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# Observable behavior and affective states of people with dementia during wayfinding:

# a pilot study in two nursing home corridors

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**Abstract**: While wayfinding skills are crucial in autonomously conducting daily activities, it is a decreasing skill for people with dementia. Understanding how people with dementia find their way around and how they emotionally respond during this activity, especially at decision moments, can provide insights into more suitable nursing home designs. Six nursing home residents with severe dementia of two care organizations were given a wayfinding task. The executed tasks were observed and analyzed on wayfinding behaviors and affective states. The majority of the observed behaviors at decision moments were pronouncing aloud destinations or directions and help by carers providing verbal navigational cues. People with dementia might need confirmation at decision moments about their routes to reduce raised confusion. Mostly, neutral facial expressions were observed, which might physiologically be varied from stressful events to relaxing moments. These findings would imply increased confusion at decision moments during active wayfinding.

**Keywords**: Decision moments; wayfinding task; mood & agitation; wayfinding behavior

## 1. Introduction

Wayfinding is an essential skill in autonomous living (Andersen, et al., 2004). People continuously find their way, sometimes consciously (e.g., in exploring a new city) but often unconsciously (e.g., in your daily route from home to work or to the coffee corner from your desk in the office). However, people with dementia lose their wayfinding skills. While wayfinding refers to the dynamic processes including several steps along the way to, in the end, reach your destination, spatial orientation is knowing your current position in space (Passini, 1984). Wayfinding skills of people with dementia deteriorate because of e.g., a decline in their spatial orientation capabilities due to their dementia process (Reisberg, et al., 1982). Due to their dementia, this leads to fading away the conscious and unconscious manner of wayfinding, and even navigating a regular route can become challenging.

Automatic routes, for example, moving from the living room to the bedroom in a nursing home, in the end becomes a significant challenge. In the Netherlands, people with advanced dementia often live in nursing homes because independent living became impossible at a later stage (Den Draak, et al., 2016). While people with dementia already experience difficulties in wayfinding in the early stages of dementia (Pai & Jacobs, 2004), adapting to new situations, for example, finding your way around in a new building design, becomes an ordeal (Lawton & Simon, 1968). The spatial and interior designs of nursing homes in the Netherlands vary,

from small-scale pavilions to large-scale buildings with endless corridors (van Liempd, et al., 2009). Nonetheless, each nursing home design has places in which decisions should be taken. These decision moments are locations in the building with a change in direction and where the user should decide left, right, or straight ahead, often shaped as a crossroad (Janzen, 2006; Veldkamp, et al., 2008). Making decisions becomes more difficult for people with dementia and some research argues that these spaces could be stressful for them (Marquardt, 2011).

Stressful situations could occur when you are unaware of where you are and are unable to discover a way to reach your destination. This could happen already to people with 'healthy' cognitive abilities. In stressful situations, people are aroused and anxious due to a situation which is unpreferred and unmanageable (Fink, 2016). People with dementia experience difficulty in spatially orienting themselves, creating a cognitive map of the space, and making decisions, which could result in stressful responses during wayfinding. Stressful responses – and affective responses in general – influence wayfinding processes; for example, the perception of space (Balaban, et al., 2017; Ruotolo, et al., 2019), attention (Balaban, et al., 2017), and making decisions (Delgrange, et al., 2020).

Wayfinding is considered by Passini (1984) as a spatial problem-solving process, including processing environmental information, development of plan, and executing the plan. Making decisions is an essential aspect of these iterative steps: in selecting relevant environmental information, developing a suitable route, and at a crossroad when executing the developed route. Related wayfinding behaviors are, for example, looking at while selecting relevant information, cognitive mapping (i.e., pronouncing aloud directions) while developing a plan, and stops on the route when executing the developed route (e.g., Rainville, et al., 2001; Mutsikawati, et al., 2021).

In the research of Van Buuren, et al. (under review), these wayfinding behavioral patterns were observed while people with dementia were just walking around in the nursing home; they were not actively asked to find a specific destination. Compared to the first type of behavior, active wayfinding behavior has a goal-oriented nature. During wayfinding, the wayfinder is actively searching for a specific destination, perhaps resulting in different behavioral patterns and affective responses.

