

Age and sex differences in spatial cognition – also a question of solution strategies

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Abstract

It is supposed that age and sex differences in spatial abilities could be explained to a large extent by the use of distinct strategies. In general, males and younger subjects are often reported to use more efficient strategies and obtain better results on average than females and older adults. The detection of these strategies in behavioural data becomes of great substantial and methodological interest. Recently, methods from automatic pattern recognition have been successfully applied to a wide range of high-dimensional data, but not yet to this kind of behavioural data. The aim of this work was to establish a method from automatic pattern recognition in the field of psychological behavioural research. For that the spatial abilities that were often reported for large age and sex differences have been measured by methods from virtual reality. These abilities were mental rotation as a facet of spatial imagery, place learning and path integration. The latter are essential capabilities during navigational tasks.

Questions: Can the proposed pattern recognition method detect strategies in spatial imagery tests as well as in navigational tasks? Are the observed strategy patterns as well as the relations between participants' strategy usage, age and sex comparable to results reported in this field of research?

Methods: In Experiment 1, I tested 200 adolescents (10–15 years of age) for their solution strategies in the Mental Rotations Test (MRT; Peters et al., 1995). In Experiment 2, I tested 200 adults (20–65 years of age) for their path integration abilities and their orientation strategies in a virtual compass pointing task. In Experiment 3, I tested 58 participants (20–59 years of age) for place learning and their search strategies in a virtual water maze. Automatic strategy detection was performed by Non-negative Matrix Factorization (NMF; Gao & Church, 2005).

Results: In the MRT, sex differences were observed and were strongly related to the use of fast and slow holistic solution strategies. But they were not related to differences in the use of holistic and analytic strategies. In the compass pointing task, age differences occurred only for the quantitative measures. However, there were observed qualitative age and sex differences in this task. Place learning performance in the water maze depended on the participants' age and sex. Search strategies depended on landmarks that were used for navigation and could be classified into egocentric and allocentric categories. For these categories age differences have been detected: Older participants were more frequently observed with egocentric strategies, while younger subjects rather used the allocentric ones.

Conclusion: The results confirmed my assumptions about the age and sex differences in both the investigated spatial abilities and the observed strategies in the related tasks. Furthermore, the results from this work are comparable to those reported in this field of research (Geiser, Lehmann & Eid, 2006; Hosenfeld, Strauss & Köller, 1997; Kallaia, Makany, Karadia & Jacobs, 2005; Astur, Tropp, Sava, Constable & Markus, 2004). It shows clearly the successful implementation of the NMF-method in behavioural science. In this thesis, I further discuss the more substantial meaning of these strategies in the light of a hypothetical model for spatial preferences and competences.