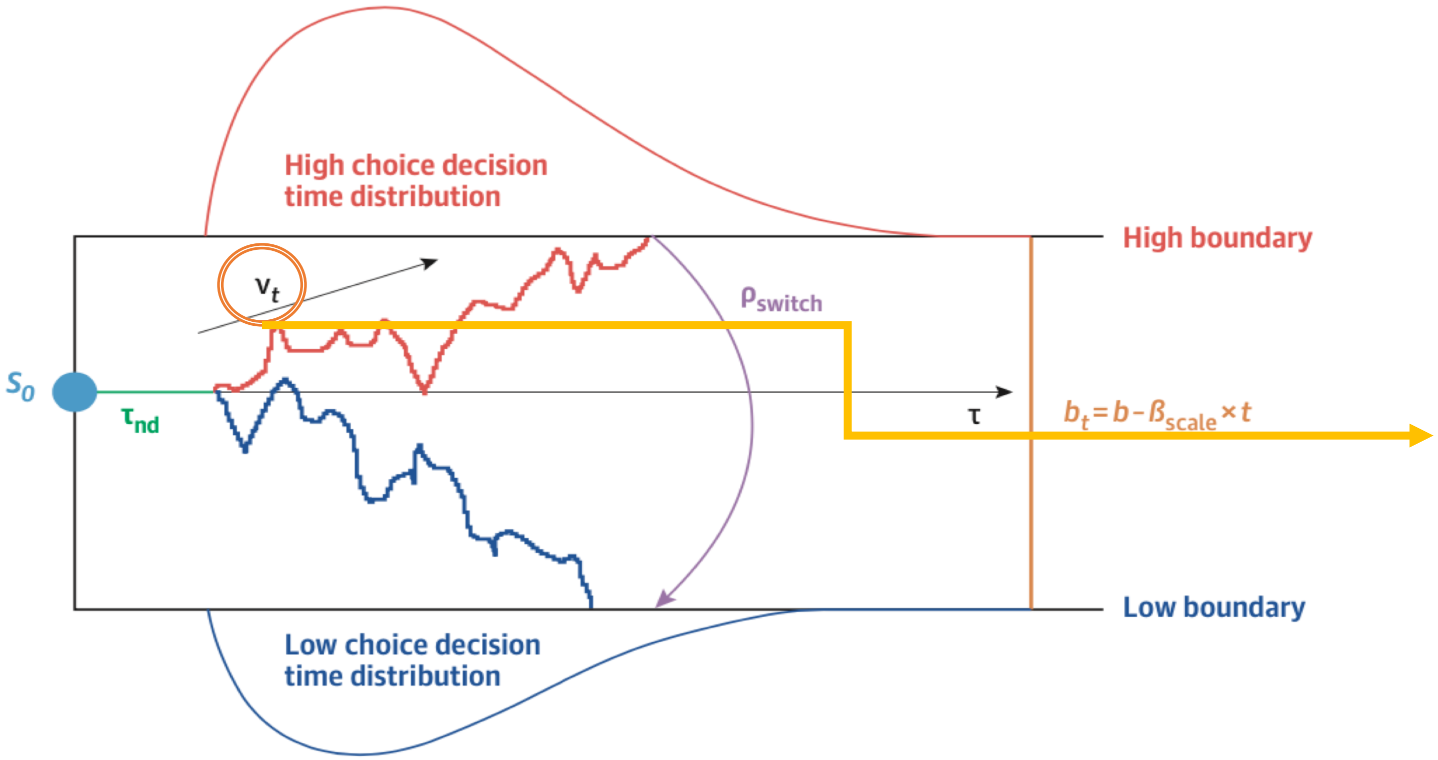
Methods

Drift-diffusion model



Methods

Drift-diffusion model



Drift rate: $V_t = V(h) - V(l)$

- Constant model:

