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Recognizing where one is, and where one is going, are critical aspects enabling persons with dementia to be self-sufficient. In unfamiliar situations people rely on environmental cues to find their way. When these cues are not easily interpreted due to cognitive impairment, autonomy gives way to dependency. The purpose of this pilot study was to develop and test a signage system for long-term care that supports wayfinding for persons with dementia.

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Developing signage that supports wayfinding for persons with dementia

Spatial disorientation is among the very first symptoms to appear in Alzheimer's disease (AD), and it worsens throughout the progression of the disease (**Alexander and Geschwind, 1984; Liu, et al., 1991**). As a result, people living with AD easily become lost and have difficulty adapting to new environments.

Wayfinding is a process through which people use information in the environment to help them reach their desired destination. Autonomy and quality of life of persons with dementia are strongly linked with their ability to reach destinations within their environment as independently as possible (**Marquardt and Schmieg, 2009**).

Impact of poor wayfinding

The search for information to aid orientation may cause frustration, anger or agitation (**Zgola and Bordillon, 2001**). Poor wayfinding abilities have been found to impact resident safety, create conflict between residents (**Rosswurm, et al., 1986**), and cause unnecessary burden to nursing home staff (**Everitt, et al., 1991**). Residents who cannot identify paths to desired locations exhibit anxiety, confusion, mutism, and panic (**Passini, et al., 2000**). The stress caused by disorientation may result in feelings of helplessness, raised blood pressure, headaches, increased physical exertion, and fatigue (**Carpman and Grant, 2001**).

Obstacles to independence

The long-term care environment often acts as an obstacle to independence and wayfinding for people with dementia. Design features, such as many similar doorways along corridors, lack of windows to the outside, and poorly planned or improvised signage result in poorer orientation (**Rule, et al., 1992**).

A poorly designed environment lacking adequate wayfinding cues can create adverse effects for people with dementia such as extreme reactions and aggressive behaviours (**Brawley, 1997**).

The most common forms of wayfinding cues are signs, landmarks, and verbal instruction. Persons with dementia may require multiple types of environmental supports at the same time to achieve the greatest level of independence.

Signs used in settings for older adults are either typographic or pictographic:

- **Typographs** are letters, digits, words, or phrases used for communication.
- **Pictographs** are symbols representing people, places and things.

In an attempt to improve residents' abili-

The pictogram of the knife and fork is a signifier for 'Dining Room;' but possibly more meaningful and representative of the 'Dining Room" to a person with dementia is the steaming bowl of soup. The pictogram below, a person seated at a table eating, also signifies 'Dining Room.' One of these pictograms was preferred by participants in the study.

ties to reach their destinations, several studies have used wayfinding cue modifications that manipulate colour, contrast, pictures, or landmarks in the environment.

Modifying wayfinding cues

Colour . . .

One common cue to facilitate understanding and wayfinding is colour. The design literature suggests that colour should be used in conjunction with other environmental cues and that the information being communicated through colour should be consistent throughout the care community. Predictability can be achieved in the environment through reliable repetition of key colours (**Cohen and Weisman, 1991**). Use of room numbers and distinguishing colors for resident rooms and doors is associated with enhanced orientation among residents (**Lawton, et al., 1984**).

Wijk's study of color perception in older adults found that variation in lightness was the critical factor in successful discrimination between color samples despite the color area (**Wijk, et al., 1999**).

Wijk also found that older adults and persons with dementia were able to reliably rank colors in order of preference, that visual function influences color discrimination and color naming, and that visual function is associated with cognitive function. Research on color preference for people

over age 65 indicated that blue, red and green were most preferred, in that order (**Wijk, 2001; Reeves, 1985**).

Contrast . . .

Contrast is another factor in developing effective wayfinding signage for persons with dementia. Contrast serves as a cue in the environment by helping people distinguish between different objects and helps to draw the attention of people who have difficulty staying on task or establishing orientation.

Healthy older persons require as much as 300% more contrast than younger persons for the recognition of objects in the environment (**Tideiksaar, 1997**). In addition, persons with dementia present with significantly more impairment of contrast perception than cognitively intact older adults (**Gilmore and Whitehouse, 1995**).

