

Design of the physical environment is increasingly recognized as an important aid in caring for people with dementia. This article reviews the empirical research on design and dementia, including research concerning facility planning (relocation, respite and day care, special care units, group size), research on environmental attributes (noninstitutional character, sensory stimulation, lighting, safety), studies concerning building organization (orientation, outdoor space), and research on specific rooms and activity spaces (bathrooms, toilet rooms, dining rooms, kitchens, and resident rooms). The analysis reveals major themes in research and characterizes strengths and shortcomings in methodology, theoretical conceptualization, and applicability of findings.

Key Words: Architecture, Alzheimer's disease, Nursing homes, Assisted living

# The Therapeutic Design of Environments for People With Dementia: A Review of the Empirical Research

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Design of the physical environment is increasingly recognized as an important aid in the care of people with Alzheimer's disease and other dementias. Facility administrators and designers now view the design of long-term care, assisted living, and other environments as more than simply decorative. Design is regarded as a therapeutic resource to promote well-being and functionality among people with dementia. This article reviews and analyzes findings from empirical research on the therapeutic impacts of design in dementia care settings.

Since the early 1980s, numerous "design guides"—books and articles offering planning, architectural, and interior design recommendations—have been written to instruct architects and care providers on how to enhance safety, homelikeness, and so forth in dementia care facilities. At least four books of design guidance for dementia environments have been published to date (see Brawley, 1997; Calkins, 1988; Cohen & Day, 1993; Cohen & Weisman, 1991), along with numerous articles in scholarly and professional books and journals (see Appendix A, Note 1). Design recommendations for dementia environments are organized on a continuum by scale, as follows (after Cohen & Weisman, 1991): (a) planning principles—broad decisions made when developing a dementia care facility (e.g., facility planning should accommo-

date a continuum of care); (b) general attributes—desired qualities of the overall environment of the facility (e.g., facility design should promote noninstitutional character); (c) building organization—desired arrangement of spaces within the facility (e.g., building design should support residents' sense of orientation); and (d) specific rooms and activity spaces—the design of particular rooms within the facility (e.g., design of bathrooms should preserve residents' dignity and privacy).

Design guides typically offer "hypotheses" for how the spatial organization and appointment of the physical environment may promote well-being for people with dementia. For example, to minimize the sensory overstimulation that afflicts many people with dementia, design guides recommend modifications such as designation of quiet rooms with soft colors, elimination of unnecessary clutter, and removal of paging systems (cf. Brawley, 1997; Cohen & Weisman, 1991). Frequently, design guidance is based on the practical experience of designers or facility administrators; other times, design guidance is research based, applying findings from clinical research on dementia in the form of design "solutions" (Weisman, Calkins, & Sloane, 1994).

Not all design guidance requires empirical research findings to justify its recommendations. For instance, design guides frequently call for enhanced quality of life in institutional settings (e.g., design strategies to increase homelikeness and autonomy for residents). Such values—essential qualities of dignity, privacy, and so forth—are arguably "inalienable rights" (Lawton, 1981, p. 245) that do not require empirical research for validation.

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Other design guidance does demand verification through empirical research, however. Empirical research is needed to resolve situations in which conflicting design recommendations are offered. Research is also warranted when recommended design solutions are of unknown effectiveness or when design recommendations have major or controversial impacts for cost or quality of life. Research on design and dementia has been conducted in earnest since at least 1980, yet findings of many studies remain unknown among designers and facility administrators. In the following sections, we review and analyze existing studies of design and well-being for people with dementia to enhance the design of dementia facilities and to provide direction for future research.

## Methods

Several strategies were used to identify potential studies for review. The first involved a key-word search of four major databases: Psych Abstracts, Medline, MAGS, and CAT (see Appendix A, Note 2). Potential studies were also identified by reviewing all issues (1980 or later) of several journals in gerontology and environment-design research (see Appendix A, Note 3). Finally, reference lists were inspected for all studies included in this review. In each case, articles, books, and chapters identified as potentially relevant (by title and by abstract if available) were collected and assessed for appropriateness.

Studies included in this review met the following criteria: a report of empirical research (see Appendix A, Note 4), published 1980 or later (see Appendix A, Note 5), written in English, with an emphasis on people with dementia or their families or staff caregivers, and with a substantial (though sometimes secondary) emphasis on the relationship between *the design of the physical environment* and *the well-being of people with dementia, their families, and/or staff*. For this review, the physical environment was loosely defined as the domain of relevance to architects, interior designers, facility managers, and/or administrators or caregivers undertaking environmental design or renovation. Thus, research on issues such as lighting, furnishings, and outdoor space was included. Research on microscale "product" design (e.g., prosthetic devices to facilitate eating) or on the sensory or social environment outside the purview of designers (e.g., incorporation of music and pets) was excluded, as were studies that did not examine actual environments or actual impacts. Well-being was defined broadly, to include factors such as residents' activities of daily living (ADL), physical well-being, cognitive function, and problem behaviors; family members' well-being; and staff well-being and job performance. Seventy-one research reports were included in the review. Because of this selective search strategy, we may have overlooked some relevant material in the review.

### Research Design and Sample Size

Much research on design and dementia comprises small size samples. For example, more than 30% of

the studies reviewed used samples of fewer than 30 participants; many included less than 10 participants. Sample sizes reflect the limited populations of residents at the single facility in which many studies were conducted, the high rates of resident mortality, and facilities' limited populations of residents in comparable stages of dementia. Although they raise concern for the validity and generalizability of findings, studies with small samples were included so as not to severely restrict the scope of this review. Research designs and samples are described in Table 1.

## Results

The rate of research on design and dementia is increasing: from 6 research reports from 1981–1985, to 17 research reports from 1986–1990, to 26 research reports from 1991–1995, and to 21 research reports already published since 1996 (see Table 1). This section summarizes findings from the research reports reviewed, according to the organizational framework presented earlier (i.e., planning principles, general attributes of the environment, building organization, and specific rooms and activity spaces). The summary is followed by a discussion and analysis of existing research on design and dementia.

### Planning Principles

These studies examine broad decisions regarding the development of dementia care settings. Studies examined impacts for well-being following relocation of people with dementia to new environments, use of respite and day care environments and of special care units (SCUs), and exposure to various group sizes of residents.

*Relocation to New Environments.*—Findings are mixed regarding the impacts of relocating people with dementia to new environments (Robertson, Warrington, & Eagles, 1993; Seltzer et al., 1988; see Appendix A, Note 6). When moved together as intact units of residents and staff, people with dementia appear to suffer few or no adverse impacts from relocation (Anthony, Procter, Silverman, & Murphy, 1987; McAuslane & Sperlinger, 1994; Robertson et al., 1993). The more pleasant environment of a new facility may partially explain the lack of negative impact for relocated residents (according to McAuslane & Sperlinger, 1994). In contrast, residents with dementia who are moved individually appear to suffer higher rates of depression and mortality following relocation (Anthony et al., 1987; Robertson et al., 1993). This effect holds when residents undergo orientation to ease relocation. Staff members also report decreased job satisfaction (attributed to anxiety) prior to moving, which returns to premove levels of satisfaction following relocation (McAuslane & Sperlinger, 1994).

*Respite Environments.*—Respite environments offer temporary care for people with dementia and provide relief to families. The impacts of respite environ-

Table 1. Summary of Key Information on the Studies Reviewed on Design and Dementia

Study	Concept of environment <sup>a</sup> , Focus of study	Research design	Sample information	Outcome measures of well-being	Physical environment features	Major finding(s) of environmental impacts on well-being
Annerstedt (1997)	Global: Environmental comparison	Quasi-experiment	28 residents <sup>b</sup> in group living; 29 residents in nursing homes; 293 residents in multiple environments	Residents' ADLs, social dependency, disorientation, confusion, aggressiveness, depression, anxiety, vocal disruptions	Group living units: small scale, private living/bedroom, shared living area and laundry	Group living had therapeutic impacts on people with dementia, especially in early stages.
Annerstedt (1994)	Global: Environmental comparison	Quasi-experiment	28 residents in group living; 29 residents in nursing homes	Residents' physical and social dependence; intellectual, emotional, and motor functions; confusion, irritability, anxiety, fear, mood, restlessness	Group living units: small scale, private living/bedroom, shared living area and laundry	Group living environments minimized dementia deficits.
Annerstedt (1993)	Global: Environmental comparison	Longitudinal study	28 residents in group living; 31 residents in nursing homes	Residents' brain damage: motor, intellectual, emotional ability; ADLs, dementia symptoms, physical activity, drug usage, cost of care	Group living units: small scale, private living/bedroom, shared living area and laundry	Group living units were associated with decreased deficits among residents, reduced emotional strain among relatives, and increased competence and satisfaction among staff.
Anthony, Procter, Silverman, & Murphy (1987)	Global: Environmental services & policies	Quasi-experiment	14 relocated residents; 39 nonrelocated residents in psychiatric hospitals	Staff job satisfaction, attitudes towards care, knowledge of dementia Residents' physical health, psychotropic and other drug usage, disruptive behavior (wandering, feeding, compliance, depressed mood, activity level); psychogeriatric dependency (orientation, self-care, memory, sensory deficits, mobility, continence, feeding) Relatives' satisfaction with unit and care Residents' cognition, function, behavior, somatic health, use of drugs, use of physical restraints	Relocation between hospitals	Relocation to a new unit was associated with depressive behavior and disorientation among residents.
Bellelli et al., (1998)	Global: Environmental comparison	Quasi-experiment	8 relatives of relocated residents 55 residents in 8 SCUs	SCUs: magnetic locks, no environmental obstacles, neutral wall colors, soundproofing, brightly colored room doors and handrails, separate activity area SCU: orientation board, color coded rooms, names/photos on doors, alarm, double door knobs	Residents in SCU demonstrated reduced behavioral disturbances and decreased use of psychotropic drugs and physical restraints.	
Benson, Cameron, Humbach, Servino, & Gambert (1987)	Global: Environmental comparison	One group pretest/posttest	32 residents in SCU	Residents' mental and emotional status (including orientation, intellectual behavior, social behavior, social interaction), ADLs, nursing needs	Residents in SCU demonstrated prolonged increases in mental and emotional functioning and ADLs.	
Blanchetti, Benvenuti, Ghisla, Frisoni, & Trabucchi (1997)	Global: Environmental comparison	One group pretest/posttest	16 residents in SCU	Residents' cognitive status, ADLs, behavioral ratings, psychotropic drug use, physical restraint use	SCU: shared rooms, large wandering area, activity area, dining room, locked doors, wayfinding cues	Upon relocation to SCU, residents demonstrated significant declines in behavioral problems, without improvements in functional abilities or cognitive status.
Chafeitz (1991)	Global: Environmental comparison	Quasi-experiment	12 residents in SCU; 8 residents in nonspecialized dementia unit	Residents' cognitive ability, behavioral appropriateness	SCU: outdoor patio, secure exit doors, secure closet and bureau drawers	SCU was associated with little impact on residents' behavior and cognitive function.
Chafeitz (1990)	Discrete: Design features	Quasi-experiment	30 residents in SCU	Residents' actual and attempted door openings	Tape strips in front of double, glass exit doors	Tape grid in front of glass door did not reduce exit attempts.
Cleary, Clamon, Price, & Shullaw (1988)	Global: Environmental comparison	Quasi-experiment	11 residents in SCU	Residents' functional behaviors, agitation, wandering, incontinence, food consumption, sleep, restraint use, medications, weight, perceptions of unit	SCU: shared rooms; tables for dining in resident rooms; neutral colors, decorations; no TVs, radios, or telephones	SCU was associated with improvements in residents' functioning, including reductions in weight loss, agitation, restraint use, and wandering. Family and staff were satisfied with the SCU.
			11 relatives of residents 32 staff members in SCU 37 general staff	Relatives' satisfaction with the unit Staff knowledge of dementia, satisfaction with work environment		Enhanced nursing home environment was associated with positive impacts on the behavior and mood of residents who pace: staff and relatives also preferred enhanced environments.
Cohen-Mansfield & Werner (1998)	Discrete: Problem behaviors	Quasi-experiment	27 residents in nursing home	Residents' location in the unit, body position, exit-seeking and trespassing, agitation, mood, pacing and wandering, confusion	Enhanced nursing home, incorporating visual, olfactory, and auditory stimuli to simulate home or nature environment	
			23 relatives of residents 29 staff members in nursing home	Preferences for modified environments		