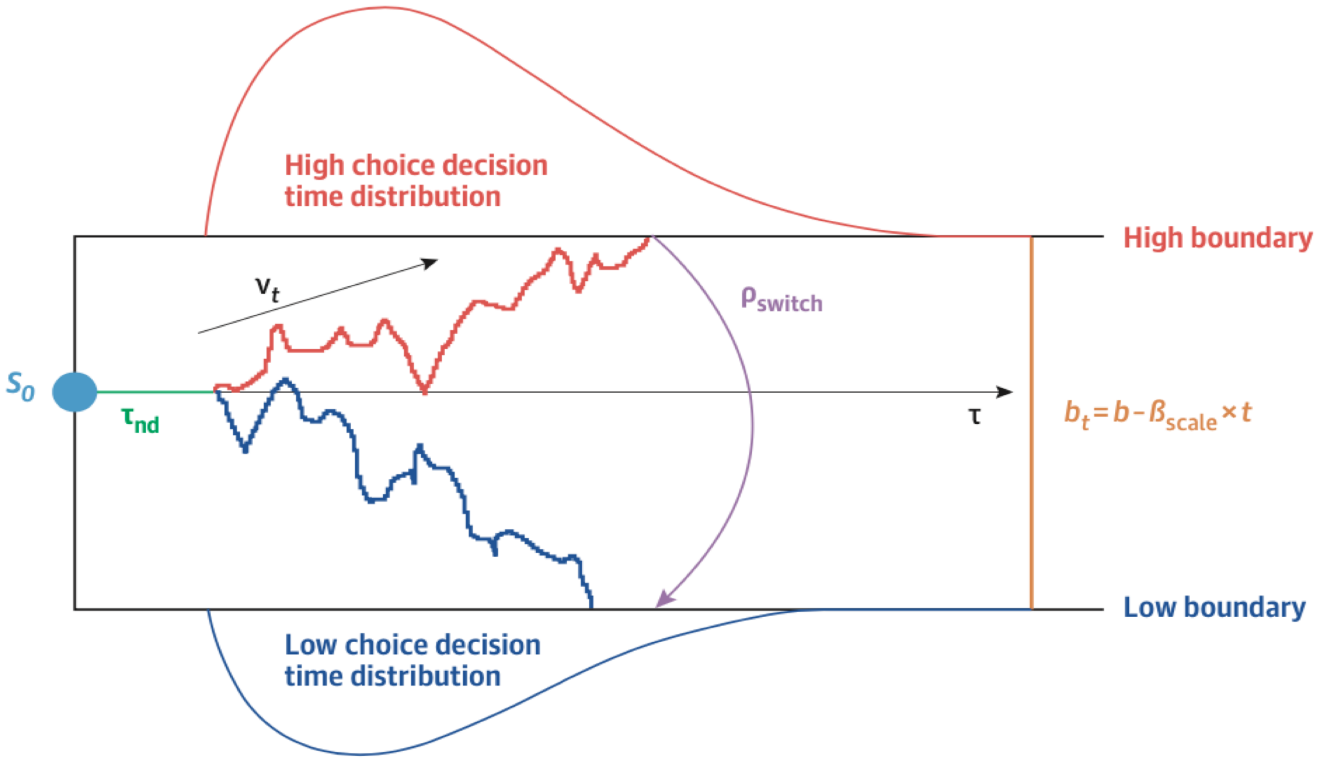
$$V(l) = 0,\ V(h) = \theta$$

- Scaling model:

