For people with cognitive dysfunction secondary to dementia, how does assistive technology support spatial navigation in physical environments?

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Introduction

- ❖ Spatial navigation (SN) is a series of cognitive skills and brain functions to follow environmental cues in order to move from one point to another (American Occupational Therapy Association [AOTA], 2020; Marick. 2018).
- ❖ The symptoms of dementia includes impaired: memory, thinking, comprehension, calculation, learning, language and judgement (Dening & Sandilyan 2015).
- ❖ Over time symptoms worsen and play a role in how people with dementia (PwD) can participate in spatial navigation resulting in requiring assistance and possibly becoming lost or dying (Capsi, 2014; Rowe & Bennett, 2003 ;Sandilyan & Dening, 2015).
- ❖ Past literature indicates compensatory strategies were more successful interventions to improve functional performance, compared to remedial approaches among PwD (Caffo et al., 2014b).
- ❖ Further research within the OT scope of practice has yet to be performed.

Learning Objectives

At the conclusion of this activity, participants shall be able to:

- ➢ Verbalize at least one type of AT that supports PwD's SN ability.
- ➢ Identify at least two factors that influence PwD's ability to engage in SN using AT.
- ➢ Describe how provided AT supports SN

Methods

Key Databases: Academic Search Premier, EBSCO Host/ CINAHL, Sage, Science Direct within Elseviser,

Key Search terms: Population: dementia, Alzheimer's Disease, cognitive decline, cognitive impairment; Intervention: technology, haptic, auditory, visual, tactile, smartphone, assistive technology, assistive devices; Activity: wayfinding, spatial navigation, spatial orientation, spatial disorientation

Inclusion Criteria:

- study focused on occupational performance & outcome of SN
- electronic based AT was used as an intervention for SN
- intervention was in a physical space
- participants had a diagnosis of dementia, aged 30 or older
- objective measure of cognitive impairment

Exclusion Criteria:

- Participants having a health condition with symptomology that includes known spatial navigation difficulty

Figure 1. PRISMA Method (Moher, D., Liberati, A., Tetzlaff, J., et al. 2009)

Results

- PwD with a cognitive impairment level could participate in SN.
- 3 styles of AT were noted
- The AT directions were provided via sensory information
- Control of AT was by participant or by researcher.
- Maintaining SN skills could be observed with AT (Caffo et al., 2014; Lancioni et al., 2013; Lancioni et al., 2013b; Lancioni et al., 2011)

Factors that influenced SN performance:

1. AT design
2. Training
3. Frequency of AT intervention
4. Researchers' definition of successful SN

Discussion and Conclusion

- Modifying the occupation has a positive impact on performance.
- Control of AT impacts independence with SN
- Safety should be considered when implementing AT.
- ***Conclusion:*** Overall, the evidence shows PwD can use AT to participate in SN and improve SN ability. The evidence shows some PwD may be independent with AT use, but the population as a whole is not.

Clinical Implications

Clinical implications relate to occupational therapy practice and the profession. Implications for practice include:

- There are choices of AT to aid PwD to participate in SN within their desired physical environments
- Safety co-requisite goals should be considered (e.g., attention to traffic lights) (Kwan et al, 2020)
- Cost of AT could be a barrier to access AT

Implications for the profession include:

- Advocate for AT coverage by insurance groups

Future Research

Areas of needed in future research includes:

- Studies that are reflective of PwD impairment levels, lifestyle choices, & ability to use SN AT in their lifestyles (e.g., a PwD with moderate impairment level using SN AT with a cane to go to the grocery store via the bus)
- Barriers to independent SN with AT
- Viability of AT interventions in real world application with long term effects

Table 1. Results

Study	Type of AT	Demonstrated Improvement	Did all participants engage in SN using the AT & reach their destinations?
Caffo et al., 2014a	• Doorbell system with strobe light • Remote controlled	Yes	Yes
Grierson et al., 2011	• Wearable, vibrating belt • Controlled by research assistant	Not Tested	Yes
Kwan et al., 2020	• iPhone • Navigation app "Maps"	Not Tested	Yes
Lancioni et al., 2013a	• Auditory cue system; remote controlled • Light cue system; remote controlled	Yes	Yes
Lancioni et al., 2013b	• Doorbell system with strobe light • Remote controlled	Yes	Yes
Lancioni et al., 2011	• Auditory cue system • Remote Controlled	Yes	Yes
Lanza et al., 2014	• HTC smartphone • Custom navigation app	Not Tested	Yes
Rosalam et al., 2020	• Wearable, vibrating belt • Built in GPS	Not Tested	Yes