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**Table 1. Summary of Key Information on the Studies Reviewed on Design and Dementia (*Continued*)**

Study	Concept of environment <sup>a</sup> ; Focus of study	Research design	Sample information	Outcome measures of well-being	Physical environment features	Major finding(s) of environmental impacts on well-being
Cohen-Mansfield, Werner, & Marx (1990)	Discrete: Problem behaviors	Survey	24 residents in long-term care facility	Residents' agitation	Location in the unit	Agitation of residents was associated with residents' location in the unit.
Dickinson, McLain-Kark, & Marshall-Baker (1995)	Discrete: Design features	One group pretest/posttest	7 residents in SCU	Residents' exit attempts	Alarmed emergency exit doors, with closed miniblinds over windows, cloth cover over panic bar	Visual barriers significantly reduced residents' exit attempts.
Elmslahti, Annerstedt, & Ahlund (1997)	Discrete: Design features	Quasi-experiment	105 residents in group living units	Residents' confusion, disorientation	Building layouts, amount of space, lighting, noise, size of hallways, homelike appearance and furnishings	Resident orientation was associated with group living unit design that facilitates perception without reducing "communication area."
Göteborg & Melin (1987)	Discrete: Design features	Experiment	21 residents in psychogeriatric ward (19 with dementia)	Residents' eating behavior, communication, activity levels	Noninstitutional dining arrangements (dining in coffee room at small tables with family style service, bright lights)	Noninstitutional dining arrangements improved eating behavior and communication among residents.
Greene, Asp, & Crane (1985)	Global: Environmental comparison	One group pretest/posttest	12 residents in SCU	Residents' hostility, agitation, appetite, self-feeding, combativeness, ambulation, incontinence, dressing, cognitive skills, withdrawal, hallucinations	SCU: single and double rooms, locked doors, personalization, music, dining area	SCU was associated with improvements in residents' behavior, cognitive skills, and affective responses.
Hanley (1981)	Discrete: Problem behaviors	Experiment and quasi-experiment	6 residents in psychogeriatric ward 2 residents in "old people's home"	Residents' orientation ability	Large, 3-D ward signs and large pictorial signs	Signs improved residents' orientation, when used in combination with orientation training
Holmes, Teresi, Weiner, Monaco, Ronch, & Vickers (1990)	Global: Environmental comparison	Longitudinal study	120 residents in skilled nursing facilities 79 residents in health related facilities 49 residents in SCUs	Residents' cognitive ability, depression, arousal, orientation, behaviors, ambulation, mood, activity limitation, family contacts, activity participation, ADLs, satisfaction with the environment, medical symptoms, sleeping, safety precautions, social activities	SCUs: locked exit with alarm, rounded edge furnishings, dining set up for optional feeding of residents, special activity rooms, staff desk placed to monitor egress	SCUs were not associated with significant impacts on residents' functional and cognitive status.
Hussain (1982/83)	Discrete: Problem behaviors	Quasi-experiment	3 residents in long-term care facility	Residents' exit attempts	Supernormal stimuli (i.e., brightly colored cardboard shapes)	Conditioning residents to respond to stimuli reduced residents' exit attempts.
Hussain & Brown (1987)	Discrete: Design features	Quasi-experiment	8 residents in public mental hospital	Residents' exit attempts	Tape grids on the floor in front of exit doors	Tape grid barriers in front of exit doors reduced residents' exit attempts.
Hutchinson, Leger-Krall, & Wilson (1996)	Discrete: Problem behaviors	Ethnographic study	Clients with dementia in day care program <sup>b</sup> 16 relatives	Residents' toileting behavior and issues Relatives' perceptions of resident toileting issues	Number, size, and design of toilet rooms	Ease of toileting was associated with increased number and size of bathrooms.
Jones (1998)	Global: Environmental comparison	Cross-sectional survey	13 day care staff members 29 staff members in two geriatric psychiatry units	Staff perceptions of resident toileting issues Staff attitudes, morale	High stimulation environment, with sociopetal furniture arrangement, recreational materials, orientation aids (mirrors, clocks, signposts, reality orientation boards)	Morale was higher among staff working in a high stimulation environment (i.e., orientation aids, recreational materials, reality orientation programs) compared with staff in a traditional ward.

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**Table 1. Summary of Key Information on the Studies Reviewed on Design and Dementia (Continued)**

Study	Concept of environment; Focus of study	Research design	Sample information	Outcome measures of well-being	Physical environment features	Major finding(s) of environmental impacts on well-being
Kihlgren, Bråne, Karlsson, Kuremyr, Leissner, & Norberg (1992)	Global: Environmental comparison	Quasi-experiment	5 residents in collective living home 5 residents of nursing home relatives' staff	Residents' mental and somatic health: orientation, motor functions, vision, hearing, speech, ADLs, behavioral disturbance, work load, psychiatric symptoms Perceptions of residents' living	Collective living home: separate apartments with own furniture, rooms for common activities	Residents in collective living demonstrated better social abilities, more alertness, reduced depression, and more disturbances, than did residents in a nursing home. Staff were more accepting of residents' behavior in collective living than in nursing home.
Koss & Gilmore (1998)	Discrete: Design features	Quasi-experiment	13 residents in dementia unit	Residents' amount of food intake, amount of help needed eating, agitation	Increased light intensity, high contrast tablecloth, place mats, dishes, and so forth for dining	Heightened contrast and increased light were associated with increased food eaten and reduced agitation among residents.
Kovach & Meyer-Arnold (1996)	Discrete: Problem behaviors	Cross-sectional survey	18 residents in SCU 15 clients in day care program	Residents' behavior (especially agitation) during bathing, caregiver behavior during bathing	Physical features in and outside the bathroom that impact bathing, tubs versus showers	Environmental (and other) features are associated with increased agitation during bathing.
Lawton, Liebowitz, & Charon (1970)	Global: Environmental comparison	Quasi-experiment	9 original residents in long-term care, 6 new residents (including one original) in SCU	Residents' mental status, number of personnel present, staff-to-resident interaction, resident-to-resident interaction, self-maintaining behavior, active interest, location of resident, excursions off unit	SCU: private rooms, noninstitutional design (bright colors, pattern, bird noises, planter, space for personal belongings), defined social space	SCU was associated with decreased personal interactions, decreased self-maintaining behavior, increased mobility, and increased range of behavior among residents.
Lawton, Fulcomer, & Kleban (1984)	Global & discrete: Environmental comparison	Post-occupancy evaluation	56 residents in SCU 134 relatives of long-term care residents 86 relatives of SCU residents 80 staff members in long-term care unit 60 staff members in SCU 6 residents in skilled nursing facility	Residents' location and social behavior Relatives' assessment of old and new building Staff assessment of old and new building	SCU: bright room decor, color coding, graphics, large orienting stimuli, large central area	SCU design was associated with increased therapeutic impact, decreased pathological behaviors, and decreased self-maintenance behaviors among residents. SCU design was associated with increased visits from relatives.
Lovell, Ancoli-Israel, & Gevirtz (1995)	Discrete: Design features	Quasi-experiment	Residents' agitation	Exposure to bright light	Exposure to bright light reduced resident agitation, with greatest impacts on residents in mid- to late-stage dementia.	Exposure to bright light reduced resident agitation, with greatest impacts on residents in mid- to late-stage dementia.
Lyman (1989)	Global: Environmental comparison	Quasi-experiment	Staff at day care center for dementia and nondementia clients	Staff stress and quality of caregiving	Relocation of day care center to enhanced facility (safety and surveillance features, enclosed garden, therapy rooms)	Relocation of day care center to enhanced facility was associated with positive and negative changes in the nature of staff stress and quality of care.
Mayer & Darby (1991)	Discrete: Design features	Quasi-experiment	9 residents in psychogeriatric ward	Residents' exit attempts	Placement of mirror, reverse mirror in front of exit door	Mirror in front of exit door reduced residents' exit attempts.
McAllister & Silverman (1999)	Global: Environmental comparisons	Ethnographic study	Population of personal care home of 59 residents. 8 residents in personal care home 8 residents in nursing home	Residents' experience of community, participation in activities, social networks and relationships, roles	Personal care home: small groups of residents, private rooms, kitchenette, dining room, living room, patio, wandering path and common rooms	Personal care home was associated with increased resident responsiveness to the environment and with community building.

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**Table 1. Summary of Key Information on the Studies Reviewed on Design and Dementia (Continued)**

Study	Concept of environment <sup>a</sup> ; Focus of study	Research design	Sample information	Outcome measures of well-being	Physical environment features	Major finding(s) of environmental impacts on well-being
McAuslane & Sperlinger (1994)	Global: Environmental services & policies	Quasi-experiment	15 residents relocated to community nursing home 12 residents remaining in psychogeriatric ward 16 relocated staff 19 staff not relocated 11 residents in SCU	Residents' behavioral dependence, problem behaviors  Staff job satisfaction	Relocation from a psychogeriatric ward to a community nursing home	Relocated residents showed no evidence of changes in behavioral dependency or in the number of problem behaviors. Staff initially reported increased job dissatisfaction prior to relocation. Closed SCU was associated with improved functioning among residents.
McCracken & Fitzwater (1989)	Global: Environmental comparison	One group pretest/posttest Experiment	21 residents in psychogeriatric ward (19 with dementia)	Residents' behavior (language, social interaction, attention, orientation, motor coordination, incontinence, eating, dressing, and grooming) Residents' eating behavior, communication	Open versus closed dementia unit  Noninstitutional dining arrangements	Closed SCU was associated with improved functioning among residents.
Melin & Göttestam (1981)	Discrete: Design features	Experiment	14 residents in psychogeriatric ward	Residents' sleep time, behavior disorders, melatonin secretion levels	Exposure to morning bright light therapy	Noninstitutional dining arrangements improved eating behavior and communication among residents.
Mishima, Okawa, Hishikawa, Hozumi, Hori, & Takahashi (1994)	Discrete: Design features	Longitudinal study	10 residents without dementia in psychiatric hospital Residents in five SCUs (each with 25–31 residents)	Residents' incidents (falls, injuries, aggression, missing, other), time spent outdoors	Therapeutic and traditional outdoor environments	Exposure to bright light increased residents' total and night sleep time, reduced day sleep time, and reduced behavior disorders.
Moony & Nicell (1992)	Discrete: Design features	Longitudinal study	22 residents in SCU Staff in SCU	Residents' experience of dining, social interaction, homelikeness, interactions with staff Staff behavior and attitudes towards residents	SCU: small group size; clustered dining and living rooms, kitchen; wandering area, views to outdoors, day light, religious corner, common areas	Use of outdoor environments reduced incidents and aggressive behavior among residents.
Morgan (1999)	Global: Implied environmental comparison (though one case only)	Ethnography	9 relatives of residents relocated from high to low density SCU 9 relocated staff members	Relatives' assessment of buildings, perceptions of density and of private rooms Staff assessment of buildings, perceptions of density and of private rooms	Low density SCU: small group size, overall facility size, private rooms and bathrooms	SCU was associated with enhanced social interaction and friendship formation among residents, but organizational and physical factors in SCU limit therapeutic potential.
Morgan & Stewart (1999)	Discrete: Design features	Cross-sectional survey	39 residents relocated from one high density long-term care unit to another 14 residents relocated from high density long-term care to low density SCUs 11 residents remaining in high density unit	Residents' disruptive and nondisruptive behavior	Small group size, small facility size, and private residents rooms of SCU were evaluated as positive features.	Small group size, small facility size, and private residents rooms of SCU were evaluated as positive features.
Morgan & Stewart (1998)	Discrete: Design features	Quasi-experiment	22 residents in SCU 12 primary care staff in SCU	Residents' disruptive and nondisruptive behavior	Group size, overall facility size, private rooms and bathrooms	Residents relocated to low density SCU displayed improvements in disruptive and nondisruptive behavior.
Namazi & Johnson (1996)	Discrete: Problem behaviors	Longitudinal study	8 residents in SCU 22 residents in SCU	Residents' bathing habits; bathing safety; bathing problem behavior, especially aggression and agitation Staff perceptions of bathing and bathing problems	Bathing environment and equipment	Institutional tub was associated with resident apprehension and resistance, and is regarded as unfamiliar.
Namazi & Johnson (1992a)	Discrete: Design features	Quasi-experiment	22 residents in SCU	Residents' ability to dress independently, staff assistance in dressing	Closet modification: presents only clothes to be worn, in appropriate order	Closet modifications enhanced residents' independence in dressing.
Namazi & Johnson (1992b)	Discrete: Design features	One-shot case study intervention	22 residents in SCU	Residents' independent selection of snacks and snacking choices	Glass-door and dormitory-style refrigerators with snacks, in resident kitchens	Neither visible nor accessible refrigerators greatly increased incidences of independent snacking among residents.
Namazi & Johnson (1992c)	Discrete: Design features	Quasi-experiment	22 residents in SCU	Residents' agitation levels, exiting behavior	Unlocking door to secure outdoor area	Free access to a secure outdoor area decreased residents' agitated behavior.