$$V(a) = \beta_{rew} * r(a) - \beta_{eff} * e(a)$$

Methods

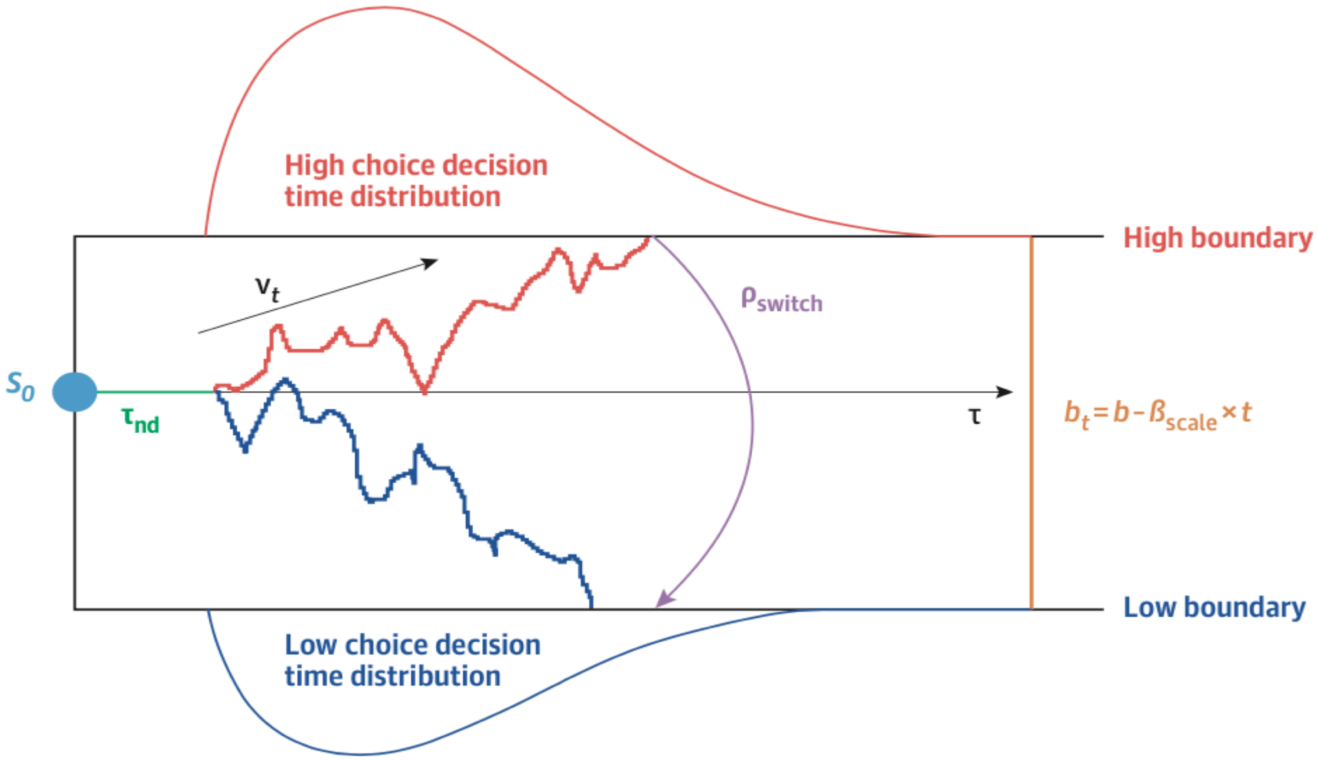
Drift-diffusion model



1. Constant + τ_{nd} + b + s_0
2. Scaling + τ_{nd} + b
3. Scaling + τ_{nd} + b + s_0
4. Scaling + τ_{nd} + b + s_0 + P_{switch}
5. Scaling + τ_{nd} + b + s_0 + β_{scale}
6. Scaling + τ_{nd} + b + s_0 + β_{scale} + P_{switch}

Methods

Drift-diffusion model



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6. Scaling + τ_{nd} + b + s_0 + β_{scale} + P_{switch}

