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Wandering and the Physical Environment

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Abstract

Background/Rationale: Guided by the need-driven dementia-compromised behavior (NDB) model, this study examined influences of the physical environment on wandering behavior. **Methods:** Using a descriptive, cross-sectional design, 122 wanderers from 28 long-term care (LTC) facilities were videotaped 10 to 12 times; data on wandering, light, sound, temperature and humidity levels, location, ambiance, and crowding were obtained. Associations between environmental variables and wandering were evaluated with chi-square and *t* tests; the model was evaluated using logistic regression. **Results:** In all, 80% of wandering occurred in the resident's own room, dayrooms, hallways, or dining rooms. When observed in other residents' rooms, hallways, shower/baths, or off-unit locations, wanderers were likely (60%-92% of observations) to wander. The data were a good fit to the model overall (LR [logistic regression] χ^2 (5) = 50.38, $P < .0001$) and by wandering type. **Conclusions:** Location, light, sound, proximity of others, and ambiance are associated with wandering and may serve to inform environmental designs and care practices.

Keywords

dementia, model testing, wandering, observational methods, physical environment, NDB model

Introduction

Wandering is acknowledged as one of the most complex, challenging, and potentially dangerous dementia-related behaviors, associated with negative consequences such as elopement, getting lost, fatigue, injury, and possibly death.[1] Owing to Lawton's environmental docility hypothesis,[2] modification of the physical environment is considered an important focus for intervention to address wandering and other dementia-related behaviors—from securing boundaries to incorporating specific internal and external design features. Yet, evidence concerning effects of core elements of the physical environment, singly or in combination, in promoting or retarding expression of wandering and other dementia-related behaviors is limited. The purpose of this study was to address this gap by examining the influence of specific elements of the physical environment on wandering behavior in elders with dementia.

Environmental Effects on Wandering

Promoting Factors. Previous studies have considered a variety of environmental factors that may promote wandering, covering 3 broad areas: personal factors (stress, boredom), the physical milieu, and the socioemotional milieu. Several authors have characterized environmental factors as stressors to the elder with dementia.[1,3,4] Some have postulated that an environment that provides limited stimulation or interest may also contribute to wandering by inducing boredom.[4,5]

Elements of the physical milieu including low noise levels, adequate lighting, and open walking areas have been suggested as conducive to pacing.[3] Time of day (ie, hours outside mealtimes) and general unfamiliarity of the environment appear to increase wandering.[3,6]

Social-emotional milieu factors including the staff mix in residential care and the perceived ambiance of the environment have also been implicated in affecting wandering.[7-9] Evidence related to social factors such as the presence or absence of others precipitating wandering is conflicting, with 1 study suggesting wandering decreases when people are alone,[10] and other evidence demonstrating wandering and dementia-related behaviors are more frequent when known wanderers are alone.[5,11] One wandering-specific study demonstrated a high proportion of wandering episodes ending in close proximity to others, suggesting that wanderers may be drawn to others[12] or that their wandering behavior is a means of calling attention to their needs.[13]

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Inhibiting Factors. Interventions focused on modifying elements of the physical environment, generally architectural design, and improving the therapeutic milieu, have shown promising results for behavior improvement but are generally not wandering-specific. Recent architectural design for dementia-specific environments has focused on creating domestic size and character in spaces, modifying floor plans to create easily navigable spaces, creating opportunities for social interaction and connection with the natural world, and providing comfortable private accommodation that supports dignity, autonomy and individualized care. These innovations are consistent with care goals for persons with dementia (PWD), including assuring security, supporting functional capacity, providing opportunity for stimulation and change, and establishing links to the healthy and familiar.[14] Environmental manipulations have included stress and stimulus-reduced calming environments,[15,16] special care units, enriched homelike environments,[10,15,17-20] and multisensory environments such as Snoezelen rooms.[21] Physical environmental interventions specific to wandering such as creating wandering areas,[22] building a wandering path,[23] and unlocking exit doors to allow access to the outdoors[24] have showed promise, though the objectives of these interventions in moderating wandering are not always explicit.