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**Table 1. Summary of Key Information on the Studies Reviewed on Design and Dementia (Continued)**

Study	Concept of environment <sup>a</sup> ; Focus of study	Research design	Sample information	Outcome measures of well-being	Physical environment features	Major finding(s) of environmental impacts on well-being
Namazi & Johnson (1992d)	Discrete; Design features	Quasi-experiment	12 residents in SCU	Residents' distractions and focus on task	Cloth barriers used to create activity areas	Environmental barriers were associated with reduced visual and auditory distractions and increased focus in attention among residents.
Namazi & Johnson (1991a)	Discrete; Design features	Experiment	14 residents in SCU	Residents' frequency and appropriateness of toilet use	Curtains surrounding toilet in lieu of doors	Visual access to toilets increased residents' use of toilets.
Namazi & Johnson (1991b)	Discrete; Design features	Quasi-experiment	44 residents in two SCUs	Residents' ability to locate and use the toilet	Signage with various words, symbols to indicate "toilet"	Verbal and pictorial signage increased residents' ability to locate the toilet.
Namazi, Rosner, & Calkins (1989)	Discrete; Design features	Quasi-experiment	9 residents in SCU	Residents' exit attempts	Tape grids in front of exit doors, cloth cover over panic bar, disguise of door knob (paint, knob cover)	Cloth covers on door knobs decreased residents' exit attempts.
Namazi, Rosner, & Rechlin (1991)	Discrete; Design features	Experiment	10 residents in SCU	Residents' identification of their rooms	Display cases outside residents' rooms, with and without personally meaningful memorabilia	Display cases with meaningful memorabilia increased residents' identification of rooms.
Negley & Manley (1990)	Discrete; Design features	Quasi-experiment	Residents in 47-bed SCU	Residents' assaultive behavior	Relocation of dining to two day rooms on dementia unit	Residents' assaultive behavior decreased following relocation of dining to the dementia unit.
Nelson (1995)	Discrete; Problem behaviors	Ethnographic study	Residents in 59-bed skilled nursing facility	Residents' disruptive behavior	Environmental stressors, including loud noise, crowds of people, frightening images, entertainment	Residents' assaultive behavior was associated with environmental stressors.
Netten (1993)	Discrete; Both design features and problem behaviors	Longitudinal study	79 residents in 13 residential care homes	Residents' apathy, social disturbance, orientation, discontentedness, agitation, smiling	Access to outdoors, private space, personalization, light, quiet, territoriality, private rooms, room size, room changes	Environmental features were associated with orientation, social disturbance, apathy, and discontentedness among residents.
Netten (1989)	Discrete; Problem behaviors	Cross-sectional survey	104 residents in 6 group homes and 7 communal homes	Residents' wayfinding ability	Building complexity, decision points, number of zones, color coding, signage	Building configuration and type of facility were associated with orientation among residents.
Passini, Rainville, Marchand, & Joannette (1998)	Discrete; Problem behaviors	Experiment	14 people with dementia 28 healthy older adults	Residents' spatial orientation, wayfinding	Building configuration, environmental information	Simple building configuration and explicit environmental information were associated with resident orientation.
Phillips et al., (1997)	Global; Environmental comparison	Cross-sectional survey	77,337 residents in 841 SCUs and nursing homes in four states	Residents' functional status, weight, ADL function, cognitive performance, behavior problems	SCUs: Overall environmental quality, including cleanliness, homelikeness, lighting, stimulation	Functional decline rates for SCU residents were comparable to those for non-SCU residents.
Pynoos & Ohta (1991)	Discrete; Design features	Evaluation research	12 caregivers of people with dementia, at home	Relatives' evaluation of effectiveness of modifications	Home modifications, including handrail, reality orientation board, raised toilet seat, bidet, grab bar, bath modifications	Nine months after adoption, most home modifications were evaluated by relatives as still effective.
Robertson, Warrington, & Eagles (1993)	Global; Environmental services & policies	Quasi-experiment	73 residents in psychogeriatric wards relocated as intact units 47 residents in psychogeriatric wards relocated individually	Residents' mortality	Relocation of residents as units or individually	Relocation was associated with increased mortality for residents who were relocated individually.

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Table 1. Summary of Key Information on the Studies Reviewed on Design and Dementia (*Continued*)

Study	Concept of environment; Focus of study	Research design	Sample information	Outcome measures of well-being	Physical environment features	Major finding(s) of environmental impacts on well-being
Satlin, Volicer, Ross, Herz, & Campbell (1992)	Discrete; Design features	Quasi-experiment	10 residents in veterans hospital	Residents' agitation, sleep patterns, restraint usage, medication usage	Exposure to bright light	Exposure to bright light was associated with improved sleep patterns among residents, but not with reduced agitation or reduced use of restraints.
Saxton, Silverman, Ricci, Keane, & Deeley (1998)	Global: Environmental comparison	Longitudinal study	26 residents in SCU	Residents' ADLs (self-care, toileting, social/cognitive function, mobility), cognitive impairment, problem behaviors, depression, falls	SCU: cluster design, small groups, wandering path	SCUs were associated with preserved mobility among residents, but not with reduced functional decline.
Scandura (1995)	Discrete; Problem behaviors	Quasi-experiment	19 residents in nursing home residents in SCU <sup>c</sup>	Residents' falls	Special furnishings: bean bag chairs, futons, mattresses placed on floor	Special furnishings were associated with reduced falls among residents.
Seltzer et al., (1988)	Global: Environmental services & policies	One group pretest/posttest	37 clients at dementia respite center in veterans hospital	Clients' cognitive status, functional status (dressing, sleeping pattern, muscular rigidity, self-feeding, ambulation, joint contractions, muteness, eye contact), language, mood, communication, social contact, cooperation	Respite environment	Respite care was associated with improved function of lower functioning residents and with slight deterioration among higher functioning residents.
Skea & Lindsay (1996)	Global: Environmental comparison	Quasi-experiment	19 residents in community hospital ward 24 residents in partnership scheme homes 8 staff in community hospital ward 12 staff in partnership scheme homes	Residents' cognitive impairment, depression, self-care, mobility, communication, social functioning, quality of life on the unit (quantity and quality of interaction) Staff job satisfaction, psychological well-being	Group size, shared common spaces, private rooms and bath rooms, control	Partnership scheme homes were associated with enhanced communication skills, self-care skills, mobility, social functioning, and quality of life among residents, but not with enhanced cognitive status.
Sloane et al., (1998)	Discrete; Problem behaviors	Cross-sectional survey	Residents in 53 SCUs in four states	Residents' agitation, wandering	SCUs: environmental quality, including design, maintenance, space, seating, lighting, noise, resident rooms, stimuli, unit size	Increased environmental quality was associated with reduced agitation and reduced wandering among residents.
Swanson, Maas, & Buckwalter (1993)	Global: Environmental comparison	Quasi-experiment	13 residents in SCU 9 residents in long-term care	Residents' catastrophic behavior, unscheduled interactions and activities, wandering	SCU: safe wandering, separation of dementia residents, safe and sturdy furnishings	SCU was associated with reduced catastrophic reactions and more spontaneous reactions among residents, but not with reduced wandering.
Teresi, Holmes, & Monaco (1993)	Discrete; Problem behaviors	Longitudinal study	77 cognitively intact residents in integrated units, including 23 living near residents with dementia	Cognitively intact residents' depression, demoralization, life dissatisfaction, living status	Residential proximity of cognitively intact residents to residents with dementia	Close residential proximity to residents with dementia was associated with increased depression, demoralization, and life dissatisfaction among cognitively intact residents.
Ulla, Johanna, & Raimo (1998)	Global: Environmental services policies	One group pretest/posttest	85 residents living at home	Residents' mood, functional ability, cognitive functioning	SCUs: homelike environments with kitchens, one in familiar urban setting and one with backyard, sauna, balcony	Use of respite environments located in SCUs was not associated with deterioration of residents, and was associated with rehabilitation for some residents.
Van Someren, Kessler, Mirmiran, & Swaab (1997)	Discrete; Design features	Quasi-experiment	22 patients with dementia	Residents' rest-activity rhythms	Exposure to indirect (ceiling-mounted) bright light	Increased exposure to bright light was associated with improved circadian rest-activity rhythms among residents.

(Table continues on next page)



Table 1. Summary of Key Information on the Studies Reviewed on Design and Dementia (*Continued*)

Study	Concept of environment <sup>a</sup> ; Focus of study	Research design	Sample information	Outcome measures of well-being	Physical environment features	Major finding(s) of environmental impacts on well-being
Webber, Breur, & Lindeman (1995)	Global; Environmental comparison	Quasi-experiment	12 residents in 4 SCUs 10 residents in 4 skilled nursing facilities 8 staff in 4 SCUs 10 staff in 4 skilled nursing facilities	Residents' cognitive functioning, behavior, problem behaviors, affect, mood, ADLs, weight, socialization, falls, activity participation, physical and pharmacological restraint usage, interaction Residents' background, dispensation Staffing patterns, training, job rewards and stressors, work history, interactions	Privacy, special therapeutic features (wandering path, special activity areas, environmental cues)	SCUs and skilled nursing facilities were associated with few differences in resident outcomes or in facility/staffing characteristics.
Wells & Jorm (1987)	Global; Environmental services & policies	Experiment	12 residents in SCU 10 residents at home using respite and other services 26 family caregivers of residents in SCU or at home using respite	Residents' and clients' cognitive ability, physical and perceptual skills, occupation, independent functioning, behavior problems, communication Caregivers' general health, anxiety, depression, quality of life, guilt, grief	SCU placement versus home plus respite care and other services	Placement of residents in SCUs was associated with reduced psychological symptoms among relatives. Both SCUs and other alternatives were associated with declines in residents' abilities.
Whall et al., (1997)	Discrete; Problem behaviors	Experiment	31 residents in 5 nursing homes	Residents' aggression, agitation	Natural elements (animal, bird, nature sounds and pictures, food) during bathing	Introduction of natural elements was associated with reduced agitation of residents during bathing.
Witzius, Gambert, & Duthie (1981)	Global; Environmental services & policies	Quasi-experiment	20 cognitively intact residents	Residents' orientation, intellectual and social behavior, social interaction, sensory perception, ADLs (hygiene, sleep, nutrition, elimination, ambulation)	Integration or segregation of people with dementia and cognitively intact residents	Integration of cognitively impaired and nonimpaired residents was associated with declines in mental and emotional status for cognitively intact residents.
Wimo, Nelvig, Adolfsson, Mattson, & Sandman (1993)	Global; Environmental comparison	Quasi-experiment and survey	31 residents in SCU in mental hospital 31 residents in mental hospital 23 staff	Residents' orientation, ADL function, imposed work load, drug usage Staff assessment of program effectiveness	SCU: familiar decorations, mirrors, signage, TV, radio, newspapers, access to personal belongings	SCU was associated with positive staff assessment. SCU and mental hospital were associated with declines in residents' ADLs, orientation, and behavior.

