

## Theoretical Background & Research Questions

### Executive Function (EF)

- umbrella term relating to a variety of cognitive processes enabling self-regulation
- involves several correlated, yet distinguishable sub-functions<sup>1</sup> (e.g., inhibitory control and cognitive flexibility) and context-specific sub-systems<sup>2</sup>: “hot” EF (needed in emotionally or motivationally involving situations) and “cool” EF (stressing the cognitive demands)
- essential predictor for many aspects of life, including academic achievement, wellbeing, psychological and physiological health<sup>3</sup>

Our project aims at exploring the development and interrelations of

- **executive sub-functions** (inhibition, flexibility, updating) and
- **executive sub-systems** (hot/cool)

in middle childhood, using a large sample and age appropriate instruments.

Here, we present first results of our project, using Cross-Lagged-Panel Analysis with a multi-group design comparing EF development over a three year period in girls and boys.

## Instruments

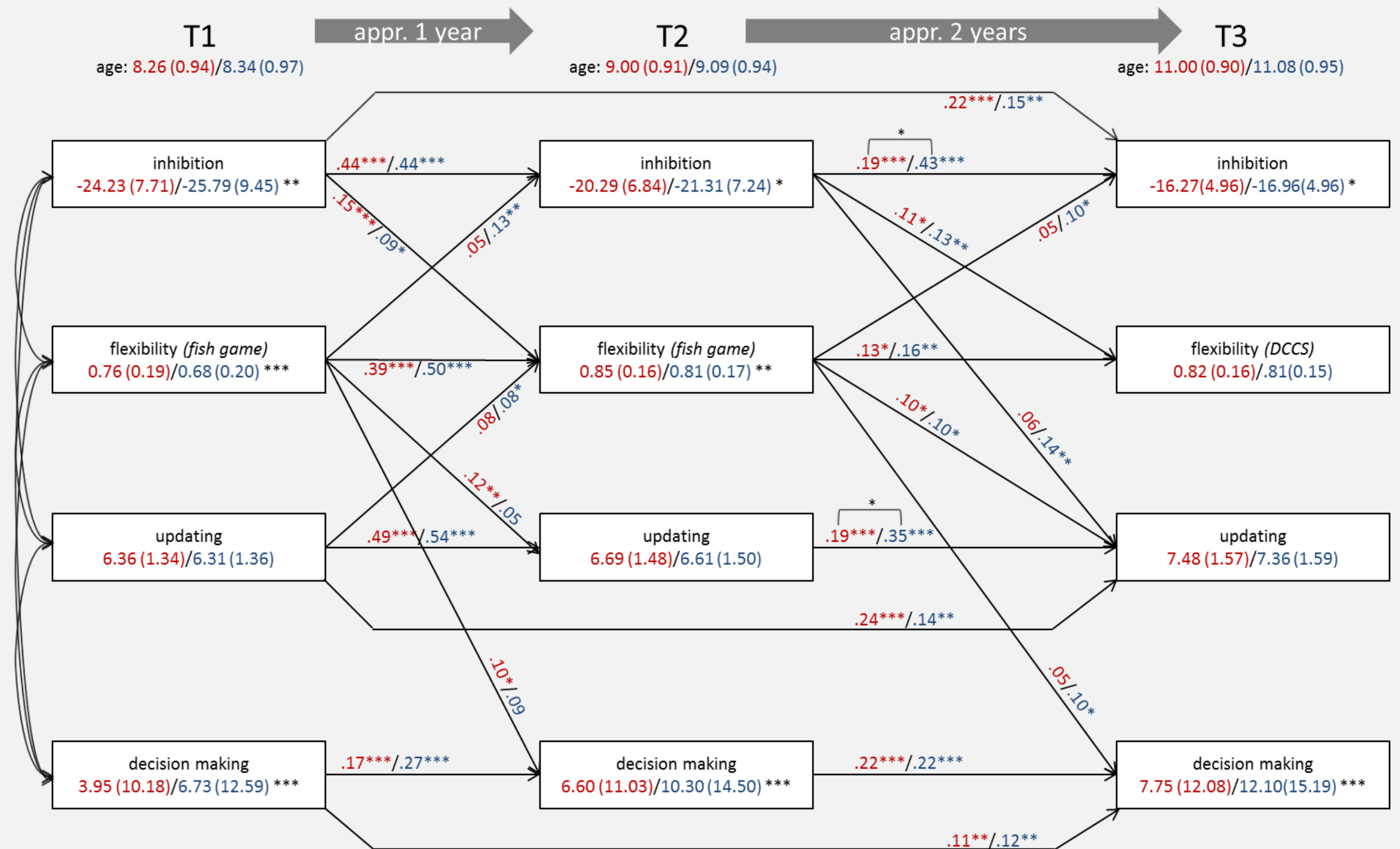
		T1 & T2	T3
cool EF	updating (working memory)	Digit Span Backwards number of correctly reproduced sequences (Petermann & Petermann, 2007)	as in T1/T2
	inhibition (inhibitory control)	Fruit Stroop reversed interference score (Roebbers et al., 2011)	as in T1/T2
	flexibility (set shifting)	Fish Game: Cognitive Flexibility Task percentage of correct switch trials (Roebbers et al., 2011)	Age appropriate computerized Dimensional Change Card Sort percentage of correct switch trials (Qu et al., 2015)
hot EF	affective decision making	Hungry Donkey: age appropriate computerized Iowa Gambling (+ reward) difference between advantageous and disadvantageous choices (Crone & van der Molen, 2004)	as in T1/T2
covariates	processing speed	Digit-Symbol Coding (Petermann & Petermann, 2007)	as in T1/T2
	socioeconomic status	Self-reported maternal education (6 levels)	-

