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Creating a Supportive Environment using Cues for Wayfinding in Dementia

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Abstract

The ability to find one's way in the world, known as wayfinding, is impaired in persons with Alzheimer's disease. Senior residential environments such as independent living, assisted living, and nursing home residences are often especially difficult for wayfinding, with long, non-distinctive hallways and poorly differentiated routes. Wayfinding problems can cause anxiety, distress, and decreased interaction in persons with dementia. Visual cues are one promising intervention to help persons with Alzheimer's disease find their way more easily. This article reviews research studies that examine the influence of visual cues on wayfinding. The literature shows evidence that persons with Alzheimer's disease have difficulty wayfinding, yet can still learn their way if the environment is supportive for wayfinding. There is beginning evidence that colorful, familiar (easily identified), and personally meaningful cues placed at key decision points and the residents' rooms can help persons with Alzheimer's find their way.

Alzheimer's disease (AD) is the most common cause of dementia, affecting over five million people in the United States. The disease progresses over time from the preclinical stage, where people exhibit few symptoms or only mild cognitive impairment, eventually to a stage of severe cognitive decline, where people exhibit profound cognitive and functional disability. The disease has no cure (Alzheimer's Association, n.d.). A common problem in AD is that individuals often cannot find their way from one place to another, an ability known as wayfinding (Marquardt, 2011). Wayfinding problems are among the earliest symptoms of AD, affecting over half of individuals even in the even in the mild stage of the disease (Chiu et al., 2004; deIpolyi, Rankin, Mucke, Miller, & Gorno-Tempini, 2007). Wayfinding is a functional ability that is important for quality of life; without this ability people are continually lost or must rely on others to assist them in navigation from one place to another (Passini, Pigot, Rainville, & Tetteault, 2000).

Most people can remember a time in their childhood when they became separated from a parent while away from home; likely, they were immediately fearful and began looking through the sea of legs to find their missing parent. That feeling of panic - of strangeness and disorientation - is what occurs in Alzheimer's disease (AD) for those who have problems

wayfinding. As the disease progresses, getting lost can become a profound problem for persons with AD and their caregivers, even leading to institutionalization or death if individuals get lost in the community (Rowe, 2003). In a qualitative study of persons with moderate stage dementia in an assisted living residence, Caspi (2014) describes the wayfinding problems experienced. She found that the residents had problems locating “their own apartments, public or private bathrooms, main activity room, dining rooms, and dining room table and seat” (p. 442). Thus, people living in these residences had difficulty meeting their most basic needs of sleep, food, socialization and toileting. Without intervention, wayfinding problems can lead a person to have a severe decrease in independence and function, along with a loss of dignity and health.

The built environment is often fraught with challenges for wayfinding, due to complexity in design, poor visibility into the distance, and a lack of distinctiveness (Marquardt, 2011). Environments such as senior residential buildings (independent living residences, assisted living residences, and skilled nursing facilities) are particularly challenging for wayfinding due to the design of long double-loaded corridors with equally spaced doors, a lack of distinctiveness of different areas of the buildings, and poor environmental cues (Passini et al., 2000). Although over 60% of persons with dementia live in the community, over 70% of the persons residing in assisted living (Zimmerman, Sloane, & Reed, 2014) and over 60% of skilled nursing residents have been diagnosed with dementia (Alzheimer’s Association, 2014). Yet, these environments are often not supportive for wayfinding. Interventions to help individuals find their way in complex environments are important for their safety and autonomy.

One promising intervention to make an environment more supportive for wayfinding is to enhance it with salient cues, especially since many environments that seniors inhabit lack salient environmental information. Salient cues are those that grab the user’s attention and stand out from the surround (Caduff & Timpf, 2008), such as a large brightly illuminated statue or three dimensional wall hanging of a bright red cardinal. The rationale for using salient cues is that they address the problem of wayfinding both visually and cognitively. Visually, salient cues can stand out from the surround, attract the wayfarer’s attention, and are more likely to be seen by the aging eye. Salient cues can enhance memory by providing environmental support for encoding and retrieval so that there is less demand on processing resources (Craik & Jennings, 1992). Thus, providing salient environmental cues may provide a way for the environment to be noticed, encoded as a memory, and again retrieved when needed for wayfinding. However, there is relatively little known about the properties of cues or landmarks that make them helpful for wayfinding in older adults with and without dementia who live in residential facilities. The purpose of this paper is to review and synthesize the research evidence about the qualities of cues that impact wayfinding in built environments for older adults with and without dementia.