Note: ADL = activities of daily living; SCU = special care unit.

<sup>a</sup>Conceptualization of the physical environment—either “globally” (i.e., as a single entity, including the physical and social environment, without isolation of specific physical features) or discretely (i.e., with one or more features of the physical environment treated as variables and other aspects of the environment held constant). (Modeled after Weisman, Calkins, & Sloane, 1994.)

<sup>b</sup>Unless otherwise specified, “residents” are people with dementia.

<sup>c</sup>Information not provided.

ments on people with dementia appear to be related to individuals' functional levels and to the type of environment. In an examination of 37 clients of respite services, Seltzer and colleagues (1988) found that, following a 2-week respite stay, lower functioning individuals showed small improvements in ADLs, whereas higher functioning individuals showed a small decline in ADLs. Both effects were minor, and neither group revealed any changes in cognitive status following respite. In a study of 85 people with dementia, use of respite environments for approximately 2 weeks was associated with little deterioration and with improvements in cognitive function and mood (Ulla, Johanna, & Raimo, 1998). Improvements were attributed to the therapeutic philosophy and care plan of the SCUs, and to the SCUs' homelike environments. Thus, findings largely support the use of respite as an alternative to home care alone, because negative impacts of respite are limited.

**SCUs.**—Generally, SCUs are segregated units that accommodate only cognitively impaired individuals, such as those with dementia. SCUs distinguish themselves by offering one or more "special" features, including dementia-appropriate activities, small groups of residents, special staff selection and training, family involvement, and specialized design (see also Berg et al., 1991). According to a survey of 31 SCUs in five states, the most typical, distinguishing environmental features of SCUs (compared to nonspecialized units) include smaller size units, fewer resident rooms, and more designated private rooms (Mathew & Sloane, 1991). SCUs are further characterized by the presence of private dining rooms, separate and larger activity rooms, and access to the outdoors (Mathew & Sloane, 1991).

The effectiveness of SCUs for people with dementia has been subject to debate. A complete review of this multifaceted research is beyond the scope of this article, in which we focus on the physical environment only (for reviews, see Maslow, 1994; Teresi, Grant, Holmes, & Ory, 1998; Weisman et al., 1994). General information on the impacts of SCUs warrant mention, however. Studies show associations between SCU environments and improvement or slowed decline in residents' communication skills, self-care skills, social function, mobility, and affective responses (Benson, Cameron, Humbach, Servino, & Gambert, 1987; Greene, Asp, & Crane, 1985; McCracken & Fitzwater, 1989; Skea & Lindesay, 1996). Additionally, SCUs are associated with reductions in behavior disturbances, abnormal motor activity, apathy, and hallucinations among residents (Annerstedt, 1993; Bellelli et al., 1998; Benson et al., 1987; Greene et al., 1985; McCracken & Fitzwater, 1989; Swanson, Maas, & Buckwalter, 1993).

Other positive impacts of SCUs reported in these studies include reduced emotional strain among relatives and increased competence and satisfaction among staff (Annerstedt, 1993; Wells & Jorm, 1987; see Appendix A, Note 7). Segregation of dementia residents into special units also appears to benefit

residents without cognitive impairments. Cognitively intact residents are found to suffer declines in mental and emotional status when living in close residential proximity to people with dementia (Teresi, Holmes, & Monaco, 1993; Wiltzius, Gambert, & Duthie, 1981).

Alternately, SCUs are reported to have little or no positive effect on residents' wandering, cognition, functionality, and behavior, or on staff job satisfaction or job pressure (Bellelli et al., 1998; Chafetz, 1991; Holmes et al., 1990; Ramirez, Teresi, Holmes, & Fairchild, 1998; Saxton, Silverman, Rica, Keane, & Deeley, 1998; Skea & Lindesay, 1996; Swanson et al., 1993; Webber, Breuer, & Lindeman, 1995). Reports of findings do not distinguish between SCUs with and without special environmental features. Many studies of SCUs include small sample sizes and lack comparison groups (see Table 1 for details.)

It is difficult to assess whether specialized design features in SCUs have any impact on people with dementia. First, SCUs are not comparable, because what is considered an SCU varies enormously (Maslow, 1994; Teresi, Holmes, Ramirez, & Kong, 1998). Second, most SCUs do not use extensive specialized design features (U.S. Office of Technology Assessment, 1992, in Maslow, 1994). Further, special features used in SCUs (staffing, activities, design, etc.) are frequently treated by researchers as one "global" intervention (Weisman et al., 1994; see Appendix A, Note 8). Thus, potential impacts from individual design features (private rooms, minimal sensory stimulation, etc.) are obscured by simultaneous modifications in other arenas. When used, design features may not be identified by researchers as highly significant aspects of the special intervention (cf. Skea & Lindesay, 1996; Swanson et al., 1993). For these reasons, the impact of specialized design cannot be easily distinguished in much existing research on the effectiveness of SCUs.

**Day Care Centers.**—Only one study was identified that specifically examined the design of day care centers in terms of therapeutic impacts. In this research, relocation of a day care center to an enhanced facility (including safety and surveillance features, an enclosed garden, and more space for day health programs and activities) was associated with positive and negative changes in staff stress and quality of care (Lyman, 1989). Following the move, staff stress shifted from that prompted by space shortages to (lower) stress associated with specific spatial configurations (e.g., difficulty involving clients in activities in new, larger activity areas). Negative impacts on quality of care associated with limited space (e.g., insufficient space for clients to conduct specific activities as long as desired) were also reduced following relocation.

**Group Size and Clusters of Residents.**—Design guides suggest that units with fewer residents may reduce overstimulation among people with dementia by controlling noise and by limiting the number of people each resident encounters. This recommendation is supported by research findings, including those of

a major survey of 53 SCUs in four states (Sloane et al., 1998). According to this study and others, larger unit sizes are associated with higher resident agitation levels and with increased intellectual deterioration and emotional disturbances (Annerstedt, 1994; Sloane et al., 1998). Further, residents in larger units exhibit more frequent territorial conflicts, space invasions, and aggressiveness toward other residents (Morgan & Stewart, 1998). In contrast, people with dementia residing in smaller units experience less anxiety and depression and more mobility (Annerstedt, 1997; Skea & Lindesay, 1996). Small group sizes are also positively associated with increased supervision and interaction between staff and residents (McCracken & Fitzwater, 1989) and with social interaction and friendship formation among residents (McAllister & Silverman, 1999; Moore, 1999; Netten, 1993). No consistent numbers are offered for what constitutes a "large" or a "small" unit.

Smaller facilities offer additional benefits for residents and staff. In a comparison of 28 residents of group living facilities (see Appendix A, Note 9) and 31 residents of traditional nursing homes, residents of group living displayed higher motor functions and slightly improved or maintained ADLs and required less usage of antibiotics and psychotropic drugs (Annerstedt, 1993; see Appendix A, Note 10). In the same study, relatives with family members in group living units reported lower levels of strain and better attitudes toward dementia care than relatives of residents in nursing homes. Staff members also experienced benefits associated with group living facilities. Staff in group living units reported greater competence, more knowledge in dealing with dementia, and greater job satisfaction than did their counterparts in nursing homes (Annerstedt, 1993).

### *General Attributes of the Environment*

These studies investigate desired qualities of the overall facility environment. Studies have examined effects on well-being associated with noninstitutional character, levels of sensory stimulation, lighting levels, and design modifications for safety.

*Noninstitutional Character.*—Design guides frequently endorse the use of noninstitutional design features, such as homelike furnishings and personalization, to promote well-being among residents. This endorsement is supported by research findings, though studies often compare facilities in which many features vary (e.g., staff training, activity programming), in addition to environmental design. Noninstitutional environments characterized as having homelike or "enhanced" ambiance (personalized rooms, domestic furnishings, natural elements, etc.) are associated with improved intellectual and emotional well-being, enhanced social interaction, reduced agitation, reduced trespassing and exit seeking, greater preference and pleasure, and improved functionality of older adults with dementia and other mental illnesses (Annerstedt, 1994; Cohen-Mansfield & Werner, 1998;

Kihlgren et al., 1992; McAllister & Silverman, 1999; Sloane et al., 1998). Compared with those in traditional nursing homes and hospitals, residents in noninstitutional settings are less aggressive, preserve better motor functions, require lower usage of tranquilizing drugs, and have less anxiety. Relatives reported greater satisfaction and less burden associated with noninstitutional facilities (Annerstedt, 1997; Cohen-Mansfield & Werner, 1998; Kihlgren et al., 1992). Staff also prefer less institutional, enhanced environments (Cohen-Mansfield & Werner, 1998).

Noninstitutional environments are not entirely beneficial, however. A higher degree of homelikeness is associated with greater restlessness, more disturbances (tied to greater assertion of independence), and increased disorientation and deterioration of diet (Elmstahl, Annerstedt, & Åhlund, 1997; Kihlgren et al., 1992; Wimo, Nelvig, Adolfsson, Mattsson, & Sandman, 1993). Studies also show that mortality and decline rates for residents do not significantly improve in noninstitutional units when compared with traditional settings (Annerstedt, 1994; Phillips, Sloane, Howes, & Koch, 1997; Wimo et al., 1993). Further, noninstitutional design requires supportive caregiving to be effective. In an ethnographic study of one facility, "institutional" caregiving practices (characterized as inflexible and formal) were described as undermining the therapeutic potential of the home-like environment (Moore, 1999).

*Sensory Stimulation.*—Residents face difficulties with sensory overstimulation, which may increase the distraction, agitation, and confusion associated with dementia. Sensory overstimulation may be exacerbated by the normal hearing loss that accompanies aging and the further hearing loss associated with dementia, both of which may increase confusion and reduce social interaction and self-esteem (Brawley, 1997; see Appendix A, Note 11). (Visual deficits, discussed later, further increase overstimulation.) At the same time, sensory deprivation has been identified as a potential problem in many dementia care environments (Cohen & Weisman, 1991). Design guides call for appropriate levels of sensory stimulation, striking a careful balance between environmental overstimulation and deprivation. Recommendations include removing unnecessary clutter, providing tactile stimulation in surfaces and wall hangings, and eliminating overstimulation from televisions, alarms, and so forth (cf. Evans, 1989; Hall, Kirschling, & Todd, 1986).

Researchers have identified characteristics and locations linked with high levels of sensory stimulation in environments for people with dementia. In an ethnographic study of one skilled nursing facility, overstimulation is associated with loud noises (loud talking, singing and clapping, etc.), with crowding and disruptive behavior from other residents, and with frightening experiences (e.g., scary movies, costumes; Nelson, 1995). High stimulation—as measured by agitation levels—was found to occur in elevators, corridors, nursing stations, bathing rooms, and other

residents' rooms, whereas low stimulation has been observed in activity and dining rooms (Cohen-Mansfield, Werner, & Marx, 1990; Negley & Manley, 1990). Detailed descriptions of these spaces were not provided by researchers.

Overstimulation may impair residents' ability to concentrate. Limited stimulation activity areas—made by hanging cloth partitions to eliminate views to ongoing activity—reduce distractions among residents by up to two-thirds (Namazi & Johnson, 1992b). Use of partitions increased the ability to focus on a task among residents in all stages of dementia by eliminating some visual and especially auditory distractions (e.g., noise, talking).

Findings on the effects of low stimulation units are mixed. Use of a neutral design and color scheme, elimination of stimulation, and consistent daily routines have been shown to reduce behavioral disturbances, curtail use of physical and chemical restraints, and encourage weight gain (Bianchetti, Benvenuti, Ghisla, Frisoni, & Trabucchi, 1997; Cleary, Clamon, Price, & Shullaw, 1988). Similarly, in one quasi-experiment, 13 residents of an SCU that incorporated structured resident routines and reduced stimulation displayed fewer catastrophic reactions and more positive interactions, compared with nine residents in long-term care (Swanson et al., 1993). Reduced stimulation units have had little effect in regulating sleep patterns, decreasing urinary incontinence, or discouraging wandering, however (Bianchetti et al., 1997; Cleary et al., 1988; Swanson et al., 1993; see Appendix A, Note 12).