Increasing contrast in the environment can support functioning in people with dementia during such tasks as eating (**Brush, Meehan and Calkins, 2002; Koss and Gilmore 1998**). Lack of environmental contrast can affect communication about caregiving activities between care providers and persons with dementia (**Brush, et al., 2012**).

Pictures, landmarks . . .

Landmarks are orientation cues that create a reference point and act as focal points within different spaces. Landmarks can be created in long-term care communities by using distinctive architectural elements such as a small alcove for unique activities (**Coons, 1985; Kromm and Kromm, 1985**).

The effectiveness of environmental cues is strengthened when these cues are bold, varied and distinctive. For example, artwork, paintings, suspended quilts, or furniture items can serve as landmarks in long-term care communities (**Brawley,**

Signage is the most commonly used cue to help people navigate from place to place.

Residents of long-term care prefered directional signage with a colored background as opposed to signs with a white background.

Participants in the study also preferred bright green to dark green or white, bright magenta compared to dark purple or white, and bright royal blue compared to dark navy blue or white.

Their preference for the placement of words (before or after the pictograms), was toward a trend that preferred the words to precede the pictogram - although not a strong preference.

A wide range of symbols are available for indicating the many activities that can take place in activity areas of a care facility. The pictograms ranged from a TV, to two people side-by-side waving (indicating community), to representations of common activities, such as TV, and card games and puzzle pieces.

The pictogram of two people sitting at a table throwing dice, can indicate interactions between people and a specific activity that might be done in the room as depicted in the figures.

1997). Distinctive objects placed at decision points along a route assist in landmark recognition (**Kessels, et al., 2011**). Display cases with personal objects and pictures are commonly used to cue recognition of a resident's room.

Signage

Signage is the most commonly used cue to help people navigate from place to place. The Americans with Disabilities Act of 1990 (ADA) provides generic guidelines for signage that are applicable to all buildings with older adults; however, specific recommendations for the use of signage in environments for cognitively impaired older adults are few and contradictory.

Recommendations in the literature vary, from using pictures instead of words for cueing and indicating direction (**Brawley, 1997**), to using "old fashioned" language on signs rather than symbols (**Torrington, 1996**), and installing signs and pictures that include objects (**Zeisel, 1999**).

Calkins (**2002**) suggests designing signs by using brighter colors (using hue, value and chroma or colour intensity), and higher contrast with the background wall.

In several small scale studies, large signs were associated with improvements in residents' orientation, when orientation training was also provided (**Hanley, 1981**). Residents in early or moderate stages of dementia were most likely to use public toilets in response to signage that was a combination of a wayfinding arrow on the floor along with the word 'toilet,' rather than the word 'restroom' (**Namazi and Johnson, 1991**).

Signage placement

The placement of signage must also be considered as many older adults will not notice signs located on the upper sections of walls as they have limited upper body range-of-motion and walk looking at a three foot or lower level (**Passini, et al., 2000; Brush, et. al., 2012**). When older adults walk with a stooped posture, they may not see the signs placed at the recommended height, for example, as per the *Americans with Disability Act of 1990* (**ADA, 2008**).

The Dementia Services Development Centre (DSDC) at the University of Sterling in Scotland recommends that signs be mounted with their lower edge no higher than four feet from the floor, clearly contrast with door or wall, use of a capital letter followed by lower case letters and include a graphic or photograph, and feature high contrast between the words, graphic and background (**Andrews, et al., 2010**).

There are also recommendations in the literature for both light lettering on a dark background and dark lettering on a white background for persons with dementia; both designs provide high contrast.

Directional signage should be in the same style as other signs and have a clear arrow in close spatial proximity to the name of the destination (**DSDC, 2012; Arthur and Passini, 1992**).

The *Americans with Disability Act of 1990* (**ADA, 2008**) provided guidelines for the use of typographic signage in buildings for older adults. These guidelines recommend dark letters that contrast with a light background, the use of *sans serif* typefaces, non use of italics, tactile signs in uppercase, visual only signs such as directional signs can be lowercase, and a mounting height of 5 feet (1,525 mm) above the floor to the centreline of the sign.

