Lifespan Developmental Differences in the Effects of Opportunity Costs on Cognitive Effort

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Introduction

Previous work suggests that lifespan developmental differences in cognitive control are due to maturational and ageing-related changes in PFC functioning [1, 2]. However, there are also alternative explanations: for example, it could be that children and older adults differ from younger adults in how they balance the effort of engaging in control against its potential benefits.

Here, we assume that the degree of engagement in effortful control depends on the opportunity cost of time (average reward per unit time) [3]. If the average reward rate is high, participants should respond faster in order to accumulate as much reward as possible. If it is low, they should respond more slowly. Developmental and ageing-related changes in opportunity cost assessments should be reflected by differences in the sensitivity to changes in reward rate.

Method

Following recent work, the average reward rate ($\bar{r}$) was calculated using the following update rule [4] :

$$\bar{r} = (1 - a)^t \bar{r}_t + [1 - (1 - a)^t] \frac{R}{t}$$

Flanker

Task Duration:
7 minutes (AD/YA)
9.8 minutes (CH/OA)

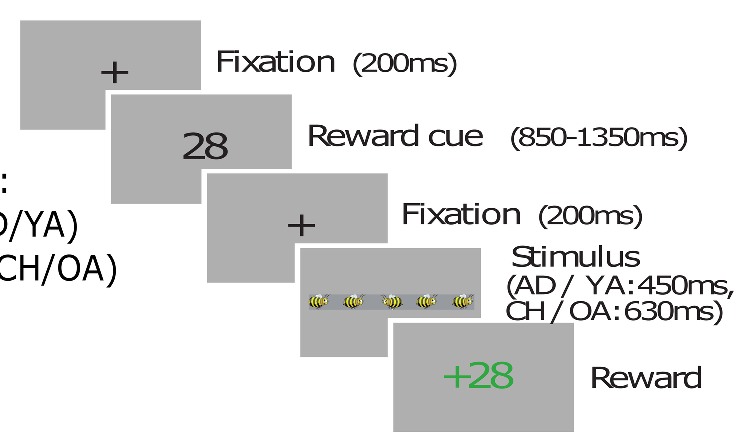

Figure 1. Participants have to indicate whether the bee in the center of the display is flying to the left or to the right. On **compatible** trials, the surrounding bees fly in the same direction. On **incompatible** trials, they fly in the opposite direction. To account for slower RT in children and older adults, we adjusted stimulus display times.

Task-Switching

Task Duration:
8 minutes (AD/YA)
12 minutes (CH/OA)

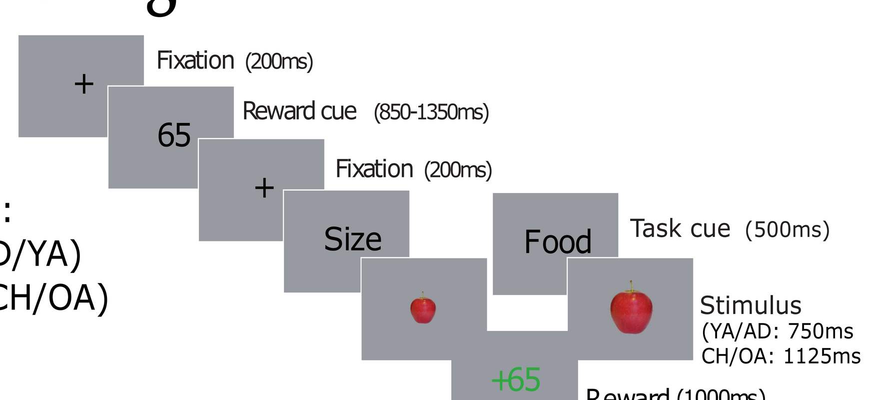

Figure 2. In the task-switching paradigm, participants either indicate whether the object was a fruit or a vegetable (Food task) or they indicate whether it was small or large (Size task). To account for slower RT in children and older adults, we adjusted the stimulus display times.