Background

Theoretical Approach to Supportive Environments

A conceptual model that helps to explain the relationship between the environment and function is Lawton and Nahemow’s (1973) environmental competence/press model. Lawton

defines competence as the abilities of the individual; and environmental press as the demands of the environment. When environmental press is too high or too low, behavior can become maladaptive. With less competence, individuals are more dependent upon the environment to be supportive in order to help them attain or maintain their highest level of function (Lawton, 1977). Using this theory, it can be proposed that in AD, persons have decreased wayfinding competence; and many built environments have very high environmental press, which can cause maladaptation. If environments can be made more supportive of wayfinding then persons have the ability to achieve higher wayfinding function, which can result in more independence, less anxiety, and a sense of environmental knowing. Thus, it is important to find scientifically supported ways in which to make the environment more supportive for persons with wayfinding disabilities due to dementia and aging.

How People Find their Way

In order to determine appropriate interventions to help with wayfinding, it is important to understand how people find their way, and how wayfinding ability changes due to dementia. In the most basic sense, in order to successfully find their way people must be able to perceive information about their environment using their sensory abilities. Then, they must be able to process the information they see, and even update this information as they navigate (as the view of the environment changes). They must be able to encode a memory of the environment to use upon future interactions, and then bring forth this learned memory upon returning so that they can find their way (Foo, Warren, Duchon, & Tarr, 2005; O'Keefe & Nadel, 1978).

In aging and with dementia, there are many changes that occur to the sensory and cognitive systems that affect wayfinding. For example, in aging there are visual changes such as decreased contrast sensitivity, visual processing speed (Owsley, 2011) and acuity, along with an increased incidence of eye diseases such as cataracts and glaucoma (Klein & Klein, 2013). With dementia, these same aging related visual changes can be worse; in addition individuals may have additional changes such as visual hallucinations and changes in color processing (Armstrong & Kergoat, 2015). Thus, how the person with dementia perceives the environment may be impaired and part of the reason for disorientation.

The cognitive functions necessary to find one's way in an environment are also impacted by aging and dementia. The ability to create an enduring memory of an environment, known as a cognitive map, has been shown to decline with aging and further with diseases such as Alzheimer's disease (Serino, Cipresso, Morganti, & Riva, 2014). The encoding of cognitive maps is highly dependent upon the hippocampus, which is in the medial temporal lobe of the brain. Changes within the hippocampal formation and related structures occur with age and with Alzheimer's disease (deIpolyi et al., 2007; Moffat, Elkins, & Resnick, 2006). These changes are thought to account for some of the wayfinding problems that people with AD experience, especially a decline in the ability to encode cognitive maps. Even older adults without AD have been shown to have impaired wayfinding ability and use different strategies for wayfinding (Davis & Weisbeck, 2015) when compared to younger adults due

to these structural and cognitive changes associated with aging (Davis, Therrien & West, 2008; Moffat, 2009).

There are other cognitive problems that persons with AD experience in relationship to wayfinding. Individuals with AD show deficits in recall of learned landmarks (Monacelli et al., 2003) and especially in recalling the order of landmarks seen on a route (deIpolyi et al., 2007) which may make learning and navigating a route difficult. Yet, persons with AD have been shown to have an increased dependence on visual elements, and an inability to disengage from visual elements that are distracting (Chiu et al., 2004; Tales, Snowden, Haworth, & Wilcock, 2005). This means that at times, people with AD may pick irrelevant cues for wayfinding. Thus, the cognitive changes that occur with normal aging and in diseases such as AD make all aspects of wayfinding challenging. More information about the types of cues or landmark that help persons with AD find their way is needed.

Literature Review

A literature search with the goal of determining the qualities of environmental cues or landmarks that impact wayfinding for older adults with and without dementia was conducted using the databases of Proquest Medical, PubMed and CINAHL, between the dates of January 1, 2000 – December 31, 2015. Combinations of the following search terms were included: dementia, Alzheimer's disease, aging, wayfinding, cues and/or landmarks. Studies were evaluated for the following inclusion criteria: research articles, written in English, and about the subject matter of persons with dementia, or aging; cues or landmarks; and wayfinding. Exclusion criteria included articles not in English, non-human studies, literature reviews, studies about other types of cues (auditory or textural), studies primarily about signage; and studies about floor plans or other types of architectural design. There were 236 articles initially retrieved from the literature search; of those, five met the inclusion criteria. An additional three articles were found by looking at the references of the chosen articles. The articles are summarized in the Table.