Design guidance argues that certain levels of sensory stimulation may be required to promote engagement in activities and interaction and to minimize withdrawal among people with dementia (cf. Calkins, 1988). The positive impacts of sensory stimulation have received limited research. The experimental Weiss Institute of the Philadelphia Geriatric Center was designed to maximize positive sensory stimulation; this facility featured resident rooms opening directly to a central open space. The spatial configuration was intended to enhance residents' orientation and engagement in activities (Lawton, Fulcomer, & Kleban, 1984). Indeed, in a postoccupancy evaluation of the Weiss Institute, residents were found to spend less time in their rooms and were more attentive to activity following relocation to this facility (Lawton et al., 1984). In a related study, a high stimulation environment (including orientation aids, recreational materials, and extensive reality orientation programs) was associated with increased morale among 16 staff members in one unit, compared with morale among 13 staff members in a traditional dementia unit (Jones, 1988). The focus on increasing structure and resident orientation in the high stimulation unit suggests other possible explanations for enhanced staff morale in this unit.

*Lighting and Visual Contrast.*—People with dementia face particular visual deficits, including difficulty

with color discrimination, depth perception, and sensitivity to contrast (Cronin-Golumb, 1995). These deficits exacerbate normal changes in vision that accompany aging, such as irritation from glare and changes in color perception (Brawley, 1997). Design guides for dementia environments recommend strategies to reduce glare, increase contrast where appropriate, and minimize confusion concerning depth perception. Design guides also recommend increasing overall light levels and exposure to bright light (cf. Brawley, 1997).

Compared with other older adults, people with dementia are exposed to inadequate levels of bright light (described as light exceeding 2,000 lux; Campbell, Kripke, Gillin, & Hrubovcak, 1988). In findings from two studies involving 24 and 10 residents, respectively, bright light treatment consistently regulated circadian rhythms and improved sleep patterns among people with dementia (Mishima et al., 1994; Satlin, Volicer, Ross, Herz, & Campbell, 1992; see Appendix A, Note 13). Results are mixed concerning the impact of bright light on agitation (Lovell, Ancoli-Israel, & Gevirtz, 1995; Mishima et al., 1994; Satlin et al., 1992).

Most often, research on the effects of bright light is conducted under laboratory conditions, requiring special equipment and the restraint of residents. The effects of bright light as a regular environmental feature have received limited attention. One quasi-experimental study was identified in which researchers examined the effect of ceiling-mounted light fixtures that provided high intensity illumination (790–2,190 lux; Van Someren, Kessler, Mirmiran, & Swaab, 1997). Bright light administered in this fashion fostered behavioral improvements and increased circadian rest-activity rhythms among 22 people with severe dementia. Residents in facilities with low overall light displayed higher agitation levels (Sloane et al., 1998). Residents in units with inadequate lighting showed no difference in psychiatric symptoms compared with residents in units with ample lighting, however (Elmståhl et al., 1997).

Little research on the impacts of visual contrast in dementia care environments was identified, though this strategy is frequently recommended to enhance "legibility" or clarity of the environment. In one quasi-experiment, 13 residents with dementia ate more and displayed less agitation when dining arrangements incorporated brighter light and heightened color contrast (i.e., high contrast tablecloths, place mats, dishes; Koss & Gilmore, 1998).

*Safety.*—Residents' attempts to leave facilities or homes present a major safety concern for staff and family caregivers. Design solutions to prevent unwanted exiting often do so by exploiting residents' cognitive deficits. For instance, in a study involving nine residents of a psychogeriatric ward, a full length mirror placed in front of the exit door reduced residents' exit attempts by half (Mayer & Darby, 1991). A reverse mirror had a similar, but less significant ef-



fect. Impacts were attributed to residents' loss of memory of personal identities; accordingly, residents may have been distracted from exiting when engaged or frightened by the image of an approaching "stranger" in a mirror (Mayer & Darby, 1991).

Another design strategy capitalized on the likelihood that, because of problems with depth perception, people with dementia may interpret two-dimensional patterns on the floor as three-dimensional barriers. In a quasi-experiment with eight residents, such two-dimensional grids successfully eliminated most exit attempts for some residents (Hussian & Brown, 1987). In other studies, two-dimensional grids either increased or failed to decrease residents' exit attempts (Chafetz, 1990; Namazi, Rosner, & Calkins, 1989). Failure to reduce exiting was attributed to the presence of glass doors and adjacent large windows, which offered views to attractive, nearby outdoor spaces (see also Morgan & Stewart, 1999). Attractive views were hypothesized to distract residents from two-dimensional grids or to entice residents to overcome their aversion to these optical illusions. In a study involving seven SCU residents, installation of closed, matching miniblinds that restricted light and views through exit door windows decreased exit attempts by half (Dickinson, McLain-Kark, & Marshall-Baker, 1995).

Other design strategies also created optical illusions that reduced unwanted exiting. The addition of a cloth panel to camouflage a door knob or "panic bar" eliminated exit attempts for most residents (Dickinson et al., 1995; Namazi et al., 1989). (Both of these studies used fewer than 10 residents.) This effect held irrespective of the color or pattern of the cloth cover (Namazi et al., 1989) and with and without the use of miniblinds to cover windows (Dickinson et al., 1995). Disguising the door knob itself (with a knob cover or by painting the knob to blend with the door) reduced exit attempts to a lesser extent (Dickinson et al., 1995; Namazi et al., 1989).

Finally, conditioning residents to respond to attention-getting signage also reduced exit attempts. Three residents with dementia who were conditioned to develop negative associations with "supernormal" stimuli—in this case, large, colored, cardboard geometric shapes placed near exits (Hussian, 1982–83; see Appendix A, Note 14)—wandered less into doors and stairways bearing those images.

Accommodating residents' exit attempts, rather than discouraging them, also generated positive outcomes. Unlocking doors to allow access into secure outdoor areas was associated with significant decreases in agitation in a quasi-experiment involving 12 residents (Namazi & Johnson, 1992d). Reduced agitation was tied to increased autonomy as well as to outdoor usage.

Surveillance is considered essential by staff for maintaining safety in environments for people with dementia (Morgan & Stewart, 1999). Design interventions may have unintended consequences for staff surveillance opportunities. In interviews with nine staff members and nine relatives associated with a

newly designed SCU, staff reported that the new facility's low density, private resident rooms, enclosed charting spaces, and secluded outdoor area and activity spaces impeded staff surveillance and increased time spent locating and monitoring residents (Morgan & Stewart, 1999). Ease of surveillance also has negative consequences. In an evaluation of the Weiss Institute, staff interaction with residents was found to decrease following occupation of this new facility (Lawton et al., 1984; see also Liebowitz, Lawton, & Waldman, 1979). Because the facility's open design accommodated staff surveillance from the nurses' station, direct staff contact with residents may have been minimized.

Preventing falls among residents is another key safety concern (cf. Morgan & Stewart, 1999; Pynoos & Ohta, 1991; Scandura, 1995). Design interventions have demonstrated some success in reducing residents' falls. A significant reduction in falls was reported in one SCU with the introduction of alternative furnishings that put residents closer to the ground (i.e., bean bag chairs, futons, and mattresses placed on the floor; Scandura, 1995; see Appendix A, Note 15). In other research, environmental modifications introduced into home environments to reduce falls were judged effective by 12 dementia caregivers at a 7-month follow-up (Pynoos & Ohta, 1991). These modifications included tub and stair rails, a nonskid bath mat, and a bath chair.

### *Building Organization*

Studies of building organization examine the desirable arrangement of spaces within facilities. Issues investigated include residents' orientation and wayfinding, and the impact of providing outdoor spaces in dementia care facilities.

*Orientation.*—Disorientation—confusion regarding place, time, personal identity, or social situation—is common among people with dementia (Cohen & Weisman, 1991). Design guides suggest numerous strategies to enhance orientation, including improvements for wayfinding (e.g., landmarks, signage) and provision of information from the environment (e.g., allowing views to accessible outdoor areas to increase residents' orientation to time of day and season).

Research confirms that residents' orientation depends, in part, on the physical environment. In a study of 79 dementia residents at 13 long-term care facilities, higher levels of orientation were associated with quiet environments (Netten, 1993). Researchers theorized that disorientation followed residents' attempts to "shut out" noisy environments. Not surprisingly, wayfinding among residents was judged less successful in facilities with low lighting levels in public areas (Netten, 1989).

Design strategies intended to enhance orientation appeared to aid at least some residents. Staff members reported that orientation among residents was supported by design modifications that included room numbers and use of distinguishing colors for



resident rooms and doors (Lawton et al., 1984). In studies with eight residents, large signs improved resident orientation, when incorporated with orientation training (Hanley, 1981); signs alone had minimal effect on residents' orientation, however.

The type of orientation device may make a difference, though research on this question is limited to one experiment involving 10 SCU residents. When displayed in cases outside resident rooms, personally significant memorabilia were somewhat more likely to help residents find their rooms than were displays without personal significance (Namazi, Rosner, & Rechlin, 1991). Personally significant memorabilia were most useful for those with moderate dementia; higher functioning residents were able to orient with nonsignificant memorabilia as well, and lower functioning residents were aided by neither.

Orientation is further impacted by building configuration. Simple building configuration is associated with resident orientation, when residents are also provided with explicit environmental information (Passini, Rainville, Marchand, & Joannette, 1998). In a quasi-experiment with 105 residents in several group living facilities, residents were found to experience greater spatial orientation in facilities designed around L-, H-, or square-shaped corridors, compared with facilities with corridor designs (Elmstahl et al., 1997). Corridor designs were also associated with higher degrees of restlessness and dyspraxia and with reduced vitality and identity (Elmstahl et al., 1997). Residents in facilities with more hallway space demonstrated less disorientation and less lack of vitality (Elmstahl et al., 1997).

In survey research with 104 residents in several homes, higher levels of orientation were identified in "cluster" facilities (comprised of small units of resident rooms and associated common spaces), compared with larger scale "communal" facilities (common spaces separated from resident rooms and shared by larger groups of residents; Netten, 1989). In cluster facilities, higher levels of orientation were associated with complex decision points and longer corridors, which allowed meaningful choices between places residents used (Netten, 1989). In communal facilities, heightened orientation was associated with short corridors and simple decision points, which allowed residents to travel only short distances without prompts and did not force residents to choose between spaces they did not use (Netten, 1989).

*Provision of Outdoor Areas.*—Design guides recommend access to the outdoors to maintain homelikeness, to accommodate activities, and to increase residents' exposure to light and sun. Limited research findings support the value of outdoor spaces to reduce aggression among people with dementia. In a longitudinal study of five facilities with and without outdoor spaces, researchers found that violent episodes among residents decreased over time in facilities with outdoor environments, whereas violent episodes increased during the same time period in facilities without outdoor environments (Mooney &

Nicell, 1992). Residents walked outdoors more often (for short periods of time) in a facility with a special therapeutic garden (Mooney & Nicell, 1992).

### *Specific Rooms and Activity Spaces*

This research investigates the design of particular rooms within the facility. Studies examine the design of bathrooms, toilet rooms, dining rooms, kitchens, and resident rooms, as these impact well-being among people with dementia and others.

*Bathrooms.*—For people with dementia, bathing is an experience that frequently compromises dignity and autonomy. Design recommendations emphasize increasing independence and control in bathing (e.g., choice of shower or tub bath), promoting a more homelike bathing experience (e.g., less institutional design), and assisting caregivers during bathing (additional space, grab bars, etc.).