While the ADA requires that sign guidelines are applied to all buildings with older adults, specific evidence-based recommendations for the use of signage in environments for cognitively impaired older adults are few and sometimes conflicting.

Evidence-based guidelines

In dementia, the capacity for decision-making is reduced to decisions based on immediate and visually accessible information (**Passini, et al., 2000**). Since less visual information is taken in by persons with dementia (**Koss and Gilmore, 1998**), and they experience other visual challenges such as contrast and depth perception deficits, spatial disorientation, and difficulty judging certain colors, it is imperative that all cues in the environment are created using evidence-based design guidelines.

While the effectiveness of some of these cueing systems has been empirically tested, more research is needed to provide designers, care staff, and administrators with guidelines that can make a significant difference in environments for people with dementia. Thus, the purpose of this research study was two-fold:

- gather information about the color, contrast and pictogram preferences of persons with dementia for dining room, activity room, bedroom, and restroom signs; and,
- use this information for creating signs that increase wayfinding independence.

Research hypotheses

It was hypothesized that:

1) signs with a darker background and white letters with more meaningful pictograms would be preferred over those with a white background and black letters; and,

2) that there would be a significant improvement in wayfinding independence for study participants after implementation of signage designs based on their preferences.

There were two distinct phases to the study during which data were collected:

1 - Human Factors Testing - with 28 persons with dementia identifying the characteristics of the signage they preferred; and

2 - Wayfinding Observations - 23 persons with dementia pre- and post-intervention (i.e., before and after installing new signs).

Settings for Phase I and II

The setting for the two-phase study was two Cleveland-area care communities with distinct memory care units. Neither care community had existing directional signs, but did have signs for location of the activity room and resident bedrooms.

Participants Phase I

Data for phase I of the study (signage preferences) were collected from 28 residents. All had a diagnosis of dementia (Alzheimer's, vascular dementia, and frontotemporal degeneration - FTD). All had MMSE scores of 6 or higher, and retained the ability to read and speak English.

Participants were required to be able to read and comprehend signage and to express their preferences verbally or by gesture. Participants must have been living at the residence for at least one month.

Exclusion criteria - Potential participants were excluded from the study if:

1) they showed signs of rapid cognitive decline or physical deterioration over the last 6 months, as evidenced by medical records and interviews with staff;

2) had medical conditions that would preclude performing activities, e.g., a terminal

Table 1 - Signage Preferences, Demographic Data (N=28)

	Mean	SD	Range
Age	86.07	8.08	(65, 100)
MMSE score	13.4	5.4	(4,26)
Gender	**N**	**%**	
Female	23	82.1%	
Male	5	17.9%	
Education Level	**N**	**%**	
High School	3	10.7%	
Some College	2	7.1%	
College/Tech school	10	35.7%	
Post Graduate	3	10.7%	
Unknown	10	35.7%	
Marital Status	**N**	**%**	
Widowed	20	71.4%	
Married	6	21.4%	
Single	1	3.6%	
Divorced	1	3.6%	
Primary Diagnosis	**N**	**%**	
Alzheimer's	7	25.0%	
FTD	1	3.6%	
Vascular Dem	3	10.7%	
Other Dementias/ Memory Loss	16	69.6%	
Other Diagnosis	1	3.6%	

illness, severely limited mobility, inability to be seated comfortably in a chair or wheelchair, or severe sensory impairment to the extent that he/she could not read the signs or hear the examiner's questions; and **3),** were unable to read and speak English.

Because the gender composition of residents in long-term care is primarily female, women were well-represented. Demographic data are presented in **Table 1**.

Participants Phase II

Wayfinding data was collected from 23 residents at the long-term care communities mentioned. Twenty-two participants completed all of the wayfinding tasks. Twenty of the participants also took part in the Phase I human factors testing.