Properties of Cues that make them Helpful for Wayfinding

In many cases, built senior environments have bland interiors with muted and tasteful décor (Passini et al., 2000). There is little evidence for the types of cues that are memorable for wayfinding. However, there have been several studies done in long term care environments which have examined the qualities of visual cues for wayfinding. For example, Gibson, MacLean, Borrie, and Geiger (2004) examined the impact of a re-designed secured dementia care unit on wayfinding ability in 29 persons with dementia. Subjects were oriented to their new rooms over a period of eight weeks, and the cues (color, texture, location, and structure (i.e. room number, name plate, lights) were verbally described to the subject by the researchers. After eight weeks, they were asked to find their own rooms, and were interviewed about how they found their way. The majority of subjects (84%) were able to find their way at the conclusion of the study. The most frequently reported helpful features were door color and structural features. The least reported helpful features were location (i.e. end of hall) and texture.

In another study, Nolan, Matthews, and Harrison (2001) examined the ability of three persons with dementia to find their rooms after placing a portrait of the resident and a name sign on their doors. All of the subjects had been impaired in wayfinding. They found that over time, the residents improved their room recognition by over 50%. Similarly, Nolan, Mathews, Truesdell-Todd and VanDorp (2002) examined the effect of memory boxes in six persons with dementia (who also had wayfinding problems) who resided in a residential facility. The memory boxes contained pictures and other personally meaningful memorabilia. They found that after instituting the memory boxes, there was a 45% improvement in room location by the residents, thus supporting the impact of familiar and meaningful cues as being effective for identifying one's room.

Other studies have used virtual reality tests to determine the properties of cues that are helpful for wayfinding. For example, Davis, Therrien & West (2008) examined the effects of the salience and complexity environmental cues on a place learning task in 20 older and 6 younger women. Place learning is the ability to create a memory (i.e. cognitive map) of an environment using cues, which can be retrieved and used for wayfinding. Subjects were tested in a virtual reality environment called the Computer Generated Arena (CGA) (University of Arizona, n.d.) over multiple trials in which they had to find a hidden target in four virtual environments which varied with respect to the types of cues present. The environments were: 1) simple salient, which had four pictures of black and white objects as cues; 2) complex salient, which had colorful and textured cues, such as a cobblestone wall, and colorful pictures; 3) nonsalient, which had two black and white abstract pictures, and 4) a control condition, which was similar to the simple salient condition except the cues changed locations among trials. Results of the study showed effects of age and cue condition, with the younger subjects faster and more accurate at finding their way. In addition, all subjects found the hidden target the best in the complex salient cue condition. The older adults had a much worse learning curve in the non-salient cue condition when compared to the younger adults. This study supported the proposition that older women may be more reliant on colorful and more numerous cues than younger women.

In a similarly designed study, Davis and Therrien (2012) examined the effects of color and familiarity of cues on place learning in 133 community dwelling adults aged 55 – 96 years without dementia. Subjects were asked to find a hidden target in four computerized environments using the CG Arena. The environments had different qualities of cues, including 1) colorful and familiar (easily named) cues such as a kite and flowers 2) colorful and abstract cues such as abstract paintings; 3) black and white familiar cues, such as line drawings of a black and white kite and star; and 4) black and white abstract cues, such as abstract paintings. The only way to find the target was to remember its location with respect to the cues. Subjects were tested repeatedly in each of the cue conditions over three days. Results showed that the subjects performed significantly better in the environment with colorful and familiar cues when compared to the other environments. The older subjects were slower than the younger but learned over time. In addition, they found a relationship between higher cognitive scores using the mini mental status examination (MMSE) and better wayfinding overall. The results of this study support the proposition that cues that are distinctive, bright, life-like color (i.e. bright flowers), large, and familiar (easy to identify

and name) are helpful for place learning. In contrast, environments that lack distinctiveness are especially difficult for older adults to find their way.