Wandering interventions focused on specific locations within the physical environment, ambient conditions (sound, light, temperature, and humidity levels), environmental ambiance, and crowding are rare in the literature. Several intervention studies have focused on the bathroom and dining room, manipulating the individual social and/or physical environment to decrease behavioral symptoms and improve the bath or meal experience, all with promising results[20,25-28]; however, only 1 study was focused on wandering.[25] Several studies have examined the impact of light on agitation, a behavior closely associated with wandering. Individualized white noise used in 2 studies[29,30] produced mixed results in decreasing agitation. Increased light intensity during the evening meal was found to decrease agitation[27] as was morning light therapy specific to individuals[31,32] and exposure to bright light.[33,34] In 1 study, exposure to indirect bright light was shown to improve circadian rest-activity rhythms.[35] A recent study found that high-intensity bluish light, compared to yellowish light or dull light, improved restless behavior in PWD.[36] A second study of the impact of all-day bright light versus dull light, with and without melatonin, showed modest improvements in night time restlessness in the bright light plus melatonin condition but little effect on other behaviors except depression in the bright light only condition.[37] The effect of environmental ambiance on locomotor activity has been explored in only 1 study,[9] high ambiance scores, specifically the engaging aspect of ambiance, being associated with lower frequency and shorter duration of walking. Crowding is mentioned frequently as a trigger for behavioral symptoms including wandering but no published study could be found focused on reducing crowding to ameliorate wandering.

In sum, the paucity of intervention studies is somewhat surprising given the impact of behavioral symptoms on the PWD, caregivers, and staff and the acknowledged importance of the physical environment in explaining behavior. Previous studies generally have been hampered by inadequate definition of the specific behavior of interest, lack of rigor in diagnosis-related inclusion criteria, use of small samples and single settings, and weak conceptual grounding. The complexity of long-term care (LTC) environments and the cost of setting up sophisticated studies to capture environmental variables under both controlled and natural conditions are also challenging to researchers.

Although the range of individual environmental variables that have been explored is limited, results from previous studies are encouraging. Further examination of specific elements of the physical environment for their influence on wandering is warranted and important to advancing understanding and guiding care.

Conceptual Model and Research Questions

We have conceptualized this study using the need-driven dementia-compromised behavior (NDB) model,[38] which posits the behavioral responses of wandering, physical aggression, and repetitive vocalizations as value-neutral expressions of unmet need. The model identifies 2 sets of factors that operate to yield these behavioral responses: (1) background factors that are potential etiologies for NDBs (eg, neurocognitive deficits, preserved strength of the person's traits and basic abilities) and (2) proximal factors that trigger the occurrence of NDBs in those prone to them. Proximal factors include those internal to the person, such as psychological and physiological needs, and those external to them, as represented in aspects of the physical and social environment. According to the model, light, noise, ambient temperature and humidity, crowding, and ambiance, that is, the general feel of the environment, are posited as triggers from the physical environment for inducing wandering and other NDBs. In this study, we posed the following research questions focused on these aspects of the physical environment as guided by the model.

1. Do aspects of the physical environment (location: ambient sound, light, temperature, and humidity levels: crowding and environmental ambiance) differ during periods when wanderers do and do not exhibit wandering behavior?
2. To what extent do aspects of the physical environment predict occurrence of wandering behavior?
3. To what extent do aspects of the physical environment predict occurrence of wandering among different types of wanderers?

Methods

Design

This study used a descriptive, cross-sectional, correlational design. Ambulatory individuals with dementia residing in nursing homes and assisted living facilities were videotaped for twelve 20-minute observations randomly distributed over 2 nonconsecutive days in their natural surroundings. Study procedures were approved by institutional review boards of 2 participating universities; each study site received a single federal project assurance. Proxies provided written informed consent for participants; participants assented at each observation day.