## Sample

- N ≈ 1657 children (52 % girls). Due to missings in the covariates, data from 1003 children are used for analysis.
- Age T1: 6–11 years (M = 8.3 years, SD = 0.95)
- Children were recruited from 33 elementary schools in the federal state of Brandenburg, Germany.
- Schools were from different rural and urban areas and socio-economic backgrounds.

## Cross-Lagged-Panel Model

Standardized path coefficients for **girls** (named first) and **boys**, controlling for child’s age, maternal education and processing speed at T1. Only significant paths are displayed. N = 1003, RMSEA = 0.04, CFI = 0.98, SRMR = 0.02. \*p ≤ .05, \*\*p ≤ .01, \*\*\*p ≤ .001



Means (and SDs) for **girls** and **boys** and significant sex differences are displayed under the variable names. Girls and boys improve significantly in all of the EF measurements over time (paired-sample t-tests for T1/T2 and T2/T3).

## Design

- Project is part of a longitudinal study on intrapersonal developmental risk factors in childhood and adolescence (PIER-study).
- First measurement point (T1) in 2012, T2 appr. 1 year later, T3 finished in July 2015.
- Children were tested individually by a trained experimenter at their schools or at home.
- Assessments were within a larger battery of tasks, including questionnaires, standardized tests and other tasks.
- Parents and teachers completed questionnaires about demographics and their evaluation of the children’s behavior.

## Preliminary Conclusion

- Girls are slightly better than boys in the cool EF inhibition (all time points) and flexibility (T1 and T2), but there are no sex differences in the updating task.
- Boys are markedly better in decision making than girls at all 3 time points, a finding that is consistent with literature. Stability in this hot EF task is the same in girls and boys, indicating comparable development, only on different levels.
- Most developmental paths do not differ significantly between girls and boys. However, T2-T3 stability for updating and inhibition is stronger in boys than in girls.
- Flexibility and inhibition both predict each other and updating, demonstrating their importance for a general cold EF ability, as well as the overlapping nature of these cool executive sub-functions. Updating at T1 shows only a minor contribution to flexibility at T2, signaling that the tasks measuring inhibition and flexibility do not seem to depend on updating ability.
- Decision making at T2 and T3 is not influenced by cool EF (with the exception of a small effect of flexibility), a possible sign of two independent sub-systems. However, we cannot exclude an influence from cold EF abilities on decision making prior to T1.

## References

- <sup>1</sup>Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., Howerter, A., & Wager, T. D. (2000). The unity and diversity of executive functions and their contributions to complex “frontal lobe” tasks: A latent variable analysis. *Cognitive Psychology*, 41, 49–100.
- <sup>2</sup>Zelazo, P. D., & Müller, U. (2002). Executive Function in typical and atypical development. In U. Goswami (Ed.), *Blackwell Handbook of Childhood Cognitive Development* (pp. 445–469). Malden: Blackwell Publishing.
- <sup>3</sup>Moffitt, T. E., Arseneault, L., Belsky, D., Dickson, N., Hancox, R. J., Harrington, H., ... Caspi, A. (2011). A gradient of childhood self-control predicts health, wealth, and public safety. *Proceedings of the National Academy of Sciences of the United States of America*, 108, 2693–2698.

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