Bathing is regarded as among the most stressful tasks in caring for people with dementia (Kovach & Meyer-Arnold, 1996; Pynoos & Ohta, 1991; Sloane et al., 1995). Several studies examine aspects of bathing associated with high stress. Negative resident reactions are associated with unfamiliar or fearful equipment or procedures (bath tub lifts, specialized tubs, getting in and out of the water, high water levels in whirlpool baths), cold tub rooms (cold air or water temperature, chills from slow tub filling or draining), design features that impede bathing (poor lighting, inadequate mats or handrails), and distractions (noisy equipment, running water, or distracting activities outside the bathroom; Kovach & Meyer-Arnold, 1996; Lawton et al., 1984; Namazi & Johnson, 1996; Sloane et al., 1995). Some evidence suggests that baths may be less upsetting than showers for residents, though findings are mixed (Kovach & Meyer-Arnold, 1996).

Perhaps because of their long-term positive association, natural elements had a calming effect when introduced during bathing in an experiment with 31 residents in five nursing homes (Whall et al., 1997). Nature sounds (e.g., animal and water noises) and pictures (e.g., birds), when provided along with favorite foods and distracting conversation, significantly decreased agitation during shower baths among residents with late stage dementia (Whall et al., 1997).

*Toilet Rooms.*—Incontinence is a major problem among people with dementia (Namazi & Johnson, 1991b). Design guides emphasize the importance of maintaining independence in toileting whenever possible, such as by making toilets easy to locate and to identify (signage, visible locations, etc.). In some instances, the design of toilet rooms may exacerbate toileting problems. Staff report that small toilet rooms make assisting with toileting difficult and that wheelchair users are more likely to have "accidents" when the toilet room is occupied, preventing access (Hutchinson, Leger-Krall, & Wilson, 1996).

Research findings, though limited, support the effectiveness of design interventions to facilitate toilet-

ing. One quasi-experiment involving 44 residents in two SCUs compared residents' responses to various forms of directional signage for toilet rooms, including the word "rest-room," "toilet," or a graphic of a familiar household toilet (Namazi & Johnson, 1991b). Early and moderate stage dementia residents were most likely to locate and use public toilets in response to primary color signage affixed to the floor (responding to residents' typically downcast gaze) comprising a series of arrows and the word "toilet" (Namazi & Johnson, 1991b). Further, frequency of toilet use increased dramatically when toilets were visibly accessible to residents (Namazi & Johnson, 1991a), though this experiment included only 14 residents. Residents' use of toilets increased by over 800% when curtains surrounding toilets (in lieu of doors) were left open, making public and private toilets clearly visible when not in use (Namazi & Johnson, 1991a). In particular, visibility increased toilet use among residents with more advanced dementia.

*Dining Rooms and Kitchens.*—Design guides offer many recommendations regarding dining and kitchen areas (cf. Calkins, 1988; Cohen & Weisman, 1991). Suggestions emphasize the importance of a familiar and normal dining experience, the need to locate dining and kitchen activity areas within each dementia unit or "household," and the value of reducing sensory stimulation to encourage eating. Research findings from an experiment with 22 residents support noninstitutional dining arrangements. Noninstitutional dining—in which residents dined "family style" at small dining tables in a coffee room, instead of from trays while seated in chairs in the corridor—was linked to increased social interaction and communication during dining and to improved eating behavior among residents (Götestam & Melin, 1987; Melin & Götestam, 1981). Institutional staff practices (e.g., assigned seating, institutional food service) provoked disruption and agitation in dining rooms with homelike design features (Moore, 1999).

In an impact not anticipated by design guidance, relocating dining to the dementia unit of an SCU—from a remote, centralized dining room—significantly decreased residents' aggression (Negley & Manley, 1990). Assaults were reduced by over 40% when residents were no longer crowded into elevators to reach the centralized dining room (Negley & Manley, 1990). (Elevators had been sites of frequent violations of personal space, which caused altercations.) In this instance, assaults may have been further reduced by designating two dining areas on the dementia unit, thus separating higher functioning residents, more likely to be assailants, from lower functioning residents, more likely to be assault victims. In the same quasi-experiment, staff reported less anxiety and more time for assisting residents after moving dining to the dementia unit.

In a study on the design of environments to encourage independent snacking, installation in kitchenettes of small, accessible refrigerators stocked with snacks prompted only a minimal increase in resi-

dents' independent snacking (Namazi & Johnson, 1992c). Transparent refrigerators, in which residents could clearly see snacks inside, were only slightly more effective than were conventional, dormitory-style refrigerators. Both styles of refrigerators may have been unfamiliar to residents. Staff provision of snacks was suggested as a possible impediment to residents' independent snacking (Namazi & Johnson, 1992c).

*Residents' Rooms.*—Design guidance emphasizes the need for homelikeness, autonomy, and privacy in residents' rooms in dementia care facilities. The relative merits of private versus shared resident rooms is a matter of debate (Cohen & Day, 1993); existing research provides limited guidance on this issue. Comparisons of facilities with and without private rooms typically incorporate other architectural and programmatic differences as well, thus obscuring the significance of resident room type (cf. Annerstedt, 1994, 1997; Skea & Lindesay, 1996).

Lawton and colleagues (1970) presented findings from a quasi-experiment involving 15 residents, which suggest that number of residents and room design may affect levels of social interaction. This study evaluated the renovation of a long-term care unit—from two institutional-looking group rooms (four and five residents, respectively), to six, less institutional-looking single rooms clustered around a common space. Following renovation, residents were found to spend comparatively less time in their rooms and more time in motion and to engage in less interaction, compared with residents before the renovation. Reduced interaction may reflect greater choice over interaction in private versus group rooms (Lawton et al., 1970).

Closet design was successfully used to enhance residents' independence in dressing. In a quasi-experiment with eight SCU residents, specially designed clothes closets were found to increase autonomy in dressing for those with middle stage dementia (Namazi & Johnson, 1992a). By presenting preselected clothing in an appropriate sequential order (undergarments first, followed by blouse, pants, etc.), modified closets reduced staff members' physical assistance in dressing and enhanced residents' independence.

## Discussion and Conclusions

From the research reviewed, four primary types of studies on design and dementia emerge. Studies are grouped according to their major focus (people/behavior vs. the physical environment) and their conceptualization of the physical environment (global or discrete). *Environmental comparison* studies compare two or more facility types for impacts on residents, staff, and family (e.g., SCUs vs. skilled nursing facilities.) *Design feature* studies assess the effects of specific environmental interventions (e.g., door modifications to reduce exit attempts). Studies of *environmental services and policies* examine organizational

decisions and policies for dementia care environments (e.g., impacts of relocating residents to new environments). Studies of *problem behaviors* investigate resident conduct that creates difficulties in caregiving (e.g., stressful aspects of bathing). One study (Netten, 1993) fit more than one type (see Table 2). Of these types, studies of design features (26 studies) and of environmental comparisons (24 studies) predominate (compared with 15 studies of problem behaviors and 7 studies of environmental services and policies). Studies should be evaluated according to the type of research they represent. For example, findings from studies of environmental comparisons should indicate which type of environment is preferred and why.

The following sections analyze findings from existing studies with respect to their implications for application and future research.

### *Recommendations to Enhance Applicability of Findings*

The focus of this article on design application demands some recommendations (though tentative) concerning the therapeutic design of environments for people with dementia. On the basis of existing research findings, dementia care environments should consider the suggestions presented in Appendix B among others.

Application of findings is often impeded by studies' research design and/or methods. Confidence in findings is impaired by the frequent use of small samples and the absence of comparison groups. Additionally, many studies use nonequivalent comparison groups (e.g., residents in varying or unspecified stages of dementia, or residents with and without dementia who vary in other characteristics, such as mobility.) Studies do not always adjust reports of findings to account for baseline differences in severity of cognitive, behavioral, or physical deficits. Of the 71 studies we reviewed, only 45 made reference to the residents' stage of dementia at baseline. Further, the interrelations between design interventions has been largely overlooked. For example, SCUs often encompass multiple interventions (smaller unit size, home-like design, low level simulation, etc.). In evaluating the impact of SCUs, studies should consider both which design features are most essential and how various design features work together or detract from

each other. These issues must be addressed to improve the validity and generalizability of future research findings.

Applicability of findings would also be enhanced by incorporating explicit hypotheses on the proposed relationships between physical environments and well-being to explain *why* design features are or are not successful. Finally, the applicability of future studies could be improved by thoroughly describing, in research reports, the physical context of the dementia environment and specific environmental modifications tied to well-being. These last two qualities are exemplified in research conducted by Namazi and colleagues at the Corrine Dolan Center, in Chardon, Ohio (see Appendix A, Note 16).

### *Recommendations for Future Research*

Findings from existing studies substantiate the need for more attention to the therapeutic use of design in dementia. Further research should be designed to confirm findings from existing research, especially from small or exploratory studies. Future research should also support the call for therapeutic design of dementia environments and should elucidate the particular characteristics of effective design interventions.

*Focus on Multiple Populations and Diverse Environments.*—Of the 71 studies reviewed, 12 clearly addressed staff well-being or job performance as outcome measures of the design of dementia environments; only 7 studies investigated outcomes concerning family members' well-being or satisfaction. With greater focus on impacts for staff and relatives, research findings could provide a persuasive rationale for design interventions that might otherwise be neglected. For example, in addition to impacts for resident well-being, research should examine the impacts of noninstitutional design on staff morale and retention and on family visitation and satisfaction with care (cf. Chapman & Carder, 1998; Hoglund, DiMotta, Ledewitz, & Saxton, 1994; Regnier, 1997). Improving staff and family well-being may also enhance caregiving.

In addition, studies should evaluate effective strategies for the therapeutic design of environments other than long-term care and SCUs. Environmental alternatives such as day care and assisted living often have resident populations, care practices and philosophies, physical environments, and regulatory realities that differ dramatically from the more "institutional" options that have been the focus of much existing research. Such environmental alternatives may present new opportunities and new challenges for therapeutic design interventions.

*Target Research and Application to Stage of Dementia.*—Research findings on the effects of design interventions reveal important differences in response according to residents' level of cognitive and behavioral function (see also Columbo, Vitali, Molla, Gioia, &

**Table 2. Primary Types of Studies on Design and Dementia**

Conceptualization of the Environment	Major Focus of Research	
	Environment	People/Behavior
Global	Studies of environmental comparisons	Studies of environmental services and policies
Discrete	Studies of design features	Studies of problem behavior



Milani, 1998; Mirmiran, Van Gool, Van Haaren, & Polak, 1986). For example, interventions targeted to people in early or middle stages of dementia (e.g., closet design to promote independence in dressing; Namazi & Johnson, 1992a) may prove useless for residents in more advanced stages, and vice versa. In developing research questions, researchers should carefully consider the stages of dementia during which design interventions are hypothesized to be of value (see Appendix A, Note 17). When possible, studies should include participants in different stages of dementia, and research reports should specify the stage of dementia for research participants.

*Focus on Quality of Life, as Well as Problem Behaviors.*—In the studies reviewed, impacts on problem behaviors were the most common outcome measure used (followed by impacts on resident ADLs, cognitive function, and social function). Because problem behaviors generate much caregiver burden, caregivers and administrators may especially appreciate this information. The emphasis on problem behaviors may also indicate, however, that many researchers and administrators do not fully appreciate the potential of environmental design to improve quality of life, beyond simply minimizing undesirable conduct. For greatest impact, design professionals and researchers must continue to educate administrators and families on the potential role of environmental design for improving quality of life in a comprehensive way. These recommendations, if implemented, will ensure continued progress in the study and design of therapeutic environments for people with dementia.