### 1.1 The current study

While wayfinding is essential to maintain the quality of life of people with dementia (Andersen, et al., 2004), it is a decreasing skill (Reisberg, et al., 1982). Being unable to find your way and being lost, could cause feelings of stress (e.g., Delgrange, et al., 2020). It is important to realize that the nature of dementia entails that the cognitive skills that are key in finding your way, are affected already in an early stage of the condition. Unfortunately, there is no cure for Alzheimer's Disease yet and the condition is progressive and degenerative. However, we can change their living environment (nursing homes) which can contribute to their quality of life (Torrington, 2007). Architecture has the strength to support wayfinding skills for people with dementia. However, prior to changing the architecture of the living environment, it is crucial to understand the performed behaviors and affective states of people with severe dementia during wayfinding in these environments.

Building on the results of the study of Van Buuren, et al. (under review), we propose that highly visible crossroads contribute to wayfinding for cognitive 'healthy' people but may be confusing for people with dementia. The question arises of which wayfinding behavioral patterns can be identified at decision moments when conducting a wayfinding task. In combination with the hypothesis that affective states related to stress

can occur at decision moments (as mentioned by Marquardt (2011)), the research question in this exploratory paper is: Which observable wayfinding behavioral patterns and affective states of people with dementia can be identified at decision moments in nursing home corridors while conducting a wayfinding task? To the best of our knowledge, this information is lacking in current literature.

## 2. Methods

To study the behaviors and affective states of people with advanced dementia in nursing homes during wayfinding, an exploratory observational study with wayfinding task was conducted. With this wayfinding task (e.g., McGilton, et al., 2003; Rainville, et al., 2001), six nursing home residents with advanced dementia (n=6) from to different nursing homes were asked to actively reach a given destination.

### 2.1 Procedure

The researcher approached the resident at a random spot in the collective living room or in the hallway, without the bedroom in a direct line of sight, and engaged in a conversation. The researcher asked if the resident could show her individual bedroom. During the wayfinding task, the researcher walked along the resident, slightly behind, to observe the behaviors and affective state. The researcher knew the location of the resident's bedroom. When the resident arrived at his/her bedroom, the wayfinding task ended. If the resident was unsuccessful in arriving at the destination and walked along her bedroom, the wayfinding task ended.

### 2.2 Data collection

A direct observation technique was used to observe the behaviors and affective states of the resident during the wayfinding task. Additionally, the wayfinding task was recorded by video from the perspective of the resident, to explore their point of view.

The following predefined wayfinding behavioral patterns were noted: looking at, cognitive mapping (i.e., pronouncing aloud direction), pronouncing aloud destination, travelled route, stops on the route, arrival at destination (e.g., Rainville, et al., 2001; Mutsikawati, et al., 2021).

Furthermore, two indicators of affective states were identified via observation: emotion and agitation levels. For both indicators, validated scales for people with dementia were used (Appendix). The OERS – Observed Emotion Rating Scale – uses six categories to identify emotion: pleasure, anger, anxiety/fear, sadness, interest, and contentment (Lawton, et al., 1996). The MEDLO – Maastricht Electronic Daily Life Observation Tool – scores agitation on a 5-point Likert scale, with zero as no agitation and four as extremely agitated (de Boer, et al., 2016). The researcher filled in the observational scales based on facial expressions, body gestures, tone of voice, and what participants said. The scales were reviewed by a peer during the study.

### 2.3 Data analysis

The notes and video footage of the wayfinding task were transcribed into a text file and in a graphic novel including the location on the map, visual image of the scene, wayfinding behavior, affective state, and quote of the resident. The behavioral mapping technique was used to annotate the behavioral patterns and affective states on the floorplan.

2.4 Context

The study was conducted in two psychogeriatric nursing homes of two different care organizations in the Netherlands (i.e., case study 1 and case study 2). Both nursing homes follow the same housing and care concept: a group of people with severe dementia lives together in a (closed) ward, with a shared living room with a kitchen and individual bedrooms. The floorplans of the wards of the nursing homes are displayed in Figure 1, indicating also the decision moments.