All had early-to-moderate stage dementia, with a primary diagnosis of either

Table 2 - Wayfinding Participants, Demographic Data (N=23)

	Mean	SD	Range
Age	86.61	7.18	(71,100)
MMSE score	12.95	5.14	(4,26)
Gender	**N**	**%**	
Female	17	73.9%	
Male	6	26.1%	
Education Level	**N**	**%**	
High School	1	4.3%	
Some College	2	8.7%	
College/Tech School	9	39.1%	
Post Graduate	3	13.0%	
Unknown	8	34.8%	
Marital Status	**N**	**%**	
Widowed	16	69.6%	
Married	6	26.1%	
Single	1	4.3%	
Divorced	0	0	
Primary Diagnosis	**N**	**%**	
Alzheimer's	7	30.4%	
Vascular Dem	2	8.7%	
Other Dementias/ Memory Loss	14	60.9%	

Alzheimer's disease, vascular dementia, or FTD. Exclusion criteria were the same as mentioned in Phase I. Demographic data are presented in **Table 2**.

Materials Phase I

We first developed a series of pictograms, some based on universally known and recognized graphics commonly used in Americans with Disabilities Act signage (i.e., the knife and fork as a signifier for Dining Room), and some that we thought may be more meaningful and representative to a person with dementia (i.e., a steaming bowl of soup or a person seated at a table eating as a signifier for 'Dining Room.' **(See pictograms, page 4)**.

For the ***Activity Area***, in particular, we explored a wide range of symbols based on the many activities that take place there. The pictograms ranged from a TV, to two people side-by-side waving (indicating community), to representations of common activities, such as dice and card games, and puzzle pieces.

We eventually developed a pictogram of two people sitting at a table throwing dice, indicating both interaction between people and a specific activity they might do in the room as depicted in the figures **(See page 5)**. Different signs were created as needed for each setting.

Based on the literature, we knew that upper and lower case lettering with *Sans Serif* type face is easier to read for older adults **(Morrell, 2001; Hartley, 1994)**.

In addition, use of upper and lower case letters increases reading speed **(Conover, 1990)**, with only *Sans Serif* letters used. Typography was set on average at 125 points in a Helvetica typeface (a font compliant with the *Americans with Disabilities Act*).

Signage systems

It was already known that, for this demographic **(from Tables 1 & 2)**, we would need to provide high contrast to aid readability and attract attention. We developed three signage systems to determine specific parameters that would be preferred by older adults with dementia.

In one signage system, ***System A***, we used a palette of bright green, purple, orange, blue, and an accent of dark grey. We used solid-colored backgrounds, with white lettering and arrows. For ***'Location'*** signs, pictograms were white, and on ***'Directional'*** signs, pictograms were set apart from lettering and arrows in dark grey on a white background. This system used a combination of dark background with light information, and some light background with dark information.

In ***System B,*** a much darker palette of similar hues to ***System A*** was used: dark green, purple, orange, blue. We used solid colored backgrounds, with white lettering, pictograms, and arrows. Everything was dark background with light information.

In ***System C***, we used white backgrounds with dark grey lettering, pictograms and arrows. Everything was light background with dark information.

Twenty-four signs were used with varied combinations of color, pictogram, and

sequence of elements as indicated. Signs identified the Dining Room (7 signs), Activity Room (5 signs), Restroom (6 signs), or Bedroom (6 signs).

Procedure Phase I

After receiving consent from the person's legal representative, each participant was informed, both verbally and in writing, of the purpose and procedure of the Human Factors Testing portion of the study, then asked for his or her signed assent to participate. Once assent was provided, a simple reading test was conducted by asking the participant to read 5 sample sentences ranging in size from 16 to 72-point type, with the visual aids they wear. All participants were able to read the sentences.

Signs were placed on easels at a height of 48" from the ground and 48 from the person with dementia. Participants were interviewed individually and gave their answer orally or by pointing. A research assistant recorded the responses for each trial on a data sheet. Signs were presented in pairs or sets of three at a viewing distance of four feet. Each trial was initiated with a member of the research staff placing signs on the easels in front of the seated participant. Research staff then asked the participant to indicate the sign that he or she preferred. If the participant did not indicate a preference, or stated that the signs were the same, staff then asked the participant to point to the sign that he or she would prefer to have on the walls of the residence in which they live. A second member of the research team observed and recorded all responses.

Results Phase I

As shown in **Table 3**, signage with a colored background were preferred (83.6%) over signs with a white background. The participants preferred bright green (51.9%) to dark green or white, bright magenta (72.7%) compared to dark purple or white, and bright royal blue (50%) compared to the dark navy blue or white.