In order to apply the findings from the above study to persons with dementia, Davis, Ohman and Weisbeck (2016) used a virtual reality (VR) simulation of a continuing care retirement community (CCRC) in order to test the use of salient cues at key decision points. The VR environment, called the Virtual Senior Living Residence, was projected onto a 12 foot screen. Subjects had to find their way to a specified location by moving about using a joystick in two environments. The standard condition had no purposeful cues other than standard architectural features; and the salient cue condition had the addition of bright, colorful, big, and memorable cues such as balloons, rainbows, flags, and animals at key decision points and at end points in hallways. The results of the study showed that although the subjects with AD were significantly impaired in wayfinding when compared to the control group, both subjects with and without AD found their way faster and more frequently when salient cues were present. These results support the proposition that colorful and familiar cues are very helpful for older adults with and without AD in wayfinding tasks, improving the accuracy of wayfinding and learning of new environments over time.

Location of Cues

Another cue property that is important to consider is the location of the cues. There have been relatively few studies on this topic other than those reported above, showing that cues placed at the residents' room (Gibson et al., 2004; Nolan et al, 2001) and at key decision points and at end points in hallways (Davis et al., 2016) are important for wayfinding. There were two additional studies that looked at memory for cues based on the location of the cues. Kessels, van Doormaal and Janzen (2011) examined memory for landmarks, which were toys and non-toys, placed at key areas of a video projected route in 20 persons with AD and 21 control subjects without AD. They found that subjects with AD were less able when compared to the control group to recall of the cues, but that they recalled the objects at the decision points significantly more often than the cues which were irrelevant for navigation. Similarly, Cherrier, Mendez & Perryman (2001) conducted a study in 16 persons with AD and 19 control subjects, in which subjects had to learn an outdoor route while walking. Results showed that the AD subjects did not learn the route as accurately as the control group. However, the AD subjects were able to recall the landmarks at decision areas with more accuracy than the spatial layout or the non-relevant objects in the environment. Thus, there is beginning evidence from video and real world studies that cues placed at key decision points may be especially memorable for persons with AD, and they may be particularly vulnerable to not encoding contextual cues or spatial layouts as well as those without the disease.

Summary of the Evidence

There is clear evidence that persons with dementia are at high risk of getting lost in large, complex, non-salient environments. There is strong evidence (see background) that even in normal aging, wayfinding ability declines (Davis & Therrien, 2012; Moffat, 2009; Rodgers, Sindone III, & Moffat, 2012), and that persons with Alzheimer's disease are at a very high

risk for wayfinding problems even in the beginning stages of the disease (Caspi, 2014; Marquardt, 2011). Based on this literature review, there is evidence to support the following recommendations for practice:

1. **Persons with dementia are impaired at wayfinding but can still learn.** Although people with dementia may be slower and less accurate in their wayfinding, in all of the studies reviewed, older adults with and without AD show the ability to learn new environments. They may need longer to learn environments and require more environmental support in order to learn and remember their way. However, it should be understood that having AD does not mean that an individual lacks the ability to learn; it means that the individual is more dependent upon a supportive environment for wayfinding success.
2. **Built environments need to be assessed for distinctiveness.** Those that lack salient information (i.e. those that have long hallways, similar views down hallways, poor differentiation, as in Figure 1) may be more difficult for older adults and those with dementia to find their way (Davis & Therrien 2012, Davis et al., 2016; Gibson et al, 2004).
3. **Color and familiarity are important factors to consider in providing environmental support.** Although the evidence is limited, there are several studies that have shown that color is a strong cue property for the identification and memory of environments (Davis & Therrien, 2012, Davis et al., 2016; Gibson et al. 2004). In addition, familiarity, in terms of meaning to the individual (Nolan et al, 2001) and the ability to easily identify the cue (Davis & Therrien 2012; Davis et al., 2016) have been shown to help persons in wayfinding.
4. **Salient visual cues need to be placed at key decision areas (i.e. hallway intersections, personal areas such as bedrooms, and end of hallways) in order to enhance wayfinding.** As reported earlier, there is beginning evidence that salient environmental cues positively affect wayfinding for older adults. All of the studies reviewed showed that salient visual cues placed either at the bedroom (Gibson, 2004; Nolan et al., 2001) or at key decision areas (Cherrier et al, 2001; Davis et al., 2016; Kessels et al., 2011) facilitate wayfinding. Figure 2 shows a comparison of a standard environment (lacking cues) and one that has been enhanced with salient visual cues.