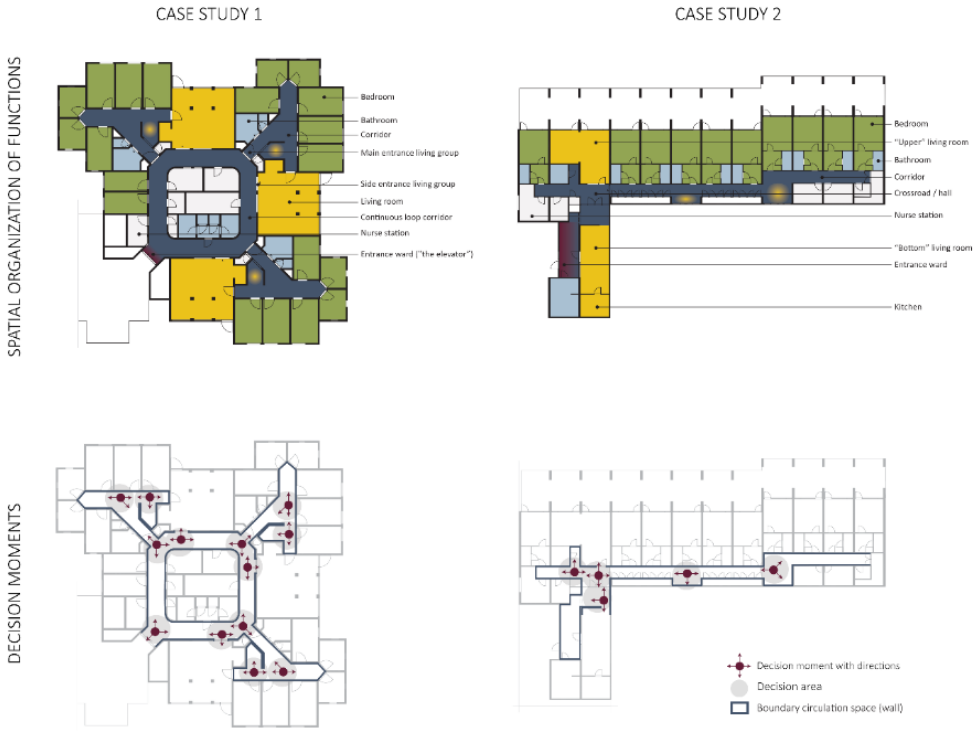



Figure 1. Floorplans of both case studies, including spatial analysis of spatial organization of functions and locations of decision areas

2.5 Sample

Six residents with severe dementia (i.e., Alzheimer's Disease and one resident with frontotemporal dementia (P1C)) (n=6) conducted the wayfinding task, three residents per nursing home. P1B (case study 1, resident B) performed the wayfinding task twice from different departure points, as control situation; resulting into seven performed wayfinding tasks. P1A used a walker during the search, P1B a walking stick, and P1C, P2A, P2B, and P2C did not use any walking aids during the task.

Informed consent for participation was given by the informal caregivers in consultation with the involved care organization. The set-up of the study was approved beforehand by the ethical review board of the Eindhoven University of Technology. On the spot, special attention was given to the consent of the residents: if the resident did not wat to conduct the task, he/she did not have to. However, all six residents agreed to conduct the task.

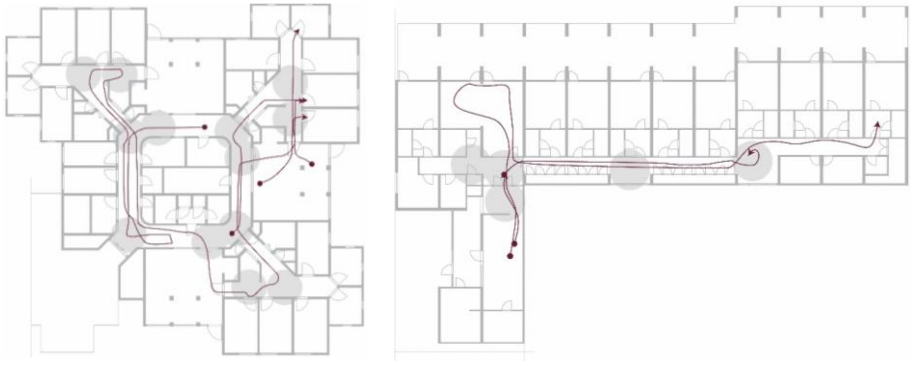
This study is part of a larger study in which daily (wayfinding behavioral) patterns (van Buuren, et al., under review) and the lived experience (Hammink, et al., under review) were measured in corridors and living rooms. However, the current study focuses on active wayfinding in the two nursing home wards.