Setting and Sample

The study was conducted in 22 nursing homes and 6 assisted living facilities having dementia-specific units; sites were chosen for convenience from the area surrounding 2 large universities in Michigan and Pennsylvania. All participants who met inclusion criteria and for whom consent could be obtained from a proxy were enrolled. Inclusion criteria were as follows: participants spoke English, met DSM-IV criteria for medical diagnosis of dementia, scored <24 on the mini-mental state examination (MMSE), were ambulatory (with or without assistive device), and maintained a stable regime of psychotropic medications, if any, over 30 days prior to and during observations. Participants (N = 122) who completed a minimum of 10 of 12 scheduled observations and displayed wandering in at least one of them were retained for analysis.

The overall sample was 77% female (n = 94), with a mean age of 83.7 years (SD = 6.48, range = 68-102). Mean MMSE score (n = 114) was 7.4 (SD = 7.2; range = −1 to 23); participants too impaired to complete the test and score a true 0 were assigned a −1. Most participants (n = 83, 68.0%) were independently mobile; 36 others required some assistance (eg, cane, walker) to ambulate. Gender, age, MMSE, mobility, or residence (NH [nursing home] vs ALF [assisted living facility]) did not differ for participants included in this analysis compared to participants with fewer than 10 observations (who were not included).

Measures

Dependent Variables. Wandering behavior was coded for rate and duration from videotapes for each observation period; coding procedures are described elsewhere.[39] Based on the coded videotapes, each observation period was designated as positive or negative for occurrence of wandering. Wandering occurred in 49.62% (n = 526) of 1060 observation periods included in analyses.

Based on their wandering rate and duration as distributed over the 10 to 12 observation periods, each participant was also categorized into 1 of 3 wandering types (classic, moderate, subclinical). Participants used in this analysis were the wanderers used to develop and validate this typology.[40] Classic wanderers (n = 14) were those with the highest amount of wandering; for this type, their average hourly rate was 9.3 episodes of wandering and their average hourly duration was 15.1 minutes of wandering. Classic wanderers wandered during more observations and more within an observation period than other types. They also were the most cognitively impaired, had the best mobility, and had the poorest health compared to other types. Moderate wanderers (n = 55) had a lesser amount of wandering (mean hourly rate of 4.3 episodes; average hourly duration of 4.3 minutes). They also had less cognitive impairment and poorer mobility than classic wanderers but the most robust health of any type. Subclinical wanderers (n = 53) displayed the least wandering (mean hourly rate of 0.8 episodes; average hourly duration of 0.9 minutes). Compared to other wanderers, they had the least cognitive impairment, slightly poorer mobility that moderate wanderers, and slightly better health than classic wanderers. The proportion of observation periods during which classic, moderate, and subclinical wanderers actually wandered varied by group; classics wandered in 74.69% of 162 observations periods, moderates during 50.16% of 610 periods, and subclinical wanderers in 24.87% of 599 periods.

Independent Variables. Choice of independent variables was driven by the NDB model that postulates a relationship between characteristics of the physical environment and wandering behavior. Variables of interest were location: ambient sound, light, temperature, and humidity levels: environmental ambiance and crowding.

Location of the participant was documented using direct observation by the videographer at 3 time points during each observation period: at onset, after 10 minutes, and at cessation. Prior to observations, specific locations of each study site (eg, dining room, dayroom) were labeled by the research staff on a floor plan of the site to enable consistency in labeling across sites.

Sound, light, temperature, and humidity of the physical environment was measured at the same time points as location during each observation period. To ensure accuracy of sound, light, and temperature and humidity measurements according to study protocols, all research assistants (RAs) were trained by the same trainer and observed monthly for proper technique using a checklist that corresponded to the steps in each protocol. Inter- and intrarater reliability was established. A physical environment assessment (PEA) form was created to accurately record environmental measures taken during observation periods. All readings for sound, light, temperature, and humidity were taken at the beginning of each observation, at 10 minutes, and at 20 minutes (end of the observation).

Sound measurements were taken using the Quest Technologies Model 2400 Sound Level Meter. According to instrument developers at Quest Technologies, the accuracy of the sound measurement is within 0.5 decibels (dB) at 25°C; within 1.0 dB over the temperature range of −10°C to 50° (Sound Level Meter 2400 Instruction Manual, Occomowoc, Wisconsin, 1999). The meter was calibrated weekly and the RAs inspected the meter microphone daily for damage. The meter was held 6 to 8 inches from and level with a subject's ear with the microphone on the top of the meter pointed toward the object or area the subject was facing. The meter ran for 5 seconds and then the value displayed digitally was recorded.

