Comparing Spatial Navigation Deficits in Mild Cognitive Impairment and Alzheimer's Disease

Adria Morales Santiago, Gillian Gouveia, and Dr. Dorota Kossowska-Kuhn

Introduction:

Dementia is a progressive decline in cognitive functioning that interferes with daily life and independence and is considered one of the leading causes of disability among older adults worldwide (World Health Organization [WHO], 2025). More than 55 million individuals currently live with dementia globally, and this number is expected to increase substantially as life expectancy rises (WHO, 2023). Among the conditions associated with cognitive decline, Mild Cognitive Impairment (MCI) and Alzheimer's disease (AD) are of particular importance. MCI is often considered a transitional stage between normal aging and dementia, affecting approximately 15–20% of adults over the age of 60 (Petersen et al., 2014; Roberts & Knopman, 2013). Although some individuals with MCI progress to Alzheimer's disease, others remain stable or improve with early intervention (Petersen et al., 2018).

One cognitive domain that appears to decline early in both MCI and AD is spatial navigation, the ability to orient oneself and move effectively through the environment. Spatial navigation relies on neural systems including the hippocampus, medial temporal lobes, and parietal regions, which support route learning and cognitive mapping (Ries et al., 2008; Ruan et al., 2016). Damage to these regions contributes to navigation impairments such as disorientation and difficulty forming mental maps of environments. Previous studies have shown that individuals with MCI and AD demonstrate significant deficits in spatial navigation tasks compared with cognitively healthy older adults (Benke et al., 2014; Hort et al., 2007; Mokrisova et al., 2016). Understanding how navigation performance differs between these groups may help identify early cognitive markers of neurodegenerative disease progression.

Methods:

- Conducted a systematic literature search across multiple academic databases including PsycInfo, PubMed, Ageline, Dissertation & Theses Global, Web of Science, and ERIC.
- Used search terms related to spatial navigation and orientation combined with terms for Alzheimer's disease and Mild Cognitive Impairment.
- Included studies that directly compared spatial navigation performance between individuals with MCI and individuals with AD.
- Extracted data on several moderating variables, including participant age, type of test administration, and type of spatial navigation task.
- Calculated standardized mean differences using Hedges' g to estimate effect sizes across studies.
- Performed a multivariate random-effects meta-analysis to synthesize results across studies.
- Applied robust variance estimation to account for dependent effect sizes within studies.

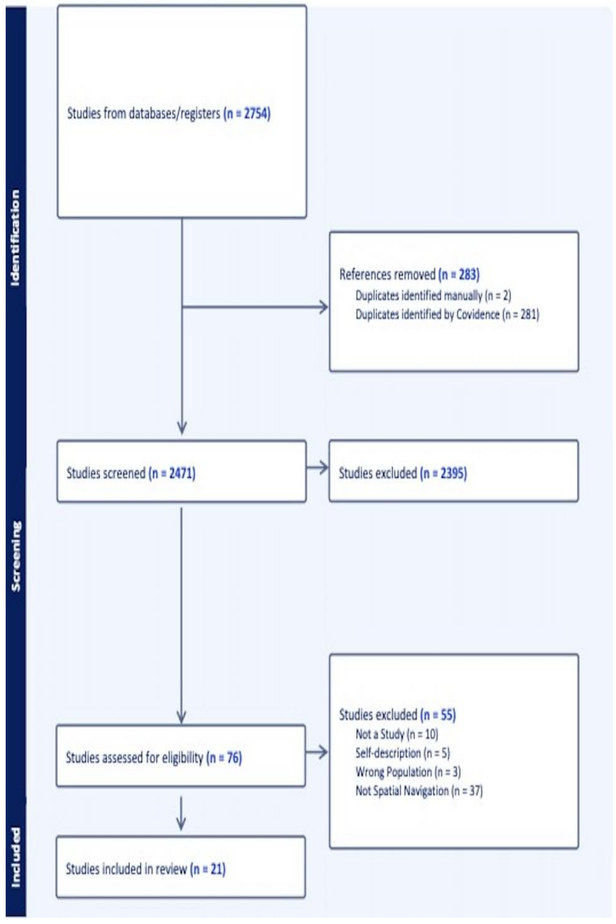

Figure 1. PRISMA Flowchart of Included Studies

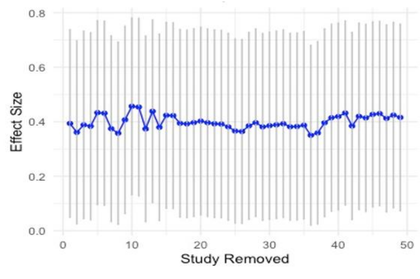

Figure 2. Leave-One-Out Analysis

Results

- 21 studies were included in the meta-analysis, producing 57 effect sizes.
- Individuals with Alzheimer's disease (AD) showed significantly poorer spatial navigation performance compared to individuals with Mild Cognitive Impairment (MCI).
- The difference between groups was statistically significant with a small effect size (Hedges' g = 0.16, p < .001).

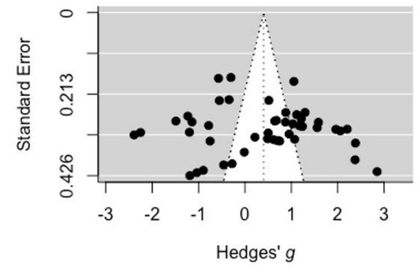

Figure 3. Funnel Plot

Discussion

The results of this meta-analysis indicate that spatial navigation performance declines as cognitive impairment progresses from Mild Cognitive Impairment (MCI) to Alzheimer's disease (AD). Individuals with AD performed significantly worse on spatial navigation tasks compared to those with MCI, suggesting that navigation abilities deteriorate as neurodegenerative changes advance. Although the effect size was small, the difference between the groups was statistically significant, indicating a consistent pattern across the studies included in the analysis.

The studies analyzed used a wide range of spatial navigation tasks and testing formats, highlighting the need for more standardized assessment methods. Future research should focus on longitudinal studies to better understand how spatial navigation deficits develop over time and to determine whether these tasks could serve as useful tools for monitoring disease progression and improving early detection of Alzheimer's disease

Works Cited