Development of performance adjustments after COGNITIVE CONFLICTS and ERRORS

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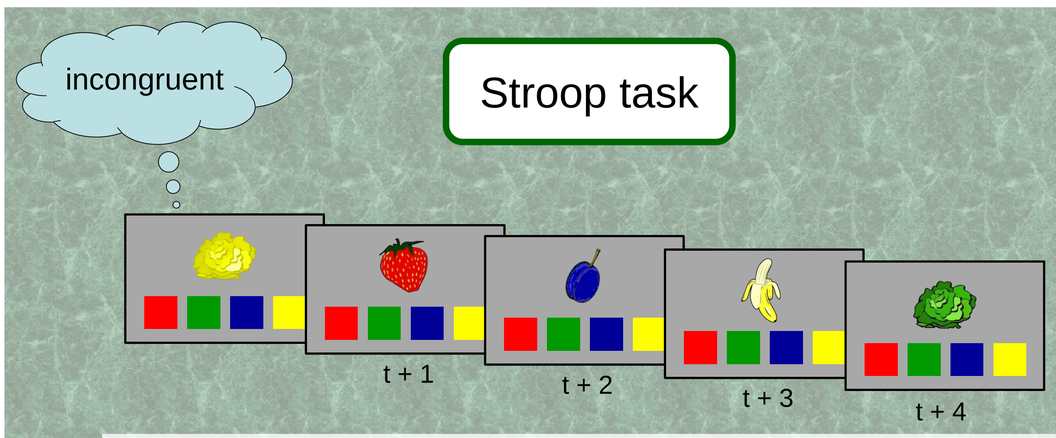
The detection of a conflict or error alerts the cognitive control system that an adaptation is needed to meet performance criteria for the accomplishment of one's goals. These performance adjustments result in the so called **post conflict slowing** (PCS) and **post error slowing** (PES). A child's growing ability to detect conflicts or committed errors and adjust performance accordingly is thought to be a driving force for developmental progression. However, only little research has been done on the development of the mechanisms underlying cognitive control adaptation. The aim of the present study was to close this gap by comparing the developmental trajectories of the after-effects elicited by cognitive conflicts and errors. To this end, participants of four age groups (8-, 10-, 12-, year-olds and young adults) performed two cognitive conflict tasks known to provoke errors on incongruent trials. Every 5th trial was incongruent. After-effects of correct vs. incorrect responses to the conflict trial were explored at the following four congruent trials (t+1, t+2, t+3, t+4).

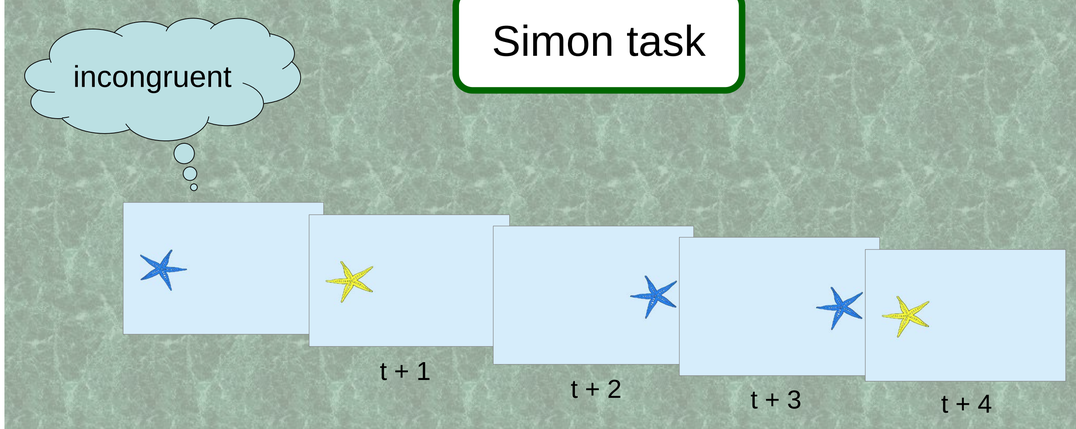
Method

Stroop task



Instruction:
Press the corresponding color of the fruit/veggie as fast and accurately as possible.
If it is an incongruent color, press the correct color.

Simon task



Instruction:
Press the left key for yellow starfish and the right key for blue starfish as fast and accurately as possible.
Ignore the site of the starfish. Respond only to the color.