Light levels (lux) were measured using the Gossen Color Pro 3F Light Meter. This meter can accurately measure ambient light from 10 to 190 000 lux (Gossen Instruction Manual, Bogen Photo Inc, Ramsey, New Jersey, Unknown date). This

Table 1. Descriptive Statistics for Environmental Variables

Variable	N	Mean	SD
Ambient light level (in lux)	1018	151.46	298.70
Ambient sound (SD; in decibels)	1048	4.72	4.16
Ambiance—engaging	1057	0.58	.042
Ambiance—soothing	1157	0.71	0.27
Number of people within 8′	1058	3.17	2.58

Abbreviation: SD, standard deviation.

meter was also held 6 to 8 inches from and level with either ear. In addition, the flat diffuser surface of the meter was pointed toward the object or area the subject was facing to avoid shadows falling on the diffuser surface and to assure a correct reading of the lux value in whole numbers.

Temperature and humidity were measured using a thermo-hydrometer (Indoor Humidity Gauge Thermometer, #63-1013, Radio Shack-Tandy Co, Fort Worth, Texas, 1999). The meter was held 6 to 8 inches from the side of the subject's head and facing the same direction as the subject. Because the meter provided a continuous read, after the button was pushed to obtain the most current temperature, approximately 1 minute was allowed before determining the final whole number reading of temperature, in centigrade, and humidity in percentage. This instrument had no mechanism for calibration.

Crowding was assessed at the same time points and by the same individual as was location. The presence or absence of people within 8 feet of the participant was documented to reflect the proximity aspect of crowding.[41]

Environmental ambiance was measured using the ambiance scale (AS) in a 9-item instrument with 2 subscales (engaging and soothing) that captures an observer's subjective impressions of the nursing home environment.[42] It was adapted from an earlier version of Leon Pastalan's instrument by the same name.[43] The current AS uses a semantic differential scoring procedure (from -2 to $+2$) for each bipolar scale response, with 0 being neutral, indicating neither a negative nor a positive emotional valence to the environment. For example, welcoming, personalized, and peaceful would be scored $+2$ while impersonal, regimented, and chaotic would be scored -2. Evidence substantiating reliability and validity of the AS has been reported for 2 independent random samples.[42] In this analysis, Cronbach α was .93 for the engaging subscale and .61 for the soothing subscale.

Data Analysis

Data on resident location were collected 3 times during each observation period, yielding up to 36 observations per resident. Associations between location and wandering were estimated at the level of the observation period using chi-square tests, with 1 observation of location from a period randomly assigned to represent that period.

Associations between environmental characteristics and wandering were estimated at the observation period level using *t* tests; data on environmental characteristics were aggregated to the observation period level by taking means or standard deviations of the observations. Logistic regression was used to test associations between multiple predictors and wandering at the observation period level, using aggregated environmental measures as predictors. Nesting of data within subjects and facilties was not accounted for in these analyses.

Results

Environmental Variables During Wandering Periods

Location. Overall, participants were observed in 11 discrete locations within study sites. About 80% of the time, residents were located in 1 of 4 locations: their own rooms (32%), dayrooms (20%), hallways (17%), and dining rooms (11%). The remaining 20% of observations were distributed across 7 locations ranging from just over 5% occurring in the lobby to approximately 2% to 3% occurring in each of 4 other areas (other residents' rooms, activities rooms, staff areas, and off-unit locations, for example, beauty shop); and <2% occurring in shower/baths and outdoors.

For observations occurring in each of 4 locations, a resident was more likely to be wandering than not (other residents' rooms, 60%; hallways, 73%; shower/bath, 92%; and off-unit locations, 72%). In 5 other locations, a resident was less likely to be observed wandering than not (dining room, 32%; dayroom, 38%; activities room, 40%; staff area, 40%; and the resident's own room, 32%). For observations occurring in the lobby and outdoors, wandering was exhibited about half of the time.