# 3. Results

## 3.1 Performed wayfinding tasks

Seven routes were taken by the six residents. Figure 2 shows the travelled routes of the participants during the wayfinding task. In case study 1, all participants succeeded in completing the task, resulting in all participants arriving at the given destination and recognized this destination. All routes contained one or multiple decision moments. P1A walked to the 'right' position of the individual room but in the wrong living group corridor. This happened twice. However, with some help from care professionals at the 'wrong' positions, P1A succeeded in arriving at the destination.

Only one wayfinding task in case study 2 was successfully completed, though with a detour due to distraction (P2B). It seemed that P2A did not understand the task correctly, and P2C did not recognize her individual room. Both the routes of P2A and P2C stagnated at decision moments.



Case study 1 (n=4 routes) Case study 2 (n=3 routes)

Legend: Circle = origin / starting point | arrow = ending point / destination; grey dot = decision area

Figure 2. Routes of wayfinding task

## 3.2 Wayfinding behavioral patterns

Figure 3 shows the wayfinding behavioral patterns annotated on the floorplans of the case studies. In both case studies, the wayfinding behavior looking at occurred often; participants looked at signs in the corridor. They pointed towards them or read them aloud during their search. In addition, care professionals provided guidance via verbal navigational cues in both case studies, especially to P1A and P2C.

In case study 1, wayfinding behavioral patterns were identified for the whole course of the routes taken; both on decision moments and other areas in the corridor. P1A showed the same behaviors at possible decision locations sequentially: (1) looking at, (2) pronouncing aloud a new destination or direction, and (3) moving accordingly (i.e., traveled route).

In case study 2, the wayfinding behavioral patterns seemed more clustered in the central hallway, near the window in the long corridor, and at the crossing near the experience spot in the corridor. These are decision moments in the floorplan.

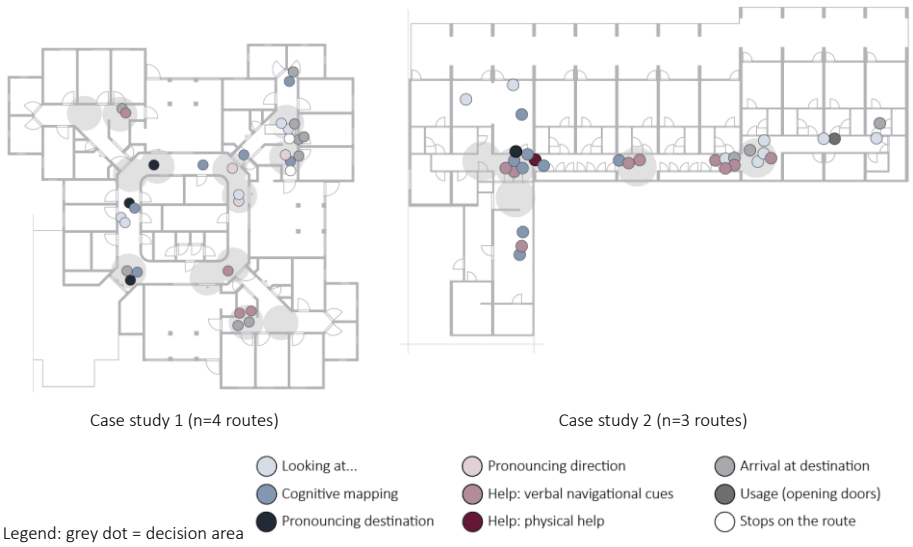



Figure 3. Wayfinding behavioral patterns observed during the performance-based orientation tasks plotted on the floorplans

### 3.3 Affective states

Emotion. In case study 1, almost all observed emotions of the participants over the entire route were positive (i.e., pleasure or interest) or contentment. In the search of P1A, a moment of anger and fear occurred when P1A failed to identify her own room for the second time (see Figure 4). Anger and fear/anxiety were observed by tone of voice's raise and looking back and forth.