➡ Prediction analysis & Replication analysis

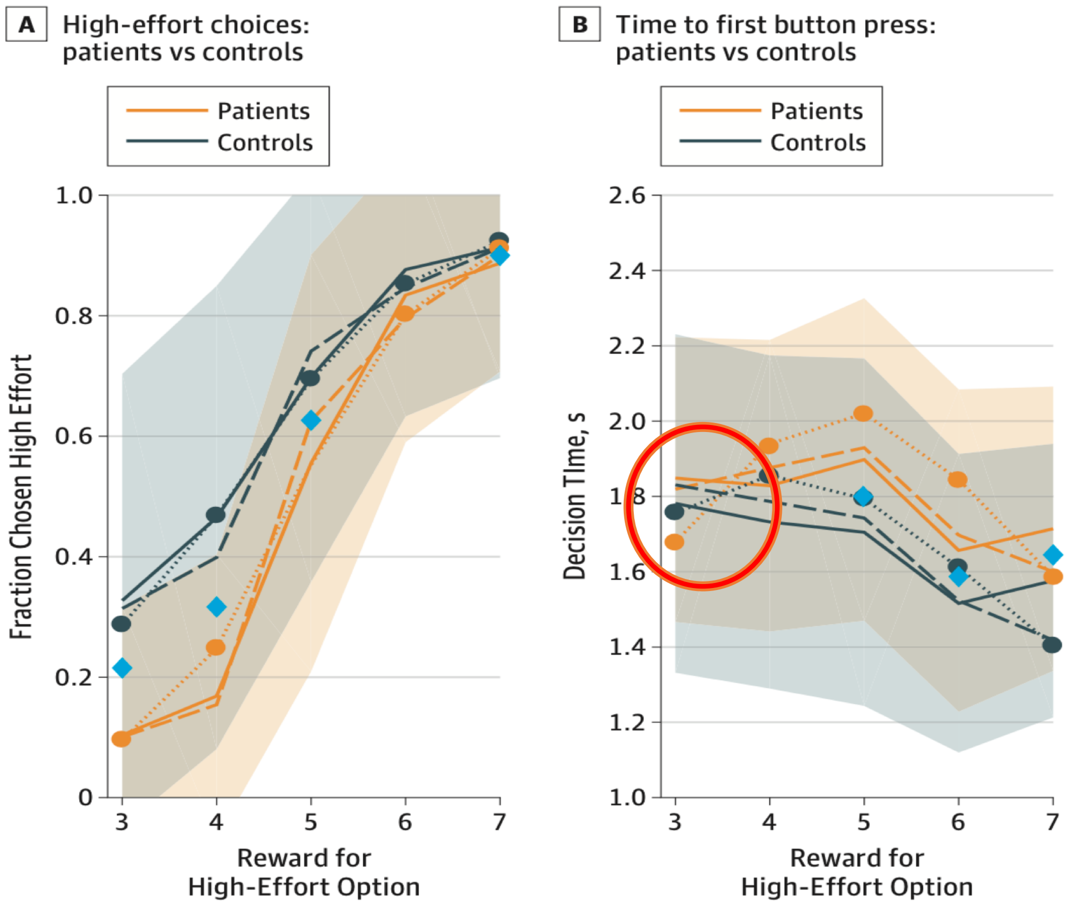
Results

Results

Computational Modeling Results

Patients vs Controls

- High-effort option ↓
- Slower decision time

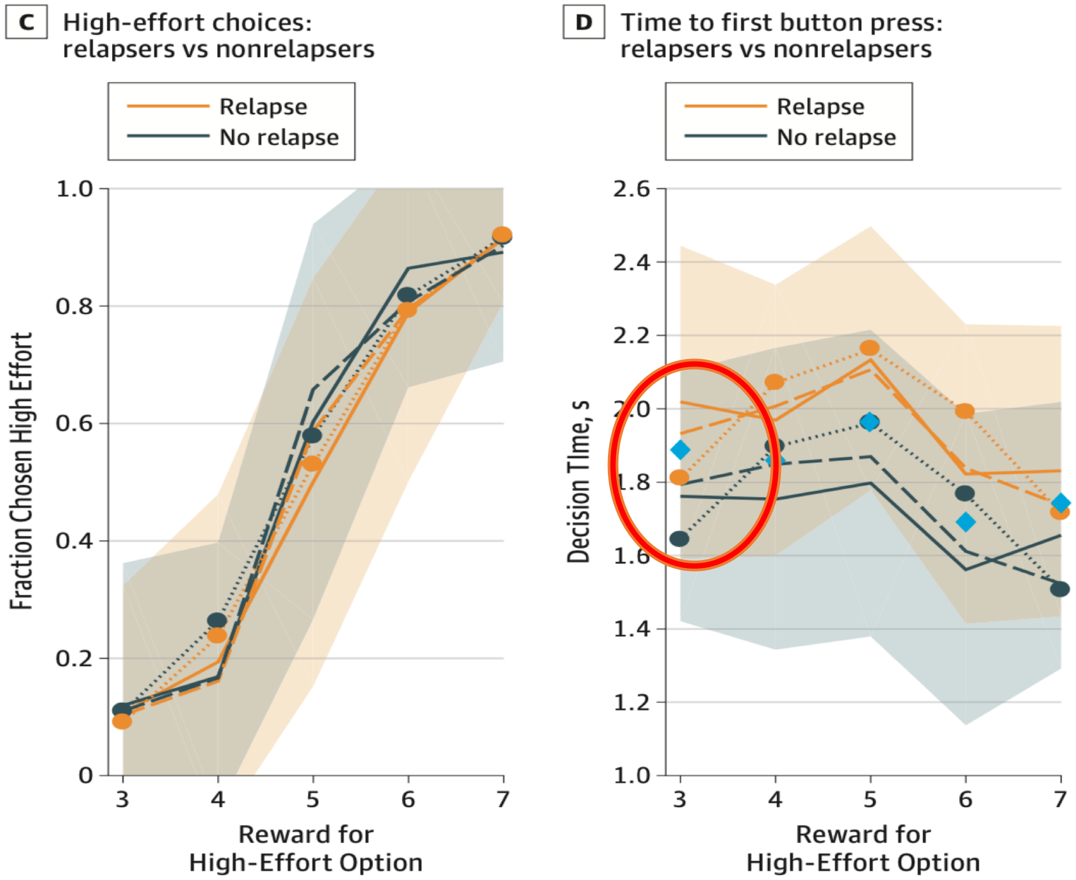