References

American Occupational Therapy Association. (2020). Occupational therapy practice framework: Domain and process (4th ed.). *American Journal of Occupational Therapy, 74*(Suppl. 2).7412410010. https://doi.org/10.5014/ajot.202074S2001

Caffo, A.O., Hoogeveen, F., Groenendaal, M., Perilli, V.A., Damen, M., Stasolla, F., …Bosco, A. (2014a). Comparing two different orientation systems for promoting indoor travel in people with Alzheimer's disease. *Research in Developmental Disabilities, 35,* http://dx.doi.org/10.1016/j.ridd.2013.12.003

Caffo,A.O., Hoogeveen,F., Groenendaal, M., Perilli,A.V., Picucci, L., & Lancioni,G.E. (2014b). Intervention strategies for spatial orientation disorders in dementia: A selective review. *Developmental Neurorehabilitation, 17*(3). 200-209. DOI: 10.3109/17518423.2012.749951

Capsi, E. (2014). Wayfinding difficulties among elders with dementia in an assisted living residence. *Dementia, 13*(4). 429-450. DOI: 10.1177/1471301214535134

Dening, T. & Sandilyan, MB. (2015). Dementia: Definitions and types. *Nursing Standard, 29*(37). 37-42. DOI:10.7748/ns.29.37.37.e9405

Kwan, R.Y.C., Cheung, D.S.K., & Kor, P.P.K. (2020). The use of a smartphone for wayfinding by people with mild dementia. *Dementia, 19*(3). 721-735. DOI:10.1177/1471301218 785461

Grierson, L.E., Zelek, J., Lam, I, Black, S.E., & Carnahan, H. (2011). Application of a tactile way-finding device to facilitate navigation in persons with dementia. *Assistive Technology, 23.* 108–115. DOI: 10.1080/10400435. 2011.567375

Lancioni, G.E., Perilli, V., O'Reilly, M.F., Singh, N.N., Sigafoos, J., Bosco, A., …& Groenewg, J. (2013). Technology-based orientation programs to support indoor travel by persons with moderate alzheimer's disease: Impact assessment and social validation. *Research in Developmental Disabilities, 34,* 1895-1901. http://dx.doi.org/10.1016/j.ridd.2012.08.016

Lancioni, G.E., Nirbhay, N.N., O'Reilly, M.F., Sigafoos, J., Renna, C., Ventrella, M., …Groenewg, J. (2013). Supporting daily activities and indoor travel of persons with moderate Alzheimer's disease through standard technology resources. *Research in Developmental Disabilities, 34*, 2351-2359. http://dx.doi.org/10.1016/j.ridd.2013.04.020

Lancioni, G.E., Perilli, V., Singh, N.N, O'Reilly,M.F., Sigafoos, J., Bosco, A., …Minervini, M. (2011). Persons with mild or moderate Alzheimer's disease use a basic orientation technology to travel to different rooms within a day center. *Research in Developmental Disabilities*, *34*, 286- 293. Doi:10.1016/j.ridd.2011.03.020

Lanza, C, Knörzer, O., Weber, M., & Riepe, M.W. (2014). Autonomous spatial orientation in patients with mild to moderate Alzheimer's disease by using mobile assistive devices: A pilot study. *Journal of Alzheimer's Disease, 42*, 879-884. DOI: 10.3233/JAD-140063

Macik, M. (2018). Cognitive aspects of spatial orientation. *Acta Polytechnica Hungarica, 15*(5). 149-167.

Moher, D., Liberati, A., Tetzlaff, J., Altman, D.G., & The PRISMA Group. (2009). PRISMA 2009 flow diagram [webpage]. Retrieved from http://prisma-statement.org/ documents/PRISMA%202009%20flow%20diagram.doc

Rosalam, C.M., Faisul, A.A., Ruhaizin, S., Khairul, M.K., Hassan, A., & Indastri, S. (2020). Non-intrusive, visual-less wearable haptic stimuli navigational assistance for elderly with dementia. *Malaysian Journal of Public Health Medicine, 20*(Special Volume 1). 128-137. https://doi.org/10.37268/mjphm/vol.20/no.Special1/art.699

Sandilyan, M.B. & Dening, T. (2015). Diagnosis of dementia. *Nursing Standard, 29*(43). 36-4. DOI:10.7748/ns.29.43.36.e9441