A chi-square analysis examining the locations recorded during observation periods with and without wandering was significant (χ^2 (10, N = 1341) = 140.12, $P < .001$). Coders frequently commented in project notes that residents were often seated so tightly together in the dining rooms during meals that they were effectively restrained; thus, we repeated this analysis excluding periods when the dining room was the documented location at all 3 time points. The resulting chi-square analysis also was significant (χ^2 (10, N = 1032) = 148.98, $P < .001$); in this analysis, wandering was more likely during periods when the resident was in the dining room part of the time (75%); other locations were unaffected. Consequently, observation periods during which the dining room was documented as the location for all 3 time points were dropped from the remainder of analyses reported in this article.

Other Environmental Variables. Descriptive statistics for other environmental variables are shown in Table 1; results of *t* tests comparing these variables during periods with and without wandering are shown in Table 2. Brighter light, more variation in sound levels, and a higher engaging quality of the environment were associated with wandering, and a higher soothing quality of the environment was associated with periods when wandering did not occur.

Table 2. *t* Tests Comparing Environmental Variables During Observation Periods With and Without Wandering

		Mean		
Variable	Df	Wandering	No Wandering	*t*
Ambient Light	2, 1016	177.75	123.91	−2.88**
Ambient sound (SD)	2, 1046	5.13	4.32	−3.14**
Ambiance—engaging	2, 1055	0.61	0.55	−2.29*
Ambiance—soothing	2, 1055	0.69	0.73	2.80**
Number of people within 8′	2, 1056	3.17	3.7	−0.0067

Abbreviation: SD, standard deviation.

Table 3. Associations Between Wandering and Environmental Variables

	Odds Ratio	95% CI	*P* Value
All wanderers (n = 1007), LR χ^2 (5) = 50.38, *P* < .0001			
People within 8′	1.87	1.14, 3.08	.013
Ambient light level	1.00	1.00, 1.00	.008
Ambient sound (S.D.)	1.05	1.02, 1.08	.003
Ambiance—engaging	1.84	1.28, 2.65	.001
Ambiance—soothing	0.28	0.15, 0.50	.000
Classic wanderers (n = 142), LR χ^2 (5) = 12.96, *P* = .02			
People within 8′	5.59	1.03, 30.33	.046
Ambient light level	1.00	1.00, 1.00	.525
Ambient sound (SD)	1.00	0.91, 1.11	.944
Ambiance—engaging	0.83	0.17, 4.13	.821
Ambiance—soothing	0.12	0.02, 0.88	.037
Moderate wanderers (n = 463), LR χ^2 (5) = 24.71, *P* = .0002			
People within 8'	0.92	0.40, 2.10	.840
Ambient light level	1.00	1.00, 1.00	.074
Ambient sound (SD)	1.08	1.03, 1.14	.003
Ambiance—engaging	1.14	0.65, 1.98	.645
Ambiance—soothing	0.24	0.10, 0.58	.002
Subclinical wanderers (n = 402), LR χ^2 (5) = 15.08, *P* = .01			
People within 8'	2.21	1.00, 4.85	.049
Ambient light level	1.00	1.00, 1.00	.020
Ambient sound (SD)	1.03	0.97, 1.09	.314
Ambiance—engaging	1.23	0.67, 2.25	.502
Ambiance—soothing	0.67	0.25, 1.82	.436

Abbreviations: CI, confidence interval, SD, standard deviation.

Physical Environment Predictors of Wandering

In a logistic regression using environmental variables (significant by *t* test) to differentiate periods with and without wandering (see Table 3), the overall model was highly significant (LR $\chi^2 = 50.38$, $P < .0001$). All 5 variables in the model were significant; odds ratios were highest for proximity to people (odds ratio [OR] = 1.87) and the ambiance engaging subscale (1.84). The ambiance soothing subscale was negatively associated with wandering.