In trials that assessed preference for placement of words, there was a trend to prefer the words to precede the pictogram (57.6%) on the sign - not a strong preference.

Participants were asked their preferences on 8 pictograms. The preference was for the pictogram of people seated playing a game (77%), compared to both the pictograms of the TV and people standing/waving.

There was a trend to prefer the pictogram of the bowl of soup (46%) over the knife and fork or the people seated at the table, although this was not a strong preference.

Participants preferred the pictogram of the toilet (71.4%) over the pictogram of the shape of the person (man standing) to indicate the restroom.

The brighter colors of **System B** were clearly preferred by a majority of participants over the darker colors of **System A.** Based on the comments the participants made during the Human Factors Testing, many perceived the dark colors in the palate of **System A** as black. Participants commented that the signs were "not bright enough", "not eye catching", "doesn't stand out", "looks like black", "very plain".

Table 3
Sign Preferences Results

COLOR PREFERENCE	Trials	%
Color	178	83.6%
Black and White	35	16.4%
Bright Colors	100	58.5%
Dark Colors	71	41.5%
Bright Green	27	51.9%
Dark Green	19	36.5%
Black and White	6	11.5%
Bright Magenta	40	72.7%
Dark Purple	9	14.4%
Black and White	6	0.9%
Bright Orange	6	22.2%
Dark Red	21	77.8%
Black	15	28.8%
Blue	34	65.4%
White	3	5.8%
Bright Royal Blue	27	50.0%
Dark Navy Blue	22	40.7%
Black and White	5	9.3%
ICON PREFERENCE	**Trials**	**%**
Dining Room		
Fork & Knife	17	30.4%
Steaming Bowl	26	46.4%
Seated Diner	13	23.2%
Activity Area		
Seated People	41	77.4%
TV	7	13.2%
Standing People	5	9.4%
Restroom		
Man Standing	8	28.6%
Toilet	20	71.4%
ORDER PREFERENCE		
Words First	76	57.6%
Icon First	56	42.4%

In comparison, when they viewed the colors in **System B** they made comments such as "my eye is drawn to that", "this one stands out better", "I can read that one easier", "I would like that one here".

Several participants also made comments about the pictogram of the soup bowl, noting that it made them "feel warm", "think of home", and that it "looked good".

Testing pictograms

Traditionally, the most common pictogram used for a restroom sign is an outline of a man or woman. This symbol was tested; but also tested was the pictogram of a toilet. Participants chose the toilet pictogram, stating that it "says what it means", "makes it easier", and "is better to see."

Materials Phase II

Based on the participants' preferences we created signs using the brighter values of color **System B** and the pictograms of the bowl of soup, two people at the table with dice, and a photo of a person.

Text was placed before each image and followed by an arrow for directional signs.

We created Directional signs that were 5" high and between 18.5" and 23" long. Location signs were 11" x 11", and Participant Room signs were 8" x 12". We placed the bottom of the signs 48" from the floor, which fit within the lower range of ADA compliance. **(See photos, page 5)**

When signs were stacked (i.e., three Directional signs in one location), the middle sign was placed at a height of 48", with the other signs above and below. We kept the stacking order of Directional signs consistent throughout the two communities.

Procedure Phase II

Wayfinding data was collected before the installation of the new signs and, again, after the signs had been in place for 2 weeks. We adapted an approach used by Passini and colleagues **(Passini, et al., 1998; 2000)**.

Each participant was asked to show research staff the route from his/her bedroom to the dining room, from the dining room to the activity room, and from the activity room to the participant's bedroom; each was given the same prompt: "Would you please show me how to get to the _____."

A member of the research team accompanied the participant during wayfinding

and recorded the time it took to get to the correct location, and the number and type of all errors made by the resident. The protocol was designed to have the activity appear as if two people were walking together and conversing.

A second member of the team followed behind and recorded the amount of time it took the person to go from place to place. Number and type of errors (e.g., wrong turns, hesitations, changes in directions, etc.), and all verbalizations were transcribed. In situations where the participant displayed distress, confusion, disorientation, or prolonged searching, the observer intervened by providing the required information or showing the way.

