# HCP-D: Cognitive Control Behavior in Adolescence and the Role of Reward

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johnflournoy.science/hcpd_task_behavior/

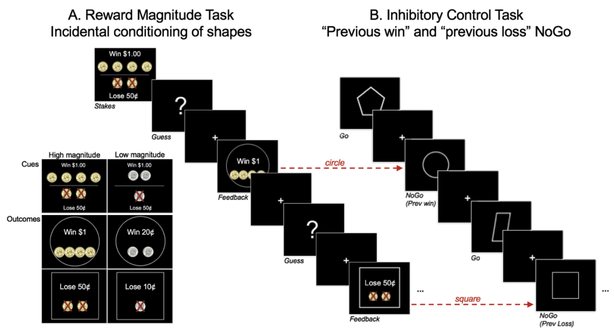
## What we did

### Introduction

Cognitive control, central to cognitive development, refines our actions in response to environmental goals, improving notably from childhood to adulthood. Not all situations demand equal cognitive control; reward-linked cues may challenge it more. Prior studies often blend cognitive control demands with reward information, hindering isolation of these two constructs. Using the **CARIT** version of the **go/no-go** task, we analyze *age* and *go-response prepotency* effects on reaction time and no-go accuracy. We also explore how previously conditioned reward and punishment cues influence these dynamics, shedding light on the development of cognitive control and influences of reward.

### Method

Using the Human Connectome Project - Development's CARIT data from 1,200 participants (age 5-22 years), we analyzed responses from two runs of 92 trials each (68 go, 24 no-go). One no-go cue was linked to previous monetary gain and the other to previous monetary loss. We employed Bayesian hierarchical linear models sampled using Stan via the `brms` package in R, describing associations with age, motor prepotency, and prior conditioning on reaction times and no-go accuracy.




**Model** *(simplified* `brms` *code)*

```
Fig 1,2,3:
 bf(correct_nogo          ~ runtime + prepotency + s(age) + s(age, by = prepotency) +
                            (runtime | pid:run) + (1 + runtime + prepotency |ID1| pid),
                            family = bernoulli()) +
  bf(RT | trunc(ub = .8) ~ runtime + prepotency + s(age) + s(age, by = prepotency) +
                            (runtime | pid:run) + (1 + runtime + prepotency |ID1| pid),
                            family = lognormal())
Fig 4:
 bf(correct_nogo_total | trials ~ reward_condition + s(age, by = reward_condition) +
                                  (1 | pid), family = binomial())
```