Future Studies

Although there is some evidence for ways in which to make environments supportive for wayfinding, there is much that is not known. For example, few studies have examined the qualities of cues that make them helpful in later stages of dementia, especially for wayfinding outside of identifying one's room. It is possible that the cues may need to be more meaningful to the wayfinding task as the disease progresses. For example, hallways in which the dining area is located may need to have food cues. Another area of research is in using multi-modal cues, such as auditory, olfactory, and tactile cues to support wayfinding (i.e., Grierson, Zelek, Lam, Black, & Carnahan, 2011). There are some beginning studies showing that other types of cues may be beneficial, especially as the disease progresses.

Looking towards the future, it is highly likely that supportive environments will include highly technical ways in which to support persons with dementia in many of their activities. For example, there is evidence from one study that auditory only global positioning satellites help persons with dementia find their way in outdoor environments while driving (Yi, Lee, Parsons & Falkmer, 2015). It is possible that similar technology could be used in complex indoor environments. Innovative ways in which to help people be autonomous yet safe are needed.

Finally, in the ideal world, senior residential environments (and other complex environments such as hospitals) would be designed from the start with good wayfinding infrastructure. Designers, architects, care providers, and scientists need to work together to test interventions that will provide the best possible supportive environment for persons with dementia. Only by working together and systematically testing interventions will true improvements be made and sustained (Marquardt, 2011).

Conclusion

O'Keefe and Nadel (1978) stated that: "Space plays a role in all of our behavior. We live in it, move through it, explore it, defend it. We find it easy enough to point to bits of it: the room, the mantle of the heavens, the gap between two fingers, the place left behind when the piano finally gets moved. Yet, beyond this ostensive identification, we find it extraordinarily difficult to come to grips with space" (p.5). Our ability to learn, remember and navigate spatial environments is an important function related to every aspect of our lives. Yet, in diseases such as Alzheimer's disease, the ability to navigate through and successfully find one's way from one place to another is often impaired (Caspi, 2014). In this review, the literature reviewing the use of visual cues to help persons find their way in build environments is discussed. There is beginning but consistent evidence that it is possible to make environments more memorable – and thus to be more supportive of wayfinding - by using bold, colorful, familiar, meaningful, and distinctive cues.

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**Figure 1.****The Problem of Complex Environments**

Note: These are pictures of hallways from two different senior residences. Note the long hallways and lack of information about what is in the hallway. There are few cues to assist with wayfinding. People who have memory and/or mobility problems can find navigating through environments like this very difficult.



Figure 2.
Non-Salient versus Salient Environments

Note: These two virtual environments show the difference between a standard environment without cues, and one with colorful and familiar salient cues added at key decision points. The flag and rainbow are bright, colorful and memorable and help persons to remember their way.

Table
 Summary of research articles found related to cues and wayfinding from 2000–2015

Citation	Purpose	Sample	Method and Measures	Findings	Conclusion
Cherrier et al., 2001	To examine route learning ability in persons with AD	19 healthy older adults and 16 persons with AD	<ul style="list-style-type: none"> Cognitive/Neuropsychological measures Route Learning Task Tested incidental learning, landmark recognition, spatial relations, and recall of the route 	<ul style="list-style-type: none"> AD group performed worse than controls on route learning task. AD group had poor memory for contextual details of the route or spatial layout. AD group performed the best overall remembering the landmarks relevant for navigation. 	<ul style="list-style-type: none"> Persons with AD have impaired route learning ability. Recall of spatial information such as layout or contextual details is impaired with AD, but some ability to recall landmarks relevant for navigation is maintained (although impaired relevant to controls).
Davis et al., 2008	To examine how the saliency of cues affects place learning in older versus younger women	20 older and 6 younger women	<ul style="list-style-type: none"> Cognitive measures Used a virtual reality program called the CG Arena in which subjects had to learn and remember the location of a hidden target with respect to the cues. They were tested over 6 trials in each of 4 conditions which varied with respect to the types of cues present. Measures included time to find the target and heading direction error. 	<ul style="list-style-type: none"> There was a main effect of age in that the younger women found their way faster and with less heading direction error overall than the older women. The best learning occurred when cues were colorful and more numerous. The older women did not show evidence of place learning when cues were abstract, few in number and not colorful (nonsalient condition); but the younger women did. 	<ul style="list-style-type: none"> Place learning ability declines with age. Older women may be more reliant on colorful and more numerous cues than younger women.
Davis & Therrien, 2012	To examine the effects of color and familiarity of cues on place learning	133 community dwelling adults aged 55–96 in 3 groups: 55–64; 65–74; and >75	<ul style="list-style-type: none"> Cognitive measures Used the CG Arena to test place learning in 4 conditions – colorful and familiar; colorful and abstract; black and white and familiar; black and white and abstract. Subjects had to find a hidden target. Outcome was time to find the hidden target. 	<ul style="list-style-type: none"> The oldest age group performed significantly worse in time to find the target than the youngest. All subjects showed learning over time. Subjects showed the best place learning when cues were colorful and familiar. Higher cognitive scores were related to better place learning performance. 	<ul style="list-style-type: none"> With age and cognitive decline, people become slower and less accurate in place learning but the ability remains. Colorful and familiar (easily identified) cues are effective at helping people in place learning tasks.