Results

Computational Modeling Results

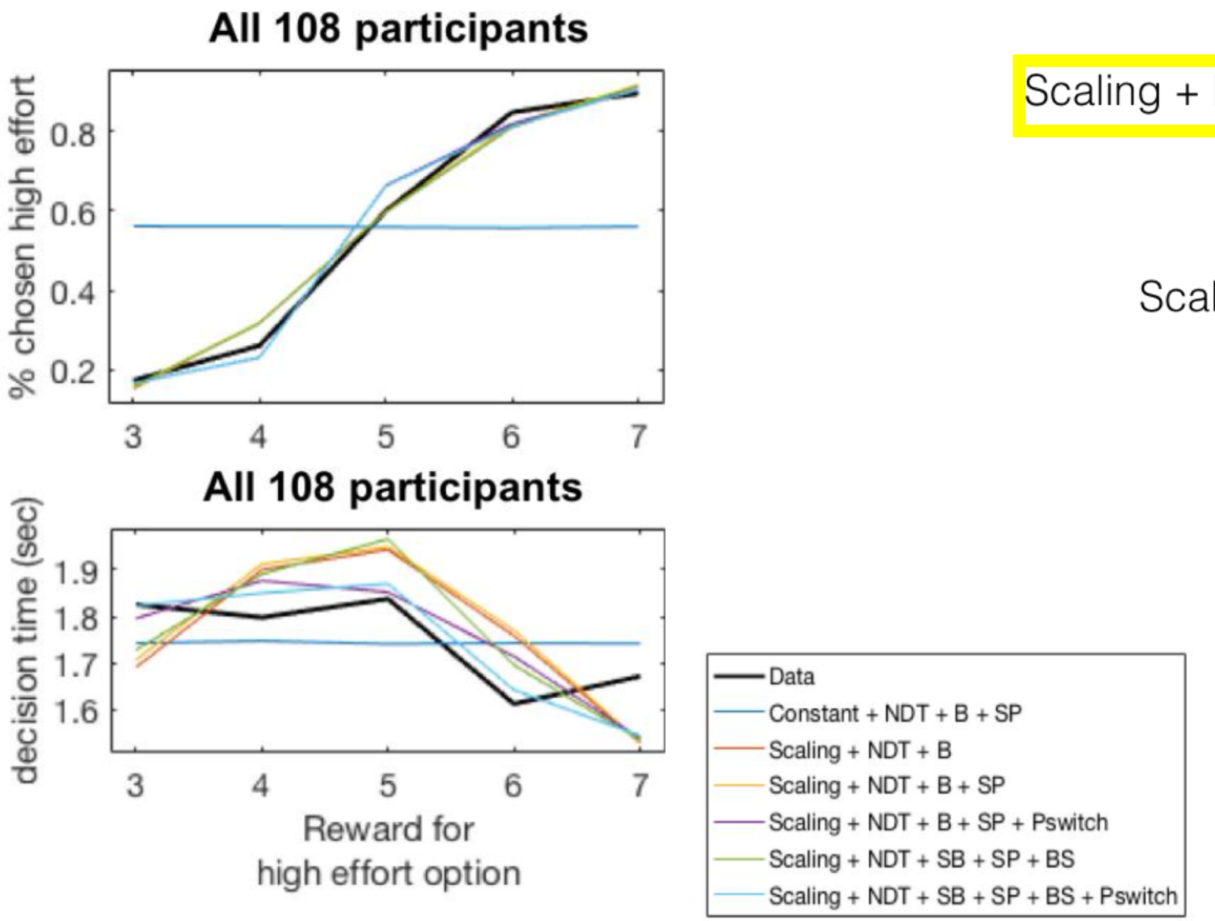
Relapsers vs No relapsers

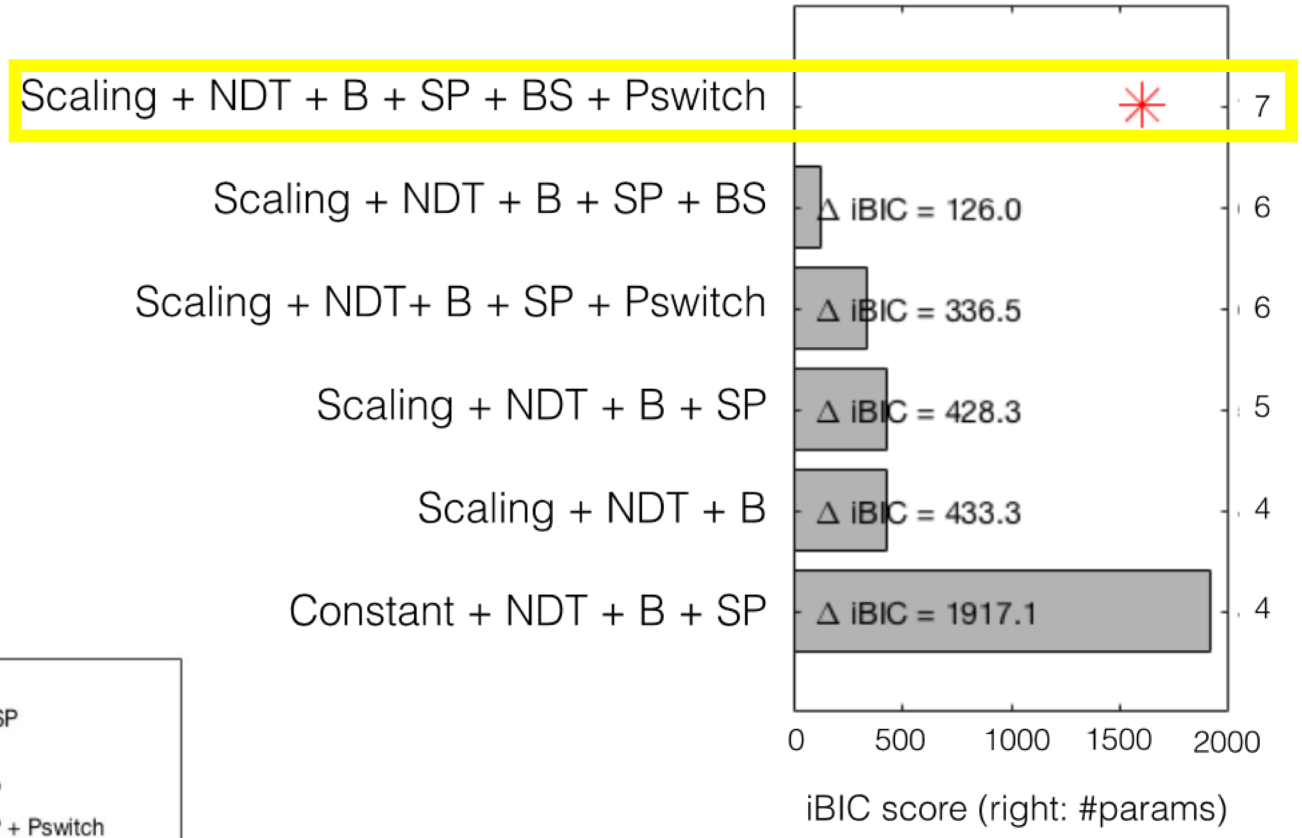
- No difference in high-effort choices
- Slower decision time