## What we found

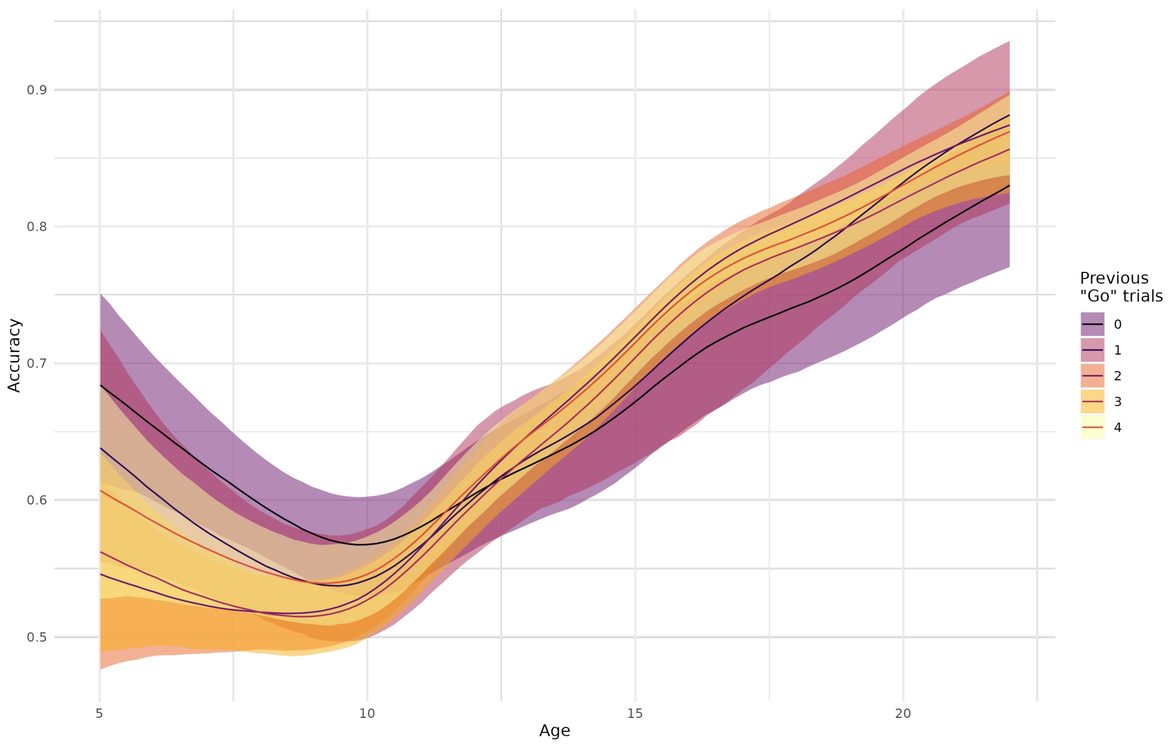
### Results

- "No-go" **accuracy increases** with age (1) & "Hit" **reaction time decreases** (2)
- Number of previous contiguous Hits (**prepotency**) was associated with **increased (slower) reaction time** (2).
- A **small or nil correlation** was observed between individual differences in **prepotency effects and accuracy** (3).
- Individual differences in **reaction times**
  - **positively correlated** with **accuracy** (3)
  - **negatively correlated** with **prepotency** (3).
- A very **small increase in accuracy** for **cues linked to prior rewards** (89% CI `[-.07, -0.1]`); no significant age differences in this effect (4).