## References

- Annerstedt, L. (1993). Development and consequences of group living in Sweden. *Social Science and Medicine*, 37, 1529–1538.
- Annerstedt, L. (1994). An attempt to determine the impact of group living care in comparison to traditional long-term care on demented elderly patients. *Aging Clinical Experimental Research*, 6, 372–380.
- Annerstedt, L. (1997). Group-living care: An alternative for the demented elderly. *Dementia and Geriatric Cognitive Disorders*, 8, 136–142.
- Anthony, K., Procter, A. W., Silverman, A. M., & Murphy, E. (1987). Mood and behaviour problems following the relocation of elderly patients with mental illness. *Age and Ageing*, 16, 355–365.
- Bellelli, G., Frisoni, G. B., Bianchetti, A., Boffelli, S., Guerrini, G. B., Scotuzzi, A., Ranieri, P., Ritondale, G., Guglielmi, L., Fusari, A., Raggi, G., Gasparotti, A., Gheza, A., Nobili, G., & Trabucchi, M. (1998). Special Care Units for demented patients: A multicenter study. *The Gerontologist*, 38, 456–462.
- Benson, D. M., Cameron, D., Humbach, E., Servino, L., & Gamber, S. R. (1987). Establishment and impact of a dementia unit within the nursing home. *Journal of the American Geriatrics Society*, 35, 319–323.
- Berg, L., Buckwalter, K. C., Chafetz, P. K., Gwyther, L. P., Holmes, D., Koepke, K. M., Lawton, M. P., Lindeman, D. A., Magaziner, J., Maslow, K., Sloane, P. D., & Teresi, J. (1991). Special care units for persons with dementia. *Journal of the American Geriatrics Society*, 39, 1229–1236.
- Bianchetti, A., Benvenuti, P., Ghisla, K. M., Frisoni, G. B., & Trabucchi, M. (1997). An Italian model of dementia special care unit: Results of a pilot study. *Alzheimer Disease and Associated Disorders*, 11, 53–56.
- Borup, J. H. (1983). Relocation mortality research: Assessment, reply to the need to focus on the issues. *The Gerontologist*, 23, 235–242.
- Brawley, E. C. (1997). *Designing for Alzheimer's disease. Strategies for creating better care environments*. New York: Wiley.
- Calkins, M. P. (1988). *Design for dementia: Planning environments for the elderly and the confused*. Owing Mills, MD: National Health Publishing.
- Calkins, M. P. (1997). A supportive environment for people with late-stage dementia. In C. R. Kovach (Ed.), *Late-stage dementia care: A basic guide* (pp. 101–112). Washington, DC: Taylor & Francis.
- Campbell, S. S., Kripke, D. F., Gillin, J. C., & Hrubovcak, J. C. (1988). Exposure to light in healthy elderly subjects and Alzheimer's patients. *Physiology and Behavior*, 42, 141–144.
- Chafetz, P. K. (1990). Two-dimensional grid is ineffective against demented patients exiting through glass doors. *Psychology and Aging*, 5, 146–147.
- Chafetz, P. K. (1991). Behavioral and cognitive outcomes of SCU care. *Clinical Gerontologist*, 11, 19–38.
- Chapman, N. J., & Carder, P. C. (1998, November). Characteristics of long-term care settings that encourage family visits to people with Alzheimer's disease. Paper presented at The Annual Meeting of the Gerontological Society of America, Philadelphia.
- Cleary, T. A., Clamon, C., Price, M., & Shullaw, G. (1988). A reduced stimulation unit: Effects on patients with Alzheimer's Disease and related disorders. *The Gerontologist*, 28, 511–514.
- Cohen, U., & Day, K. (1993). *Contemporary environments for people with dementia*. Baltimore: Johns Hopkins University Press.
- Cohen, U., & Weisman, G. D. (1991). *Holding on to home: Designing environments for people with dementia*. Baltimore: Johns Hopkins University Press.
- Cohen-Mansfield, J., & Werner, P. (1998). The effects of an enhanced environment on nursing home residents who pace. *The Gerontologist*, 38, 199–208.
- Cohen-Mansfield, J., Werner, P., & Marx, M. S. (1990). The spatial distribution of agitation in agitated nursing home residents. *Environment and Behavior*, 22, 408–419.
- Columbo, M., Vitali, S., Molla, G., Gioia, P., & Milani, M. (1998). The home environment modification program in the care of demented elderly: Some examples. *Archives of Gerontology and Geriatrics (Suppl. 6)* 83–90.
- Coons, D. (1987). *Designing a residential care unit for persons with dementia*. Washington, DC: U.S. Congress Office of Technology Assessment.
- Cronin-Golumb, A. (1995). Vision in Alzheimer's disease. *The Gerontologist*, 35, 370–376.
- Dickinson, J. I., McLain-Kark, J., & Marshall-Baker, A. (1995). The effects of visual barriers on exiting behavior in a demented care unit. *The Gerontologist*, 35, 127–130.
- Elmstahl, S., Annerstedt, L., & Ahlund, O. (1997). How should a group living unit for demented elderly be designed to decrease psychiatric symptoms? *Alzheimer Disease and Associated Disorders*, 11, 47–52.
- Evans, B. (1989). *Managing from day to day: Creating a safe and workable environment*. Minneapolis, MN: Department of Veterans Affairs Medical Center.
- Gates, G. A., Karzon, R. K., Garcia, P., Peterlein, J., Storandt, M., Morris, J. C., & Miller, P. (1995). Auditory dysfunction in aging and senile dementia of the Alzheimer's type. *Archives of Neurology*, 52, 626–634.
- Götestam, K. G., & Melin, L. (1987). Improving well-being for patients with senile dementia by minor changes in the ward environment. In L. Levi (Ed.), *Society, stress, and disease*. (pp. 295–297). Oxford, England: Oxford University Press.
- Greene, J. A., Asp, J., & Crane, N. (1985). Specialized management of the Alzheimer's disease patient: Does it make a difference? *Journal of the Tennessee Medical Association*, 78, 559–563.
- Hall, G., Kirschling, M. V., & Todd, S. (1986). Sheltered freedom—An Alzheimer's unit in an ICF. *Geriatric Nursing*, 7, 132–137.
- Hanley, I. G. (1981). The use of signposts and active training to modify ward disorientation in elderly patients. *Journal of Behavioral Therapy and Experimental Psychiatry*, 12, 241–247.
- Hiatt, L. G. (1987). Environmental design and mentally impaired older people. In H. J. Altman (Ed.), *Alzheimer's Disease. Problems, prospects, and perspectives* (pp. 309–320). New York: Plenum Press.
- Hoglund, J. D., DiMotta, S., Ledewitz, S., & Saxton, J. (1994). Long-term care design: Woodside place—the role of environmental design in quality of life for residents with dementia. *Journal of Healthcare Design*, 6, 69–76.
- Holmes, D., Teresi, J., Weiner, A., Monaco, C., Ronch, J., & Vickers, R. (1990). Impacts associated with special care units in long-term care facilities. *The Gerontologist*, 30, 178–183.
- Hussian, R. A. (1982–83). Stimulus control in the modification of problematic behavior in elderly institutionalized patients. *International Journal of Behavioral Geriatrics*, 1, 33–42.
- Hussian, R. A., & Brown, D. C. (1987). Use of two-dimensional grid to limit hazardous ambulation in demented patients. *Journal of Gerontology*, 42, 558–560.
- Hutchinson, S., Leger-Krall, S., & Wilson, H. S. (1996). Toileting: A bio-behavioral challenge in Alzheimer's dementia care. *Journal of Gerontological Nursing*, 22(10), 18–27.
- Hyde, J. (1989). The physical environment and the care of Alzheimer's patients: An experiential survey of Massachusetts' Alzheimer's units.