Results

Computational Modeling Results



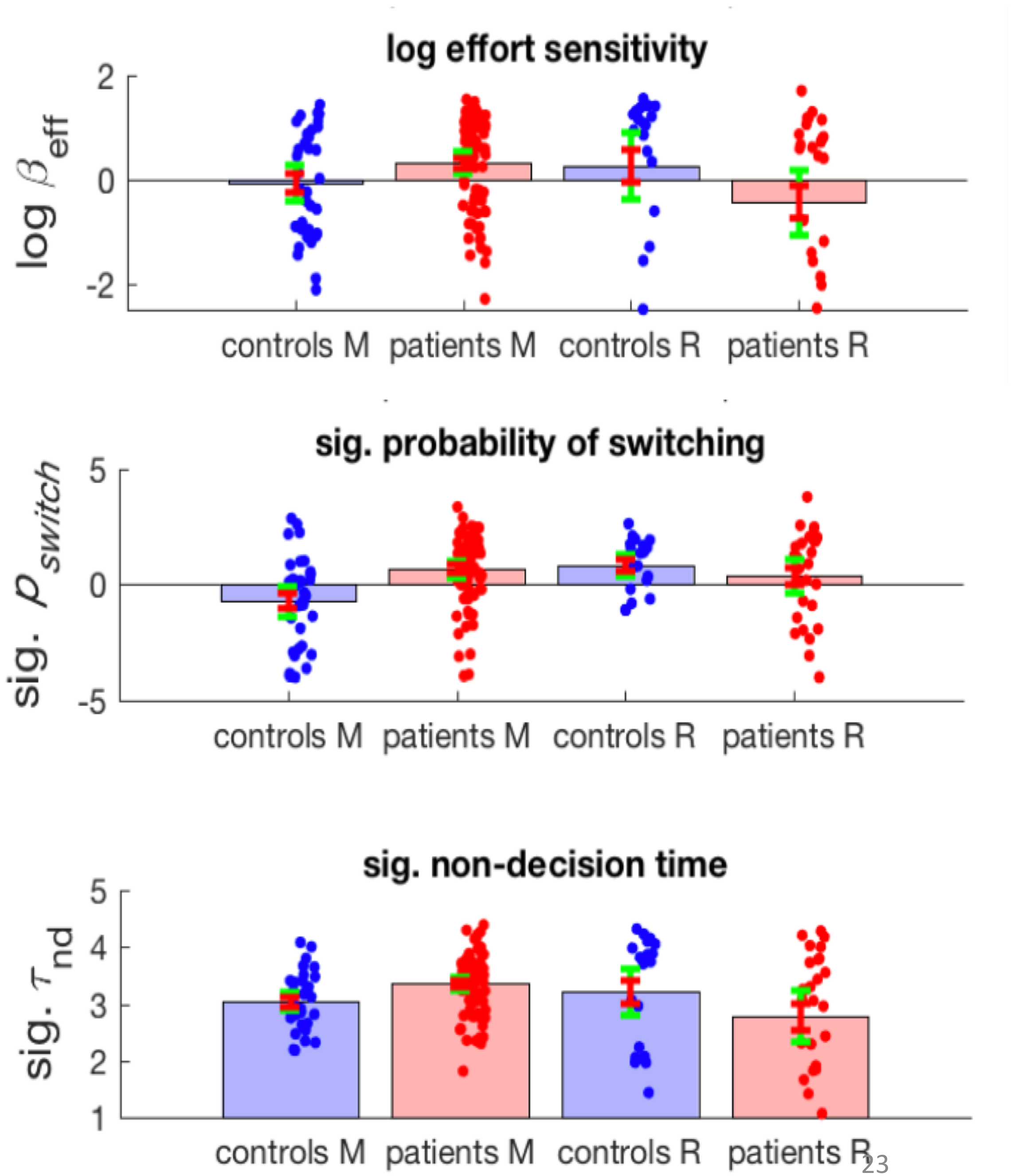


Results

Computational Modeling Results

Patients vs Control

- Effort sensitivity: Patients > Controls
- Pswitch: Patients > Controls
- Nondecision times: Patients > Controls

