ELSEVIER

Archives of Clinical Neuropsychology
20 (2005) 761–769

Archives of CLINICAL NEUROPSYCHOLOGY

Assessing olfaction in the neuropsychological exam: The relationship between odor identification and cognition in older adults

Holly James Westervelt [a,b,*], Jessica Somerville Ruffolo [b], Geoffrey Tremont [a,b]

[a] *Rhode Island Hospital, Physician's Office Building, Suite 430, 593 Eddy Street, Providence, RI 02903, USA*
[b] *Brown Medical School, RI, USA*

Accepted 9 April 2005

Abstract

The relationship between odor identification and cognition has not been previously well characterized. The neuroanatomy of the olfactory system and the frequent finding of olfactory dysfunction in neurodegenerative diseases suggest a likely relationship between odor identification and memory, language, and executive functioning, though previous studies have often failed to demonstrate the expected relationship. The current study examined this relationship in across a continuum of ability levels ($N = 100$). Strongest correlations were found between odor identification and language, most aspects of memory, and a measure of general cognitive functioning. Significant but more modest correlations were seen between odor identification and attention, motor, visuospatial, and executive functions. A regression analysis revealed language as the only significant predictor of olfactory performance. These findings suggest that odor identification is most closely associated with other measures of temporolimbic functioning. The implications of these findings, particularly in consideration of the assessment of older adults, are discussed.

Keywords: Olfaction; Odor identification; Memory; Cognitive assessment

* Corresponding author. Tel.: +1 401 444 4500; fax: +1 401 444 6643.
E-mail address: hwestervelt@lifespan.org (H.J. Westervelt).

0887-6177/$ – see front matter
doi:10.1016/j.acn.2005.04.010

The nature of the relationship between odor identification performance and cognition has not been well established, though an association between olfaction and at least certain aspects of cognition would be expected based on the neuroanatomy of the olfactory system. In particular, a relationship with memory is likely given the anatomic proximity of areas critical for memory processing (i.e., hippocampus) and processing of olfactory information (i.e., piriform cortex with projections to the amygdala, periamygdaloid cortex, and entorhinal cortex). In addition, the prefrontal cortex is a secondary area for olfactory processing, suggesting the likelihood of a relationship between odor identification performance and executive functioning. Functional imaging and resection studies support the importance of these regions in olfactory functioning (Dade, Zatorre, & Jones-Gotman, 2002). Furthermore, deficits in odor identification are commonly observed in neurodegenerative and other dementing diseases which often present with prominent memory disturbance such as Alzheimer's disease (Serby, Larson, & Kalkstein, 1991), diffuse Lewy body disease (Westervelt, Stern, & Tremont, 2003), and vascular dementia (Knupfer & Spiegel, 1986).

Although a relationship between these processes seems intuitive, the few prior studies which have examined the relationship have often failed to find an association. The two studies assessing memory failed to find statistically significant associations between memory functioning and olfaction (Carone et al., 1999; Weber, 2004), and the two assessing the relationship between olfaction and other temporal processes such as confrontation naming had mixed results (c.f., Carone et al., 1999; Larsson, Semb, Winblad, Wahlund, & Backman, 1999). The relationship with executive functioning has also been inconsistent, with one study finding a modest but statistically significant association (Weber, 2004), but another failing to find a relationship (Larsson et al., 2004) In some of these studies, the surprising null results may have reflected the likely limited range of performance in the samples studied (e.g., patients with Alzheimer's disease) or limited sample sizes.

The current study explores the relationship between odor identification and a variety of cognitive domains (i.e., attention, executive functioning, visuospatial skills, language, motor skills, and memory) in a large sample of older adults representing a continuum of performance ability. Based on an anatomic rationale, we anticipated the strongest relationships with tasks involving significant temporal and anterior frontal processing (i.e., memory, executive functioning, and language), and more modest, if any, relationships with other cognitive tasks.

1. Method

1.1. Participants

The study sample consisted of 100 participants (46 men) with a mean age of 70.27 (S.D. = 9.21) and mean educational level of 13.8 (S.D. = 3.20). The study included only older adults (age 50+) because: (1) olfactory measures appear especially well suited for identifying and distinguishing neurodegenerative disease; and (2) the range of performance on the olfaction measure is extremely limited in younger adults (Doty, Marcus, & Lee, 1996). Seventy-four of the participants were patients presenting for assessment of memory concerns to the outpatient service of a large, urban, academic general medical center. Of the 74 patients, 63