Participants were scored for each of the three wayfinding destinations based on the amount of assistance needed:

(3) independent (the person reached the destination directly, without help);

(2) independent with error (the person reached the destination without help, but made errors which were self-corrected);

(1) partial aid (the person needed the observers' cues or assistance with wayfinding decisions to reach the destination); and,

(0) total aid (participant was taken to the destination by the observer).

During wayfinding, particular attention was paid to whether or not participants paid attention to landmarks or signage, described or discussed its content, and if they made any comments regarding using the new signage as a navigational aid.

Results Phase II

Given that the two participant residential locations were different in terms of factors such as distances of route components and layout, data were analyzed separately for each location as shown in **Table 4**.

Our focus was on two primary measures: length of time (in seconds) to navigate routes, and ratings of amount of assistance required to navigate routes (3 = totally independent without error; 0 = totally dependent on others to get to target location).

Comparisons were made between baseline and 2-week post-test assessments for each of these measures using paired t-tests. Means (and S.D.s) associated with these measures, along with statistical significance levels, are also shown in **Table 4**.

Data are presented for participants who had complete data at baseline. Some residents did not complete some routes at post-test due to refusals.

Table 4 - Wayfinding Results

Comparison of Baseline and Post-test Means (and SDs) for Time to Navigate Routes (seconds) and Ratings of Independence in Wayfinding by Location and Route

Route	Time to Navigate Route[1]		Ratings of Independence[2]	
	Baseline	Post-test	Baseline	Post-test
Location 1				
Lounge to Dining Room	138 (96)	59 (45)	0.67 (0.7)	1.56 (1.4)
Dining Room to Activity Room	219 (67)	80 (44)**	0.22 (0.4)	1.11 (1.3)
Activity Area to Bedroom	248 (70)	77 (48)*	0.14 (0.4)	2.29 (3.1)
Location 2				
Bedroom to Dining Room	122 (54)	70 (39)*	1.33 (1.4)	2.33 (1.2)*
Dining Room to Activity Area	104 (40)	60 (25)	1.38 (1.4)	2.75 (0.5)*
Activity Area to Bedroom	69 (42)	80 (37)*	2.63 (0.7)	2.50 (0.9)

Notes: **1** = in seconds; **2** = Scores range from 0-3; * p <.05; ** p.001

In Location 1, routes were: R1 - Lounge to the Dining room; R2 - Dining room to the Activity Room; and R3 - Activity room to the Bedroom.

There were decreases in average time to navigate all three route segments from baseline to post-test, though this measure only reached statistical significance for Route 2 ($t(8) = 5.07$, $p<.001$), and for Route 3 ($t(6) = 4.77$, $p<.003$).

In Location 2, routes were: R1 - Bedroom to the Dining room; R2 - Dining room to the Activity Area; and R3 - Activity Area to Bedroom. There was a significant decrease in time to navigate Route 1 from baseline to post-test ($t(8) = 4.56$, $p<.002$) and for Route 3 ($t(7) = 2.83.$, $p<.025$). Route 3 showed almost no change.

With regard to ratings of amount of assistance needed to navigate routes, in Location 1 there was an increase in rated independence for navigating all routes, though none reached statistical significance.

In Location 2, there was a significant increase in rated independence for Route 1 from baseline to post-test ($t(8) = 2.45.x$, $p<.04$), and for Route 2 ($t(7) = 3.27.x$, $p<.014$), and no change for Route 3.

The baseline level of independence shown for Route 3 was near total independence level, which probably created a ceiling effect for measures for this route. Percentage of participants who showed improvement for these two outcomes for each location and route are shown in Table 4. In general, a majority of participants showed improvement from baseline to post-test, especially with regard to time to navigate routes, though this showed variability across routes and locations.

As shown in **Table 4**, all error types decreased in both locations from baseline to post-test. This was especially the case for errors of disorientation in Location 1 and for change of direction and hesitation errors in Location 2.

Summary

The purpose of this study was to develop prototype signage for persons with dementia based on the expressed preferences of long-term care residents with dementia, and to determine the effects of placing such signage in residential settings.