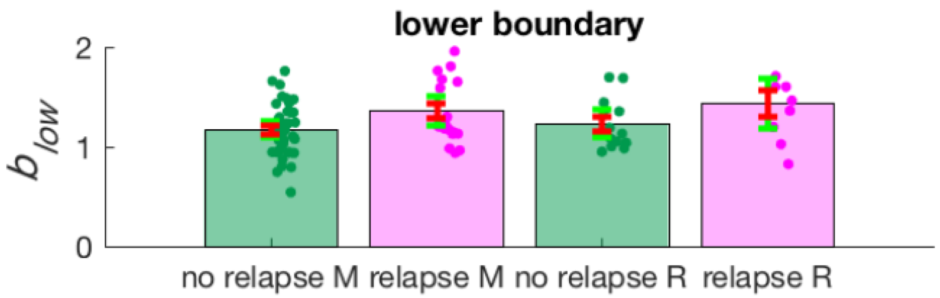


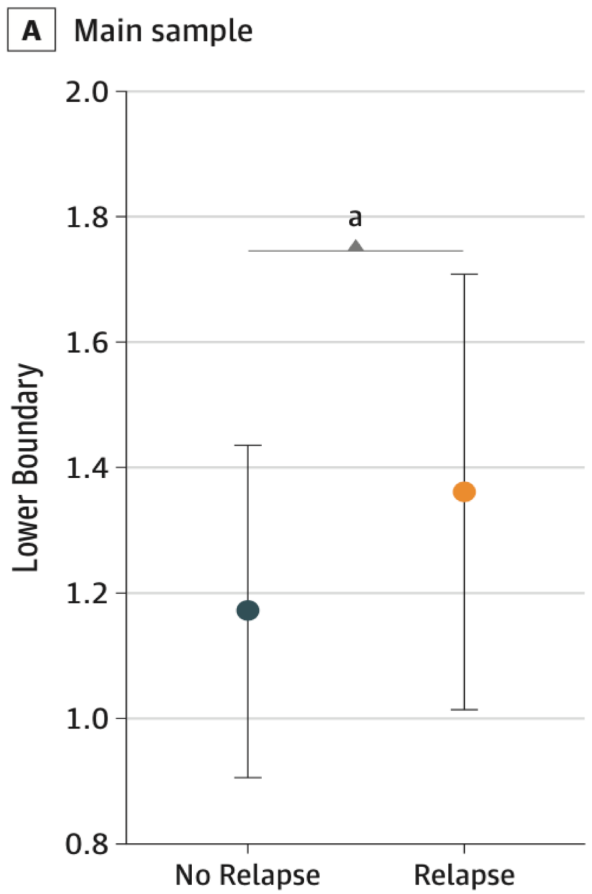
Results

Computational Modeling Results

Relapsers vs Nonrelapsers

- Boundary to the low effort: relapsers > Nonrelapsers

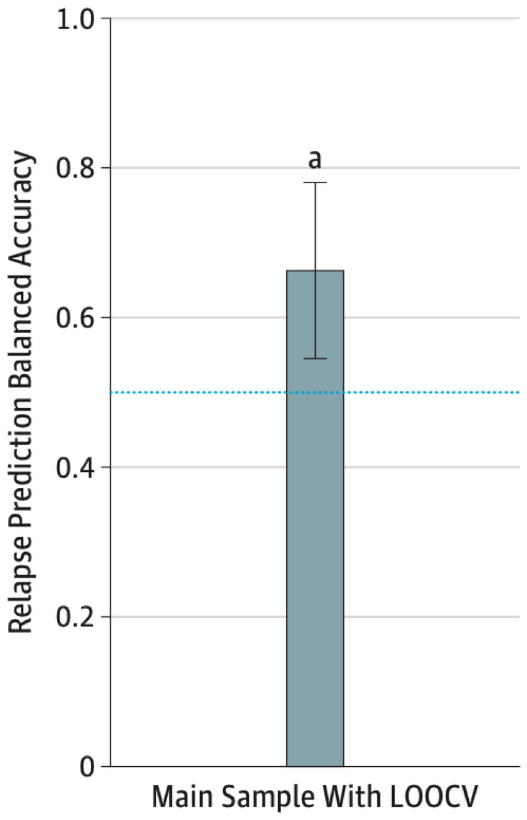




Relapsers needed more evidence before decision-making

Results

Computational Modeling Results

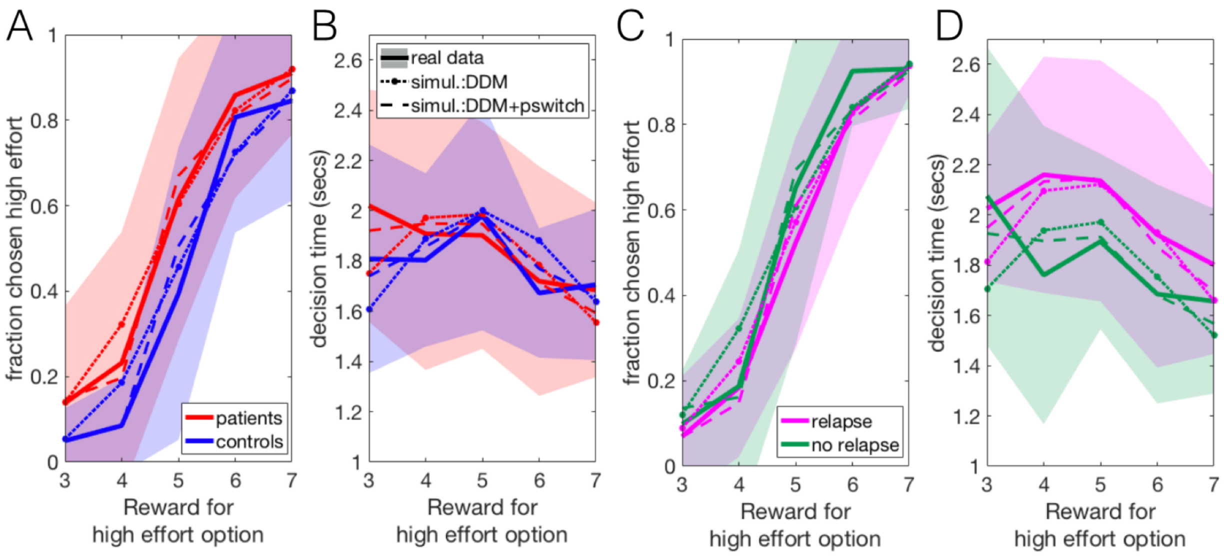


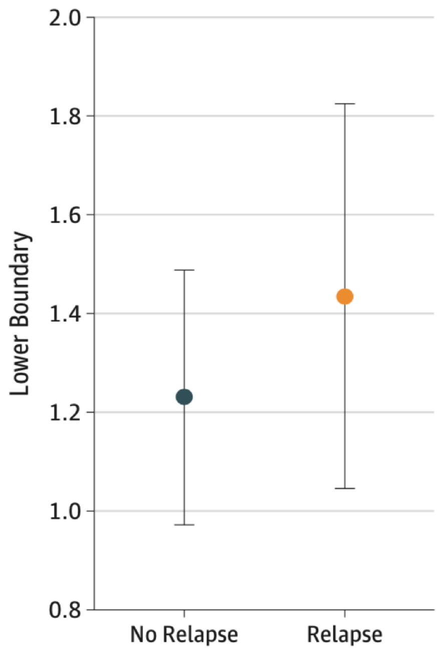
Decision time predicted relapse

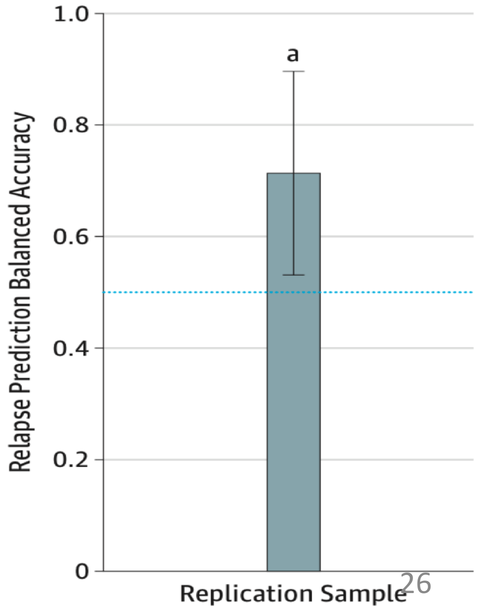
Results

Replication Sample Results

- Behavioral differences between patients vs controls did not replicate.
- Computational model showed same mechanisms
- Relapse prediction accuracy of 0.71







Discussion & Limitations

Discussion

- Actual execution of the effort was not different between patient and control group.
- Reward sensitivity did not differentiate patients from healthy controls.
- Duration of the decision process was predictive of subsequent ralapse.
- Decision times and choices were dissociated in patients.

Limitations

- Different helathy control behavior
- Test-retest reliability was at most moderate
- Small sample size
- Study used a purely observational design

Thank you 😃

Methods

Drift-diffusion model

The 'deviation' model took some probability mass from the high-effort choice decision-time distribution $p(h,\tau)$ and added it to the low-effort choice decision-time distribution $p(l,\tau)$. Specifically, on trials where $r(h) < 5$, we let:

$$p(h,\tau) = p(h,\tau) * (1 - p_{switch}) \qquad 2$$

$$p(l,\tau) = p(l,\tau) + p(h,\tau) * p_{switch} \qquad 3$$