Citation	Purpose	Sample	Method and Measures	Findings	Conclusion
Davis, Ohman & Weisbeck, 2016	To determine the effect of salient cues on wayfinding in older adults with and without AD	50 persons aged 62 and older without cognitive decline; and 38 persons aged 62 and older with mild cognitive impairment (MCI) due to AD or early stage AD	<ul style="list-style-type: none"> Cognitive and sensory measures Virtual Senior living; a large scale simulation of a senior residential environment. Subjects had to find their way to a destination repeatedly over 5 trials in 2 conditions – standard, with no additional cues, and salient, with cues placed at key decision points and hallway end points. 	<ul style="list-style-type: none"> Subjects with MCI/AD had decreased ability to find their way compared to the control group, but showed learning over time. Both groups found their way significantly more often when salient cues were present. 	<ul style="list-style-type: none"> Persons with MCI/AD are impaired at wayfinding when compared to those without MCI/AD. Colorful, bold, bright, cues placed at key decision points and hallway end points can enhance wayfinding in older adults with and without MCI/AD.
Gibson et al., 2004	To examine wayfinding ability in persons after move to a redesigned dementia unit; and to determine the relationships among orientation and other variables.	19 males with dementia who lived in the facility	<ul style="list-style-type: none"> Cognitive measures Residents were oriented to the new facility using a protocol for 8 weeks by the staff. Afterwards, they were asked to find their room. Persons were interviewed about how they found their way. 	<ul style="list-style-type: none"> 84% of the residents could find their way after 8 weeks. Indicated most helpful features for wayfinding included color and structure (room number, name plate, lights). Least helpful features were location and texture. 	<ul style="list-style-type: none"> Color and structure are important for wayfinding. Persons with dementia can learn their room location over time. Instruction and practice for wayfinding may improve wayfinding ability.
Kessels et al., 2011	To examine memory for objects relevant for wayfinding as opposed to irrelevant (contextual)	21 persons with AD and 20 age-matched controls	<ul style="list-style-type: none"> Cognitive measures All subjects watched a video showing a route through a museum There were 20 objects placed at key decision points and 20 irrelevant objects. Some were toys. Subjects were asked to remember the toys; and also the route. They were shown the video twice. Then they were shown the 40 objects and 40 distractor objects and asked to identify which were in the video. Response time and accuracy was measured. 	<ul style="list-style-type: none"> The AD subjects had a longer response time than the controls, and were less accurate overall at recognizing the objects. The AD and control subjects were more likely to recognize the non-toy objects at key decision points. 	<ul style="list-style-type: none"> Landmark recognition is impaired in persons with AD. Older adults and those with AD are more likely to remember landmarks relevant for wayfinding than those that are not relevant for wayfinding.

Citation	Purpose	Sample	Method and Measures	Findings	Conclusion
Nolan et al., 2001	To examine the effects of a personal portrait and name place on the residents door for room identification	3 persons with dementia who exhibited wayfinding problems.	<ul style="list-style-type: none"> A portrait of the resident and their name was placed on the door. Residents were asked to show the researchers their room location. 	<ul style="list-style-type: none"> Room identification improved by 45% 	<ul style="list-style-type: none"> Personally meaningful cues can help persons with dementia who have wayfinding problems identify their rooms.
Nolan et al., 2002	To examine the effects of a memory box intervention on room identification	6 persons with dementia who also had wayfinding problems	<ul style="list-style-type: none"> Memory boxes included a portrait of the resident and personal memorabilia Subjects showed researchers their room location 	<ul style="list-style-type: none"> Subjects improved room recognition by 45%. 	<ul style="list-style-type: none"> Personally meaningful and familiar objects serve as wayfinding cues in persons with dementia.