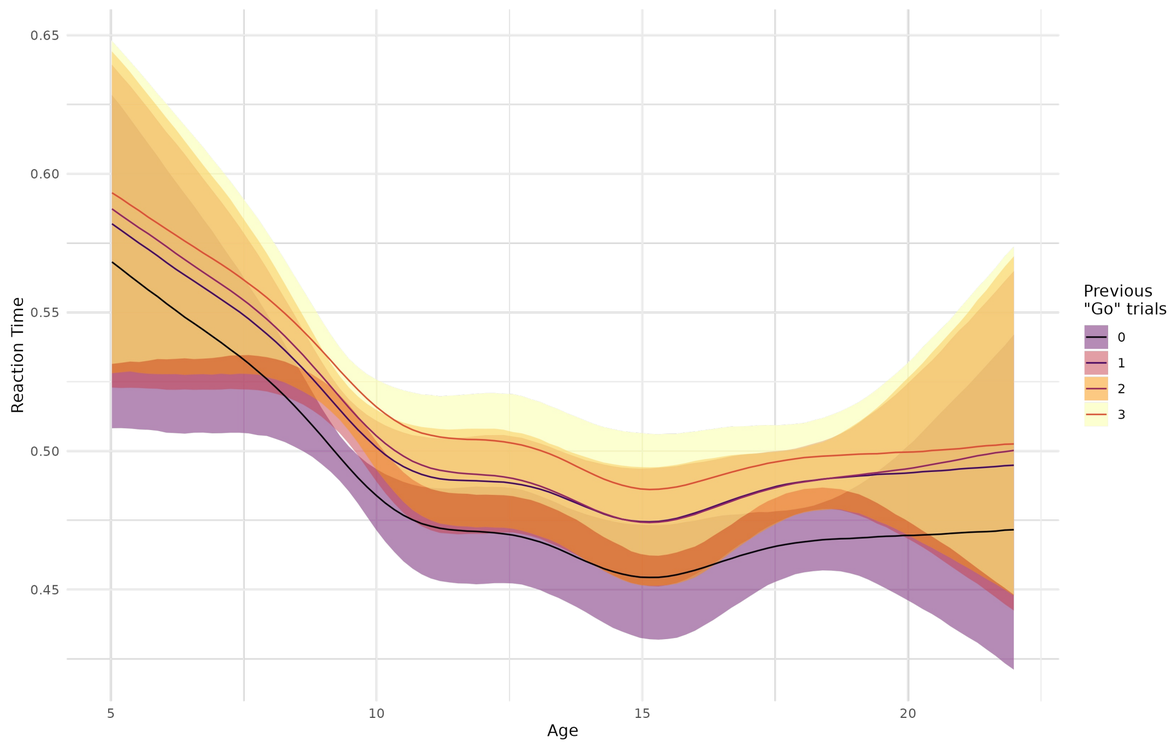
### Conclusion

1. As kids mature, their proficiency on the CARIT task increases, pointing to improved cognitive control. 2. Their strategic behavior, on average, suggests an understanding of the task's structure. 3. Compared to same-age peers, slower participants are typically more accurate and less strategic. 4. Kids and adolescents appear sensitive to value manipulation through stimulus conditioning during an unrelated task.

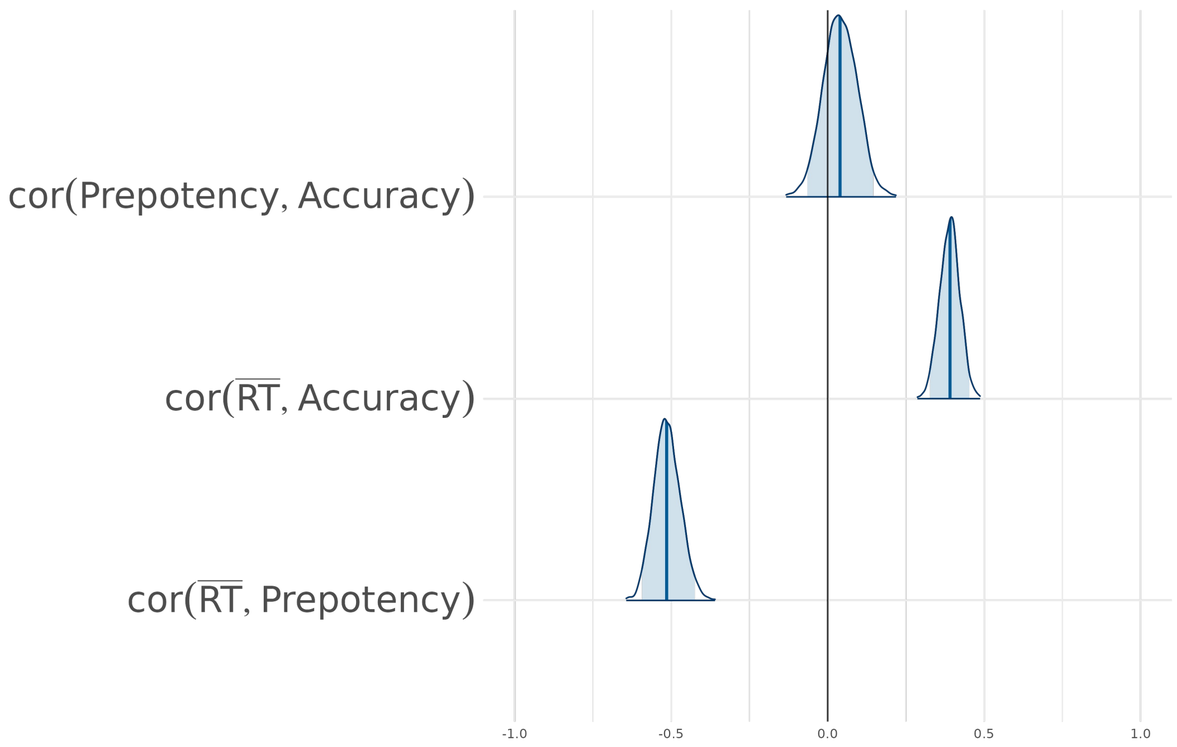
## 1."No-Go" Accuracy




## 2. "Go" Reaction times




## 3. Individual Differences




## 4. Previous conditioning