In case study 2, participants showed a variety of emotions: pleasure, interest, contentment, and sadness. The sadness measurements belonged to participants P2A and P2C. Based on unstructured observations during the day of the measurements, they were in a sad mood the whole day.


Figure 4. Observed moods at locations of wayfinding behavioral patterns annotated on the floor plans

Agitation. In both case studies, almost no agitation was observed during the performance-based orientation tasks (see Figure 5). Except for one moment of P1A, when she failed in arriving at her room for the second time.


Figure 5. Observed agitation levels at locations of wayfinding behavioral patterns annotated on the floor plans

## 4. Discussion

Although wayfinding skills are decreasing for people with dementia, wayfinding is still essential to autonomously conduct daily activities to maintain their quality of life. Understanding how people find their way and how they emotionally respond during this activity, especially at decision moments, can ultimately provide insights to create a more suitable design for nursing homes. Therefore, this study aimed to identify which observable wayfinding behavioral patterns and affective states people with dementia exhibit at decision moments while wayfinding. Seven routes were undertaken by six nursing home residents in two case studies. In case study 1, all routes taken succeeded in arriving at the destination, while in case study 2, only one route was successful.

### 4.1 Wayfinding behavioral patterns at decision moments

In case study 2, the wayfinding behavioral patterns were more clustered surrounding the decision moments, while in case study 1, these behaviors were more scattered throughout the entire route. Most of the observed behaviors at decision moments were signals concerning cognitive mapping (i.e., pronouncing aloud destinations and directions), help by carers providing verbal navigational cues, and in case study 2, looking at (although prompted by a care professional). This might indicate that participants needed a spoken directional cue before deciding their next direction, either from themselves of by a care professional. These decision moments required some extra thinking from the residents. Possibly, it might suggest that the architecture of these spaces lack sufficient guidance to proceed the wayfinding task.

Knowledge about the overall architecture of the layout of the nursing home ward, is often captured in cognitive maps. Cognitive mapping is a decreasing skill for people with dementia in general (Passini, et al., 1998). However, although we cannot literally measure if the residents have drawn a cognitive map of the route in their minds, we can identify some indicators, such as pronouncing directions and destinations out loud. This was observed in the study (e.g., ‘second door on the left’). This might indicate that some participants still try to develop a cognitive map, helping them to find their way around.

4.2 Affective states at decision moments

At decision moments, in almost all observations, signals of contentment mood without agitation were often observed in both case studies. Sometimes a sad emotion was observed, but this was also the baseline emotion of that particular resident. Only P1A showed some signs of anger, anxiety, and agitation. The question arises if these signs were built up during the route because she had some wrong 'arrivals'. However, the signs were relatively shortly observed, because after directions of a care professional, P1A showed signs of positive mood.

Based on this explorative study, we cannot describe the decision moments as stressful based on facial expressions and body language, as expected by Marquardt (2011). However, literature mentions innovative possibilities to measure affective states with wearable sensors (Bourne, et al., 2019; Kreiberg, et al., 2010). In the study of Hammink, et al. (under review), they observed that what happens inside – physiologically – while a contentment mood was observed varied from stressful events to relaxed moments. Therefore, we recommend to measure the affective states of people with dementia at decision moments both via observations and biometric sensors.

4.3 Limitations and recommendations for future research

The study encountered a couple of limitations. First is the limited sample size of six residents. It is always challenging to conduct empirical research with people with advanced stages of dementia due to ethical and practical reasons. The current study was an exploratory research to discover behaviors and affective states at decision moments. We recommend conducting research to a greater extent to gather more empirical data to develop a solid source of information about the behaviors and affective states of people with advanced stages of dementia during wayfinding. To ultimately provide knowledge on the designs of suitable living arrangements.