Under high demands of **cognitive control, children** and **older adults** adjust performance according to the **opportunity cost of time.**

Take a picture to download the extended abstract and supplementary information!

Results

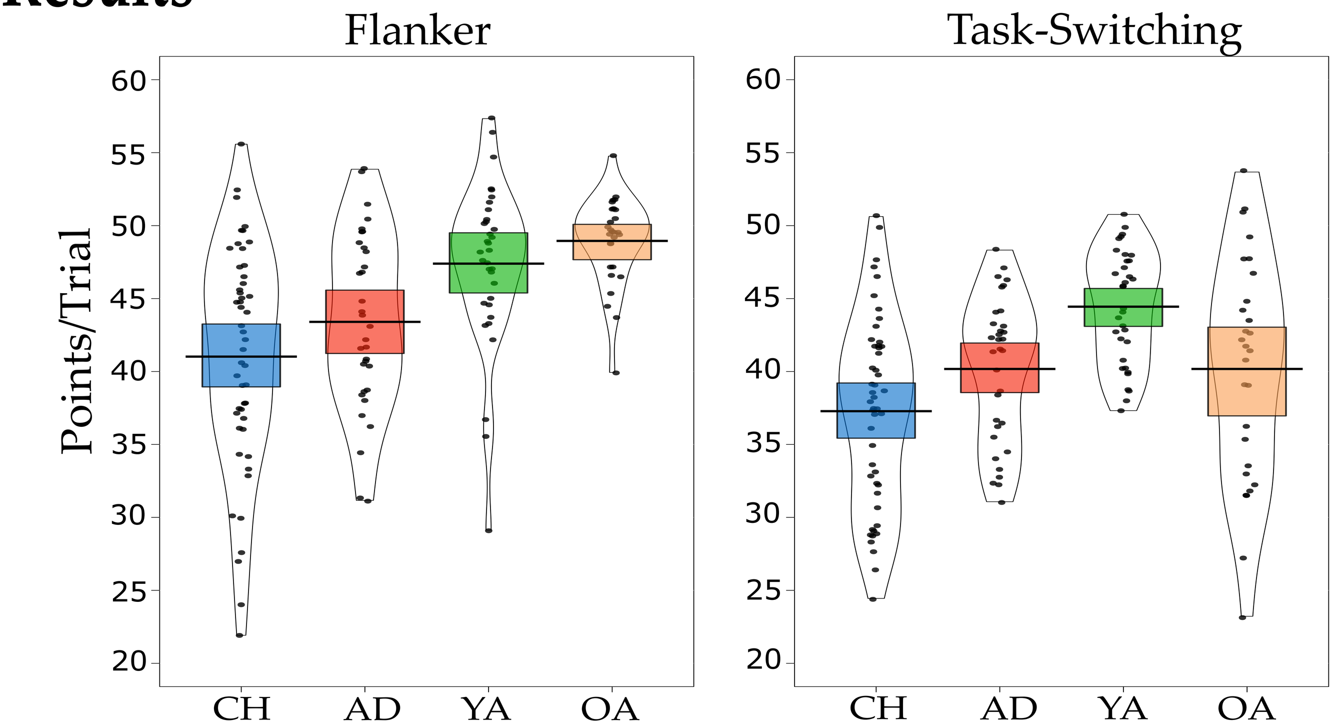

Figure 3. Points per trial for each subject in both task. In the Flanker task, older adults perform better than all other age groups. In task-switching however, their performance falls below that of young adults.

