Abstract in English

Human sense of smell (olfaction) exhibits remarkable plasticity. The olfactory system subjects to damage and regenerates cyclically throughout life. Regeneration of the olfactory system can be induced by exposure to odors. In animals, olfactory stimulation supports the survival of the neurons and increases olfactory abilities. In humans, exposure to odors changes brain structure and functionality, which is reflected in enhanced olfactory performance. Plasticity of the olfactory system is used for treating olfactory dysfunction – a regular, structured stimulation of the sense of smell (olfactory training, OT) promotes olfactory rehabilitation and leads to structural and functional reorganization of the olfactory brain network.

Among the sensory systems, the olfactory system has a unique neuroanatomical architecture. Odors directly activate the limbic system without a complete thalamic relay. Thus, olfactory input may modulate certain emotional and cognitive processes. Additionally, structures comprising primary and secondary olfactory cortices are functionally engaged in emotional and cognitive functions. For this reason, OT has been hypothesized to have effects not only in the olfactory domain but also benefit emotional functioning and cognition. Preliminary empirical evidence supports this hypothesis. Thus far, no studies on the cognitive and emotional effects of OT in children have been reported.

Olfactory development in childhood is intertwined with the maturation of cognitive and emotional functions. However, OT effects in children are understudied, with only preliminary verification of OT effects on olfactory abilities being available. This dissertation aimed to investigate how OT might influence children's olfactory, emotional, and cognitive functions. To this end, three experimental studies were conducted.

Study 1 verified if OT conducted in a school setting (i.e., with maximized compliance) may benefit 8-year-old children's olfactory sensitivity and odor identification ability. Control group performed an odorless training. Whereas OT did not change children's olfactory sensitivity, it increased odor identification ability and this increase continued after OT offset. The latter finding suggests that OT in children may induce changes in olfactory knowledge (e.g., increase odor awareness) that lead to better odor identification also after OT completion.

Study 2 investigated whether OT might benefit the olfactory and cognitive (executive functions, fluid intelligence) abilities of children and adolescents aged 6 to 16 years who sustained mild traumatic brain injury and their healthy counterparts. In this study OT effects were investigated in two variants – OT was conducted with either high- or low-concentrated odors. OT with low-concentrated odors improved olfactory sensitivity in children after mTBI, and increased fluid intelligence in both injured and healthy children, for the first time demonstrating potential cognitive effects of OT in children.

Study 3 verified if OT might improve working memory across three sensory domains (olfaction, vision, audition) and enhance the ability to match emotional facial expressions in children aged 6 to 9 years. The control group performed an odorless training. Whereas working memory scores did not change after OT, children performing OT improved in matching emotional facial expressions. The gathered evidence demonstrates that OT effects might exceed to the emotional domain.

Altogether, this dissertation deepened the knowledge about OT effects in children and demonstrated that certain psychological effects of OT may be observed in olfactory, cognitive, and emotional domains. Further research, including neuroimaging studies, is required to explore what other domains of children's functioning might benefit from OT, and what mechanisms lead to the observed effects.

Keywords: olfactory training, olfaction, cognitive abilities, emotional functioning, children, adolescents