Second, although in our study familiar routes were evaluated, 'unfamiliar' routes in their living environment could be examined as well. While regular, familiar routes can become challenging due to dementia, this study showed that the majority of the wayfinding tasks were successfully completed. The routes from the living room to the individual bedroom are taken daily by the residents, sometime multiple times a day. However, more 'unfamiliar' routes, for example, from the collective living room to the restaurant of the nursing home, might require more cognitive capacities of the people with severe dementia, and could result into additional or other wayfinding behavioral patterns and affective states.

Lastly, a deep analysis of the architecture of the decision moments lacks in this paper. This lack was intentionally, since this paper focuses on the behaviors of the residents. However, architecture can influence people's behavior as well as affective states (Karol & Smith, 2019). Based on the literature, people with dementia can still develop a route if proper environmental information is provided (Passini, et al., 1995), but they can experience difficulties in selecting relevant information during the search due to dementia (e.g., Davis & Sikorskii, 2010; Kuliga, et al., 2021). Understanding these kind of mechanisms could provide valuable information about how to design suitable living spaces for this target group.

## 5. Conclusion

The observed wayfinding behavioral patterns and affective states at decision moments highlight that that confusion seems to increase for people with severe dementia at these decision moments during active wayfinding, just like during movement behavior in corridors (i.e., passive wayfinding) in the study of Van

Buuren, et al. (under review). This explorative study showed that people with advanced dementia in nursing homes might need some confirmation about their routes at decision moments, either from themselves (i.e., pronouncing the direction aloud) or from carers (i.e., by verbal navigational cues). Decision moments on routes in nursing home designs can be confusing; also the more distraction displayed at these place, the more confusion could arise. It is at these places, that we saw many different objects in the case studies. Future studies should delve into the architecture of these decision moments and related behaviors and affective states to design sufficient nursing homes.

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## Appendix | Observational scales affective state

Observed Emotion Rating Scale (OERS) (Lawton, et al., 1996)

| Category | Signs |
|---|---|
| Pleasure | Smile, laugh, stroking, touching with "approach" manner, nodding, singing, arm or hand outreach, open-arm gesture, eye crinkled |
| Anger | Clench teeth, grimace, shout, curse, berate, push, physical aggression or implied aggression, like fist shaking, pursed lips, eyes narrowed, knit brows/lowered |
| Anxiety/fear | Furrowed brow, motoric restlessness, repeated or agitated motions, facial expression of fear or worry, sigh, withdraw from other, tremor, tight facial muscles, calls repetitively, hand wringing, leg jiggling, eyes wide |
| Sadness | Cry, tears, moan, mouth turned down at corners, eyes/head down turned and face expressionless, wiping eyes, horse-shoe on forehead |
| Interest | Eyes follow object, intent fixation on object or person, visual scanning, facial, motoric or verbal feedback to other, eye contact maintained, body or vocal response to music, wide angle subtended by gaze, turn body or move toward person or object |
| Contentment | Comfortable posture, sitting or lying down, smooth facial muscles, lack of tension in limbs, neck, slow movements |

Maastricht Electronic Daily Life Observation Tool (MEDLO) (de Boer, et al., 2016).

| | Deviating verbal expressions | Motoric agitation | Aggressiveness | Resistance to care (professional) |
|---|---|---|---|---|
| 0 | Not present | Not present | Not present | Not present |
| 1 | Low volume, not disruptive in milieu, including crying | Pacing or moving about in chair at normal rate (appears to be seeking comfort, looking for spouse, purposeless movements) | Verbal threats | Procrastination or avoidance |
| 2 | Louder than conversational, mildly disruptive, redirectable | Increased rate of movements, mildly intrusive, easily redirectable | Threatening gestures; no attempt to strike | Verbal/ gesture of refusal |
| 3 | Loud, disruptive, difficult to redirect | Rapid movements, moderately intrusive or disruptive, difficult to redirect | Physical toward property | Pushing away to avoid task |
| 4 | Extremely loud screaming or yelling, highly disruptive, unable to redirect | Intense movements, extremely intrusive or disruptive, not redirectable verbally | Physical toward self or others | Striking out at caregiver |