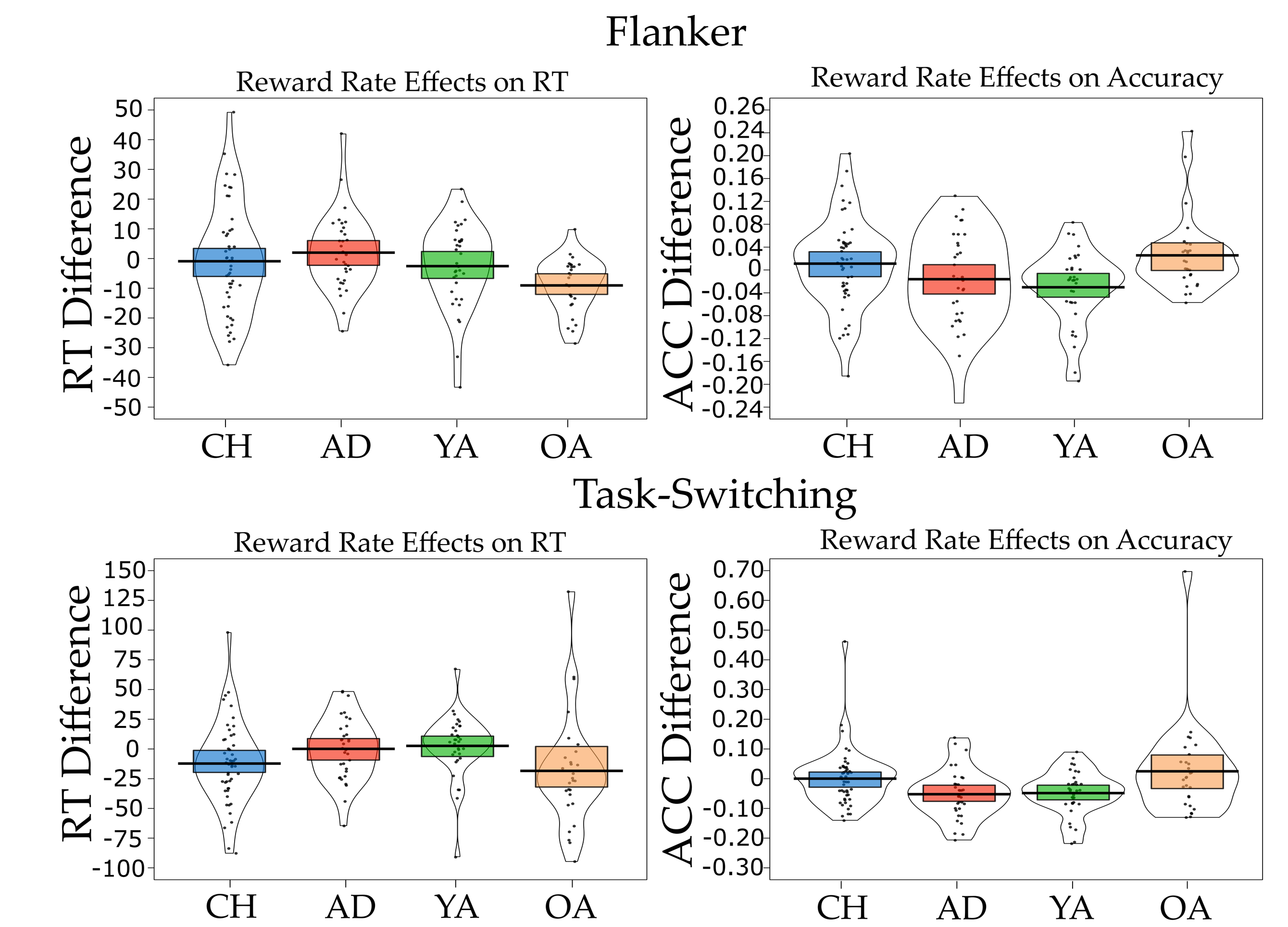

Figure 4. Reward rate difference scores on RT and Accuracy in both tasks (high - low). In the Flanker, OA were most sensitive to changes in reward rate. In the task-switching, CH also became sensitive to changes in reward rate.

Discussion

When task complexity reached cognitive load limits in the task-switching paradigm, children and older adults became sensitive to changes in reward rate. This sensitivity allowed them optimize performance. We are currently trying to replicate these effects in YA by parametrically manipulating cognitive load.

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1. Braver & Barch (2002), *Neuroscience and biobehavioral reviews* 2. Bunge et al. (2002), *Neuron* 3. Otto & Daw (2019), *Neuropsychologia*