

Differential Development of Executive Functions in Adolescence

A Cross-sectional Study in Subjects Aged 12-19



Annemarie Boschloo, Aukje Aben, Renate de Groot, Joyce Akse & Jelle Jolles

School for Mental Health and Neuroscience, Faculty of Health, Medicine and Life Sciences, Maastricht University
P.O. Box 616 - 6200 MD - Maastricht - The Netherlands
<http://www-np.unimaas.nl> - www.brainandlearning.eu - annemarie.boschloo@np.unimaas.nl

Background

Executive functions are important for goal-directed behaviors that guide our daily life functioning.^{1,2} Brain research and neuropsychology research have shown that executive functions continue to develop in adolescence and suggest a differential development.^{3,4,5} Age-extrinsic factors such as sex and parents' education level may play a role in this development.⁶

Research question

Do executive functions show a differential development in adolescents aged 12-19, and is this development influenced by sex and parents' education level?

Methods

This study had a cross-sectional design. Subjects were 55 (46%) boys and 65 (54%) girls, aged 12-19 years. Their parents' education level was: 37 (31%) middle, 83 (69%) high. Executive functions were measured with a self-report questionnaire, the Behavior Rating Inventory of Executive Function - Self-Report Version (BRIEF-SR)⁷. This questionnaire contains 80 items, for example:

- I have trouble sitting still* ('Inhibition')
- I overreact to small problems* ('Emotional Control')
- I have problems completing my work* ('Task Completion')

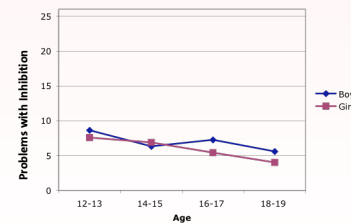
Subjects had to indicate if these behaviors were never, sometimes or often a problem over the past 6 months. Backward, stepwise multiple regression analyses were done for each scale, with the predictors age, age², sex, parents' education level, and their interaction effects.

References

1. Anderson, P. (2002). Assessment and development of executive function (EF) during childhood. *Child Neuropsychology*, 8(2), 71-82.
2. Luria, A. (1973). *The working brain*. New York: Basic Books.
3. Casey, B. J., Tottenham, N., Liston, C., & Durston, S. (2005). Imaging the developing brain: what have we learned about cognitive development? *Trends in Cognitive Sciences*, 9(3), 104-110.
4. Huizinga, M., Dolan, C. V., & van der Molen, M. W. (2006). Age-related change in executive function: developmental trends and a latent variable analysis. *Neuropsychologia*, 44(11), 2017-2036.
5. Luna, B., Garver, K. E., Urban, T. A., Lazar, N. A., & Sweeney, J. A. (2004). Maturation of cognitive processes from late childhood to adulthood. *Child Development*, 75(5), 1357-1372.
6. Wassenberg, R. (2007). *Differential cognitive development: a neuropsychological approach* (PhD-thesis). Maastricht University, Maastricht.
7. Guy, S. C., Isquith, P. K., & Gioia, G. A. (2004). *BRIEF-SR: Behavior Rating Inventory of Executive Function-Self-Report Version: Professional Manual*. Lutz, FL: Psychological Assessment Resources, Inc.

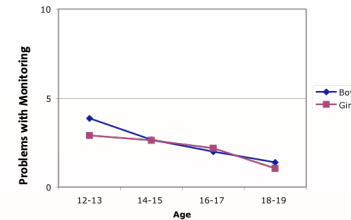
Results 1

Older adolescents reported fewer problems with controlling their impulses and behaviors than younger adolescents ($p < 0.001$).



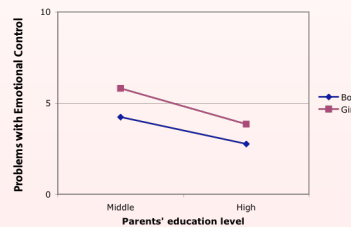
Results 2

Older adolescents reported fewer problems with being aware of their own behavior and its impact on others than younger adolescents ($p < 0.001$).



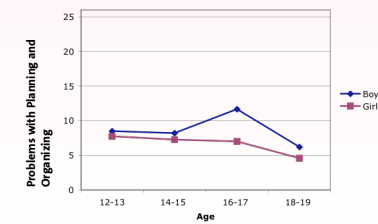
Results 3

Girls reported more problems with the modulation of emotions than boys ($p = 0.035$). Adolescents with highly educated parents reported fewer problems than adolescents whose parents have a middle education level ($p = 0.008$).



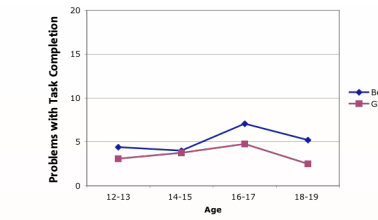
Results 4

Boys (especially 16-17 year old boys ($p = 0.021$)) reported more problems with planning and organizing events than girls ($p = 0.011$).



Results 5

Boys reported more problems with completing schoolwork and tests in time than girls ($p = 0.017$). 16-17 year old adolescents report more problems with Task Completion than younger and older adolescents ($p = 0.023$).



Results 6

No relationships were found between **Shifting**, **Working Memory** and **Organization of Materials** and age, sex and, parents' education level.

Summary

- Sex differences were found in planning and organizing, task completion and controlling emotions.
- Parents' education level was related to emotional control.
- Age differences were found in inhibition, monitoring of behavior, planning and organizing and task completion.
- No relationships with age were found in shifting, working memory, emotional control and organization of materials. Thus, these functions were already fully developed at age 12.

Conclusion

This self-report questionnaire study confirms evidence for differential development of executive functions in adolescence, and adds that sex and parents' education level are related to it.