Overall, we found patterns of improvement in wayfinding in residents with dementia in two residential settings on a variety of outcomes. This was accomplished without any intervention other than placing the signage into these environments.

We assume that practice effects alone would not account for these outcomes, as these residents already had been living in this setting and attempting to navigate routes before the placement of our signage.

In future research, we plan to evaluate the effectiveness of cueing residents to read and interpret signs, and giving residents practice utilizing information contained in the signs to assist with wayfinding.

Factors such as specific routes tested in-

and recorded the time it took to get to the correct location, and the number and type of all errors made by the resident. The protocol was designed to have the activity appear as if two people were walking together and conversing.

A second member of the team followed behind and recorded the amount of time it took the person to go from place to place. Number and type of errors (e.g., wrong turns, hesitations, changes in directions, etc.), and all verbalizations were transcribed. In situations where the participant displayed distress, confusion, disorientation, or prolonged searching, the observer intervened by providing the required information or showing the way.

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In Location 1, routes were: R1 - Lounge to the Dining room; R2 - Dining room to the Activity Room; and R3 - Activity room to the Bedroom.

There were decreases in average time to navigate all three route segments from baseline to post-test, though this measure only reached statistical significance for Route 2 ($t(8) = 5.07$, $p<.001$), and for Route 3 ($t(6) = 4.77$, $p<.003$).

In Location 2, routes were: R1 - Bedroom to the Dining room; R2 - Dining room to the Activity Area; and R3 - Activity Area to Bedroom. There was a significant decrease in time to navigate Route 1 from baseline to post-test ($t(8) = 4.56$, $p<.002$) and for Route 3 ($t(7) = 2.83.$, $p<.025$). Route 3 showed almost no change.

With regard to ratings of amount of assistance needed to navigate routes, in Location 1 there was an increase in rated independence for navigating all routes, though none reached statistical significance.

In Location 2, there was a significant increase in rated independence for Route 1 from baseline to post-test ($t(8) = 2.45.x$, $p<.04$), and for Route 2 ($t(7) = 3.27.x$, $p<.014$), and no change for Route 3.

The baseline level of independence shown for Route 3 was near total independence level, which probably created a ceiling effect for measures for this route. Percentage of participants who showed improvement for these two outcomes for each location and route are shown in Table 4. In general, a majority of participants showed improvement from baseline to post-test, especially with regard to time to navigate routes, though this showed variability across routes and locations.

As shown in **Table 4**, all error types decreased in both locations from baseline to post-test. This was especially the case for errors of disorientation in Location 1 and for change of direction and hesitation errors in Location 2.

Summary

The purpose of this study was to develop prototype signage for persons with dementia based on the expressed preferences of long-term care residents with dementia, and to determine the effects of placing such signage in residential settings.

Overall, we found patterns of improvement in wayfinding in residents with dementia in two residential settings on a variety of outcomes. This was accomplished without any intervention other than placing the signage into these environments.

We assume that practice effects alone would not account for these outcomes, as these residents already had been living in this setting and attempting to navigate routes before the placement of our signage.

In future research, we plan to evaluate the effectiveness of cueing residents to read and interpret signs, and giving residents practice utilizing information contained in the signs to assist with wayfinding.

Factors such as specific routes tested in-

fluenced outcomes, and we are interested in further exploring these and other features of the physical environment that can increase, or mitigate, effects of better signage for residents with dementia.

In addition, we wish to explore, with this population, those cognitive factors that may interact with signage for wayfinding. For example, when arriving at the goal location at the end of a route, such as a dining room, some residents could not recognize the location. If a resident does not recognize a dining room as such, then signage for a dining room might not be useful until the resident can be taught to recognize the dining room.

Given the results of this study, we must consider that traditional approaches to signage in long-term care communities may not be adequate to support persons with cognitive impairment. There are still many aspects of signage that require indepth study, such as resident preference for other placement options, additional color choices, and the size and shape of signs.

Regardless, if preferred designs of environmental cues are in place in dementia care facilities, residents should be able to navigate more independently, thereby reducing their level of frustration and increasing their autonomy. ■

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