Predictors of Wandering Among Wandering Types. Logistic regression analyses were repeated using the same model for each subset of observations representing classic, moderate, and subclinical wanderers. All models were significant (see Table 3) and each had different significant variables. For observations of classic wanderers, significant variables were proximity to people (OR = 5.59) and the ambiance soothing subscale (OR = .12). For observations of moderate wanderers, significant variables were variation in sound levels (OR = 1.09) and the ambiance soothing subscale (OR = .24); the ambiance engaging subscale had the highest odds ratio (1.14). For observations of subclinical wanderers, significant variables were proximity to people (OR = 2.21) and the average light level (OR = 1.002); the ambiance engaging subscale had the highest odds ratio (1.23).

Discussion

Results of this study support relationships posited in the NDB model as concerns the physical environment. With the exception of ambient temperature and humidity, for which variation was insufficient to demonstrate effects, the models evaluated were a good fit to the data. When wandering occurred, most environmental factors measured were at the higher end of obtained values. At the high end, only the soothing aspect of environmental ambiance had a mitigating effect on wandering.

This study clearly demonstrates that the physical environment varies in important ways in relation to the occurrence of wandering behavior and that differing aspects of the environment were significant for different types of wanderers. Wanderers were shown to enter into all areas of the LTC setting, even if relatively infrequently for some locations. Although it is not known whether the observed distribution of locations occurred by self-selection or due to nonobvious effects of exit monitoring and control practices, wanderers were concentrated in 4 locations: their own rooms, dayrooms, hallways, and dining rooms. Only in hallways and dining rooms (during other than meals) did the proportion of observations containing wandering exceed those that did not. The high likelihood of wandering occurring in hallways suggests that facility designs eliminating or minimizing them may serve to reduce a substantial amount of wandering.

Locations in which wanderers were less likely to wander were also those where the likelihood of social interaction was greater (ie, activities room, dayroom, staff area), where the environment was more soothing (ie, their own room); or where rooms had a designated purpose (eg, dayrooms, the wanderer's own room, activities, and staff areas). Conversely, in the dining room (except for mealtimes), bathroom, and other people's rooms—also having specific purposes—wandering was more likely to occur. This contrast suggests that a clear purpose to a space may give clues disfavoring wandering, and thus, when wandering does occur in such spaces, it may indicate either legitimate effort to address a need, such as to locate food in the dining room or to use the facilities in shower/baths, which would be consistent with the NDB model, or misidentification of place, as in the case of entering other residents' rooms. Our data on location are also consistent with an early hypothesis that single purpose use of space may promote function of people with dementia within residential care settings.[44]

In general, individuals known to wander were more likely to do so when a location was more brightly lit, variation in sound level was greater, and surroundings were more engaging; they were less likely to wander when surroundings had a soothing quality. These results are congruent with other investigations by Cohen-Mansfield et al[3] and Yao and Algase.[9] Accordingly, when reducing wandering is an appropriate therapeutic goal, modifying environmental conditions or directing the individual to locations with lower light levels, less variation in sound level, and higher soothing qualities may be beneficial. Conversely, if the goal is to attract or contain wanderers without modification of the amount of wandering, access to a well-lit area fitted with engaging materials or activities may be more appropriate. Ambient temperature and humidity did not differ across observations with and without wandering, possibly due to limited variance in these measures.

The overall logistic regression model and all environmental variables it contained were significant in differentiating observations with and without wandering. However, while results remained significant when the model was examined for to each type of wanderer, they revealed variations in the effects of specific environmental factors for each type. This information may be helpful in modifying environments to better manage the wandering of individuals who fit these profiles.

In sum, this study demonstrated that wandering is ubiquitous throughout LTC settings but is found more frequently in a certain set of locations and more likely than not to occur when the wanderer is present in a somewhat different set of locations. Environmental variables posited in the NDB model were shown to be a good fit to the data in explaining environmental conditions under which wandering was more likely to manifest. The physical environment has long been thought to contribute to behavior. This study offers empirical evidence to support that better lighting, greater variation in sound levels, proximity of others, and an engaging atmosphere are associated with wandering. A soothing environment is inversely associated with wandering. These findings have implications for the design of care environments and practices when working with the wanderers, a vulnerable group of individuals with dementia.

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The author(s) declared no conflicts of interest with respect to the authorship and/or publication of this article

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