Sample

group	M_{age}	age range	n	errors Stroop	errors Simon
8-year-olds	8.3	7.7 – 8.9	32	2.4	4.3
10-year-olds	10.2	9.6 – 11.1	26	2.1	4.1
12-year-olds	12.3	11.6 – 13.8	31	2.2	4.1
adults	22.7	19.5 – 32.9	19	1.6	3.3

Design

4 (age) x **2** (slowing type: PCS vs. PES) x **4** (trial: t+1, t+2, t+3, t+4)

DV: Reaction times (RT) corrected for speed differences by subtracting individual mean RTs of a *pure congruent block*

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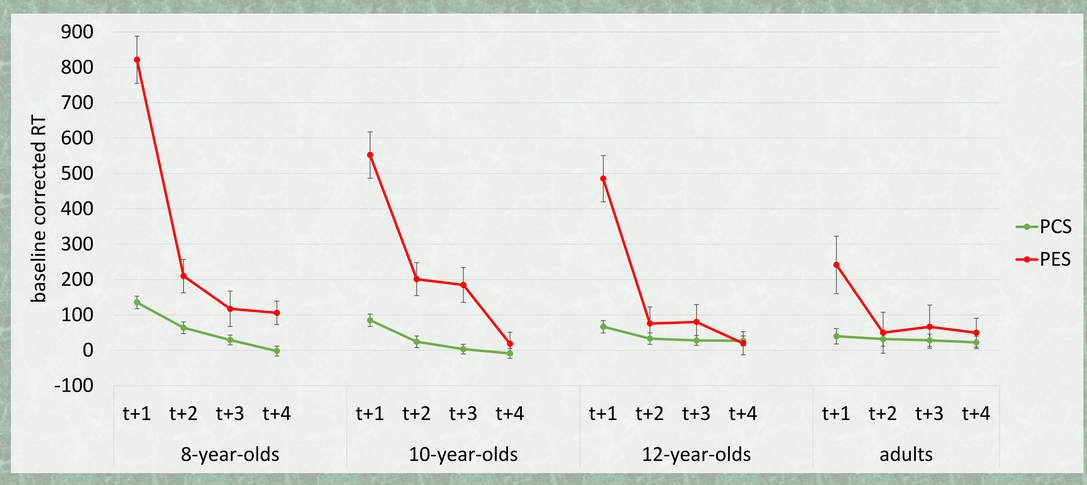
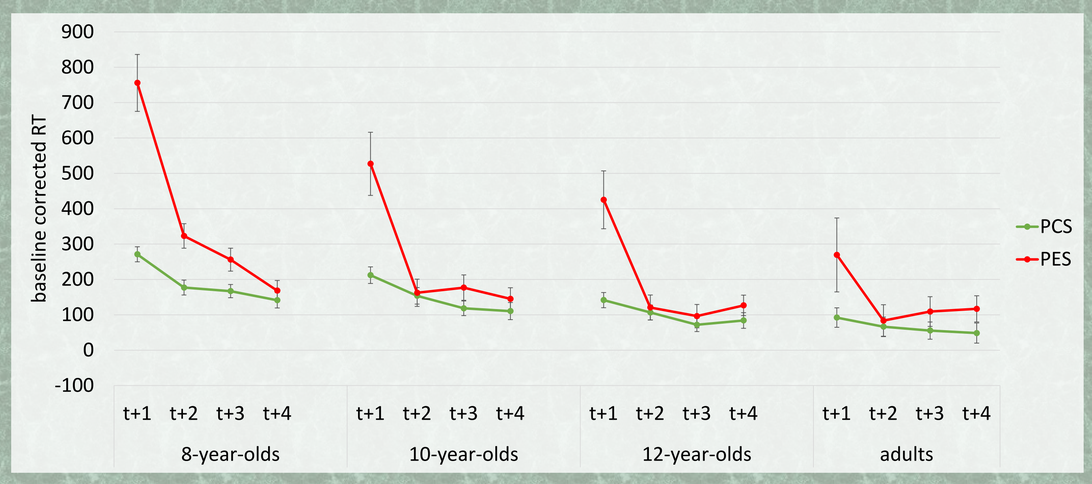
Results

Stroop task



Simon task



Effect	Stroop	Simon	Summary
Age	$p < .001$	$p < .001$	Less slowing with age
Slowing type	$p < .001$	$p < .001$	Stronger PES compared to PCS
Trial	$p < .001$	$p < .001$	Slowing is most pronounced on the first trial (t+1) and decreases over trials (= recovery)
Age x slowing type	$p < .001$	$p = .025$	Age-related decrement in slowing starts earlier and is more pronounced in PES than PCS
Age x trial	$p < .001$	$p = .004$	Faster recovery from conflicts and errors with age (indicating more efficient adjustments)
Slowing type x trial	$p < .001$	$p < .001$	Steadily vs. abruptly decreasing PCS vs. PES
Age x slowing type x trial	$p = .009$	$p = .116$	Stronger and longer-lasting PES in younger children (esp. Stroop task)

Conclusion

Less slowing after conflicts and errors suggest more efficient performance adjustments with age. Most age-related change is found in PES suggesting different developmental trajectories of the processes involved in PCS and PES.