- American Journal of Alzheimer's Care and Related Disorders and Research*, 4, 36–44.
- Jones, R. G. (1988). Experimental study to evaluate nursing staff morale in a high stimulation geriatric psychiatry setting. *Journal of Advanced Nursing*, 13, 352–357.
- Kihlgren, M., Bråne, G., Karlsson, I., Kuremyr, D., Leissner, P., & Norberg, A. (1992). Long-term influences on demented patients in different caring mileaus, a collective living unit and a nursing home: A descriptive study. *Dementia*, 3, 342–349.
- Koss, E., & Gilmore, G. C. (1998). Environmental interventions and functional ability of AD patients. In B. Vellas, J. Fitten, & G. Frisoni (Eds.), *Research and practice in Alzheimer's disease 1998* (pp. 185–193). New York: Springer.
- Kovach, C. R., & Meyer-Arnold, E. A. (1996). Coping with conflicting agendas: The bathing experience of cognitively impaired older adults. *Scholarly Inquiry for Nursing Practice: An International Journal*, 10, 23–36.
- Lawton, M. P. (1979). Therapeutic environments for the aged. In D. Canter & S. Canter (Eds.), *Designing for therapeutic environments. A review of research* (pp. 233–276). Chichester, England: John Wiley and Sons.
- Lawton, M. P. (1981). Sensory deprivation and the effect of the environment on management of the senile dementia patient. In N. Miller & G. Cohen (Eds.), *Clinical studies of Alzheimer's disease and senile dementia* (pp. 227–251). New York: Raven Press.
- Lawton, M. P., Fulcomer, M., & Kleban, M. (1984). Architecture for the mentally impaired elderly. *Environment and Behavior*, 16, 730–757.
- Lawton, M. P., Liebowitz, B., & Charon, H. (1970). Physical structure and the behavior of senile patients following ward remodeling. *Aging and Human Development*, 1, 231–239.
- Liebowitz, B., Lawton, M. P., & Waldman, A. (1979). Evaluation: Designing for confused elderly people. *American Institute of Architects Journal*, 68, 59–61.
- Lovell, B. B., Ancoli-Israel, S., & Gervitz, R. (1995). Effect of bright light treatment on agitated behavior in institutionalized elderly subjects. *Psychiatry Research*, 57, 7–12.
- Lyman, K. A. (1989). Day care for persons with dementia: The impact of the physical environment on staff stress and quality of care. *The Gerontologist*, 29, 557–560.
- Maslow, K. (1994). Current knowledge about special care units: Findings of a study by the U.S. Office of Technology Assessment. *Alzheimer's Disease and Associated Disorders*, 8 (Suppl. 1), S14–S40.
- Mathew, L. J., & Sloane, P. D. (1991). Environmental characteristics of existing dementia units. In P. D. Sloane & L. J. Mathew (Eds.), *Dementia units in long-term care* (pp. 163–173). Baltimore: Johns Hopkins University Press.
- Mayer, R., & Darby, S. J. (1991). Does a mirror deter wandering in demented older people? *International Journal of Geriatric Psychiatry*, 6, 607–609.
- McAllister, C. L., & Silverman, M. A. (1999). Community formation and community roles among persons with Alzheimer's disease: A comparative study of experiences in a residential Alzheimer's facility and a traditional nursing home. *Qualitative Health Research*, 9, 65–85.
- McAuslane, L., & Sperlinger, D. (1994). The effects of relocation on elderly people with dementia and their nursing staff. *International Journal of Geriatric Psychiatry*, 9, 981–984.
- McCracken, A. L., & Fitzwater, E. (1989). The right environment for Alzheimer's: Which is better—open versus closed units? Here's how to tailor the answer to the patient. *Geriatric Nursing*, 10, 293–294.
- Melin, L., & Götestam, K. G. (1981). The effects of rearranging ward routines on communication and eating behaviors of psychogeriatric patients. *Journal of Applied Behavior Analysis*, 14, 47–51.
- Mirmiran, M., Van Gool, W. A., Van Haaren, F. V., & Polak, C. E. (1986). Environmental influences on brain and behavior in aging and Alzheimer's disease. In D. F. Swaab, E. Fliers, M. Mirmiran, W. A. Van Gool, & F. V. Haaren (Eds.), *Progress in Brain Research* (pp. 443–459). Amsterdam: Elsevier Science.
- Mishima, K., Okawa, M., Hishikawa, Y., Hozumi, S., Hori, H., & Takahashi, K. (1994). Morning bright light therapy for sleep and behavior disorders in elderly patients with dementia. *Acta Psychiatrica Scandinavica*, 89, 1–7.
- Mooney, P., & Nicell, P. L. (1992). The importance of exterior environment for Alzheimer residents: Effective care and risk management. *Healthcare Management Forum*, 5, 23–29.
- Moore, K. D. (1999). Dissonance in the dining room: A study of social interaction in a special care unit. *Qualitative Health Research*, 9, 133–155.
- Morgan, D. G., & Stewart, N. J. (1998). High versus low density special care units: Impact on the behavior of elderly residents with dementia. *Canadian Journal on Aging*, 17, 143–165.
- Morgan, D. G., & Stewart, N. J. (1999). The physical environment of special care units: Needs of residents with dementia from the perspective of staff and caregivers. *Qualitative Health Research*, 9, 105–118.
- Namazi, K. H., & Johnson, B. D. (1991a). Environmental effects on incontinence problems in Alzheimer's patients. *American Journal of Alzheimer's Care and Related Disorders and Research*, 6, 16–21.
- Namazi, K. H., & Johnson, B. D. (1991b). Physical environmental cues to reduce the problems of incontinence in Alzheimer's disease units. *American Journal of Alzheimer's Care and Related Disorders and Research*, 6, 22–29.
- Namazi, K. H., & Johnson, B. D. (1992a). Dressing independently: A closet modification model for Alzheimer's disease patients. *American Journal of Alzheimer's Care and Related Disorders and Research*, 7, 22–28.
- Namazi, K. H., & Johnson, B. D. (1992b). The effects of environmental barriers on the attention span of Alzheimer's disease patients. *American Journal of Alzheimer's Care and Related Disorders and Research*, 7, 9–15.
- Namazi, K. H., & Johnson, B. D. (1992c). Environmental issues related to visibility and consumption of food in an Alzheimer's disease unit. *American Journal of Alzheimer's Care and Related Disorders and Research*, 7, 30–34.
- Namazi, K. H., & Johnson, B. D. (1992d). Pertinent autonomy for residents with dementias: Modification of the physical environment to enhance independence. *American Journal of Alzheimer's Care and Related Disorders and Research*, 7, 16–21.
- Namazi, K. H., & Johnson, B. D. (1996). Issues related to behavior and the physical environment: Bathing cognitively impaired patients. *Geriatric Nursing*, 17, 234–239.
- Namazi, K. H., Rosner, T. T., & Calkins, M. P. (1989). Visual barriers to prevent ambulatory Alzheimer's patients from exiting through an emergency door. *The Gerontologist*, 29, 699–702.
- Namazi, K. H., Rosner, T. T., & Rechlin, L. (1991). Long-term memory cuing to reduce visuo-spatial disorientation in Alzheimer's disease patients in a special care unit. *American Journal of Alzheimer's Care and Related Disorders and Research*, 6, 10–15.
- Negley, E. N., & Manley, J. T. (1990). Environmental interventions in assaultive behavior. *Journal of Gerontological Nursing*, 16(3), 29–33.
- Nelson, J. (1995). The influence of environmental factors in incidents of disruptive behavior. *Journal of Gerontological Nursing*, 21(5), 19–24.
- Netten, A. (1989). The effect of design of residential homes in creating dependency among confused elderly residents: A study of elderly demented residents and their ability to find their way around homes for the elderly. *International Journal of Geriatric Psychiatry*, 4, 143–153.
- Netten, A. (1993). *A positive environment? Physical and social influences on people with senile dementia in residential care*. Aldershot, England: Ashgate.
- Passini, R., Rainville, C., Marchand, N., & Joanne, Y. (1998). Wayfinding and dementia: Some research findings and a new look at design. *Journal of Architectural and Planning Research*, 15, 133–151.
- Phillips, C. D., Sloane, P. D., Howes, C., & Koch, G. (1997). Effects of residence in Alzheimer disease special care units on functional outcomes. *Journal of American Medical Association*, 278, 1340–1344.
- Pynoos, J., Cohen, E., & Lucas, C. (1988). *The caring home booklet: Environmental coping strategies for Alzheimer's caregivers*. Los Angeles: Long-Term Care National Resource Center at UCLA/USC.
- Pynoos, J., & Ohta, R. J. (1991). In-home interventions for persons with Alzheimer's disease and their caregivers. *Physical & Occupational Therapy*, 9(3–4), 83–92.
- Ramirez, M., Teresi, J. A., Holmes, D., & Fairchild, S. (1998). Ethnic and racial conflict in relation to staff burnout, demoralization, and job satisfaction in SCUs and non-SCUs. *Journal of Mental Health and Aging*, 4, 459–479.
- Rapcsak, S. Z., Kentros, M., & Rubens, A. B. (1989). Impaired recognition of meaningful sounds in Alzheimer's disease. *Archives of Neurology*, 46, 207–210.
- Regnier, V. (1997). Design for assisted living. *Contemporary Long Term Care*, 20(2), 50–52.
- Robertson, C., Warrington, J., & Eagles, J. M. (1993). Relocation mortality in dementia: The effects of a new hospital. *International Journal of Geriatric Psychiatry*, 8, 521–525.
- Satlin, A., Volicer, L., Ross, V., Herz, L., & Campbell, S. (1992). Bright light treatment of behavioral and sleep disturbances in patients with Alzheimer's Disease. *American Journal of Psychiatry*, 149, 1028–1032.
- Saxton, J., Silverman, M., Ricci, E., Keane, C., & Deeley, B. (1998). Maintenance of mobility in residents of an Alzheimer Special Care facility. *International Psychogeriatrics*, 10, 213–224.
- Scandura, D. A. (1995). Freedom and safety: A Colorado center cares for Alzheimer's patients. *Health Progress*, 76(3), 44–46.
- Seltzer, B., Rheume, Y., Volicer, L., Fabiszewski, K. J., Lyon, P. C., Brown, J. E., & Volicer, B. (1988). The short-term effects of in-hospital respite on the patient with Alzheimer's disease. *The Gerontologist*, 28, 121–124.
- Skea, D., & Lindsay, J. (1996). An evaluation of two models of long-term residential care for elderly people with dementia. *International Journal of Geriatric Psychiatry*, 11, 233–241.
- Sloane, P. D., Honn, V. J., Dwyer, S. A. R., Wieselquist, J., Cain, C., & My-



- ers, S. (1995). Bathing the Alzheimer's patient in long term care: Results and recommendations from three studies. *American Journal of Alzheimer's Disease*, 10(4), 3-11.
- Sloane, P. D., Mitchell, C. M., Preisser, J. S., Phillips, C., Commander, C., & Burkner, E. (1998). Environmental correlates of resident agitation in Alzheimer's disease special care units. *Journal of the American Geriatrics Society*, 46, 862-869.
- Swanson, E. A., Maas, M. L., & Buckwalter, K. C. (1993). Catastrophic reactions and other behaviors of Alzheimer's residents: Special unit compared with traditional units. *Archives of Psychiatric Nursing*, 7, 292-299.
- Teresi, J. A., Grant, L. A., Holmes, D., & Ory, M. G. (1998). Staffing in traditional and special dementia care units. *Journal of Gerontological Nursing*, 24, 149-153.
- Teresi, J. A., Holmes, D., & Monaco, C. (1993). An evaluation of the effects of commingling cognitively and noncognitively impaired individuals in long-term care facilities. *The Gerontologist*, 33, 350-358.
- Teresi, J. A., Holmes, D., Ramirez, M., & Kong, J. (1998). Staffing patterns, staff support, and training in Special Care and Nonspecial Care Units. *Journal of Mental Health and Aging*, 4, 443-458.
- Uhlman, R. F., Larson, E. B., & Koepsell, T. D. (1986). Hearing impairment and cognitive decline in senile dementia of the Alzheimer's type. *Journal of the American Geriatrics Society*, 34, 207-210.
- Ulla, E., Johanna, T., & Raimo, S. (1998). Special care units (SCUs) are efficient in respite care of demented patients. In B. Vellas, J. Fitten, & G. Frisoni (Eds.), *Research and practice in Alzheimer's disease 1998* (pp. 223-232). New York: Springer.
- Van Someren, J. W., Kessler, A., Mirmiran, M., & Swaab, D. F. (1997). Indirect bright light improves circadian rest-activity rhythm disturbances in demented patients. *Biological Psychiatry*, 41, 955-963.
- Webber, P. A., Breuer, W., & Lindeman, D. A. (1995). Alzheimer's special care units vs. integrated nursing homes: A comparison of resident outcomes. *Journal of Clinical Geropsychology*, 1, 189-205.
- Weinstein, B. E., & Amsel, L. (1986). Hearing loss in senile dementia in the institutionalized elderly. *Clinical Gerontologist*, 4(3), 3-15.
- Weisman, G. D., Calkins, M., & Sloane, P. (1994). The environmental context of special care units. *Alzheimer's Disease and Associated Disorders*, 8, S308-S320.
- Wells, Y., & Jorm, A. F. (1987). Evaluation of a special nursing home unit for dementia sufferers: A randomised controlled comparison with community care. *Australian and New Zealand Journal of Psychiatry*, 21, 524-531.
- Whall, A. L., Black, M. E., Groh, C. J., Yankou, D. J., Kuperschmid, B. J., & Foster, N. L. (1997). The effect of natural environments upon agitation and aggression in late stage dementia patients. *American Journal of Alzheimer's Disease*, 12, 216-220.
- Wiltzius, S. F., Gambert, S. R., & Duthie, E. H. (1981). Importance of resident placement within a skilled nursing facility. *Journal of the American Geriatrics Society*, 29, 418-421.
- Wimo, A., Nelvig, J., Adolfsson, R., Mattson, B., & Sandman, P. O. (1993). Can changes in ward routines affect the severity of dementia? A controlled prospective study. *International Psychogeriatrics*, 5, 169-180.
- Zeisel, J., Hyde, J., & Levkoff, S. (1994). Best practices: An environment-behavior (E-B) model for Alzheimer special care units. *American Journal of Alzheimer's Care and Related Disorders and Research*, 9, 4-21.
- tional, and barrier. Searches generating more than 400 references were discarded as overly broad.
3. Journals reviewed systematically included *Ageing and Society*, *Environment and Behavior*, *The Gerontologist*, *Journal of Architectural and Planning Research*, *Journal of Environmental Psychology*, *Journal of Gerontology: Psychological Sciences*, *Journal of Gerontology: Social Sciences*, and the *Journal of Mental Health and Aging*.
4. Case studies and nonpeer-reviewed work, such as dissertations, were excluded, as were articles that reported only design guidance, or that had only minor reports of research, or incomplete descriptions of research design.
5. This period was identified as the time of greatest productivity in research on dementia and design. An earlier article by Lawton and colleagues (1970) was also included. This article evaluates the impact of a renovation to the Weiss Institute of the Philadelphia Geriatric Center, a premier, experimentally designed dementia care facility.
6. See Borup (1983) for a review of the extensive research literature on the effects of relocation on older adults in institutional settings.
7. Wells & Jorm (1987) examine the use of an SCU for respite versus permanent care. The authors found beneficial impacts for family members associated with use of this SCU for respite care.
8. "Global" studies of SCUs with special environmental features include Annerstedt (1993), Bellelli et al. (1998), Benson et al. (1987), Chafetz (1991), Greene, Asp, and Crane (1985), Holmes et al. (1990), McCracken and Fitzwater (1989), Phillips et al. (1997), Skea and Lindsay (1996), Swanson, Maas, and Buckwalter (1993), Webber, Breuer, and Lindeman (1995). Table 1 describes only those studies of SCUs that specifically note environmental features.
9. Swedish group living facilities compare to both group homes and SCUs in the United States. These residences for 8-10 people are tailored—in design and in care plan—to the needs of people with dementia. Emphasis is placed on involving families and on making care more affordable than institutional alternatives (Annerstedt, 1993).
10. Group living units in this study differ from traditional nursing homes in that group living units use noninstitutional design features and specialized dementia caregiving, in addition to small group size.
11. Evidence suggests that the prevalence and severity of hearing loss is greater among people with dementia; however, the cause and effect relationship between dementia and hearing loss is not well understood (cf. Gates et al., 1995; Rapcsak, Kentros, & Rubens, 1989; Uhlman, Larson, & Koepsell, 1986; Weinstein & Amsel, 1986).
12. Similar changes in other facilities are associated with comparable results (cf. Hall, Kirschling, & Todd, 1986).
13. Circadian rhythms refer to daily activity cycles based on 24-hr patterns.
14. Exaggerated, simple stimuli were hypothesized to be most effective, since subtle or complex stimuli may be difficult for people with dementia to comprehend (Hussian, 1982-83). Conditioning occurred by reinforcing positive associations, such as a favorite food, with one shape, and negative associations, such as loud clapping, with another.
15. Changes in furnishings were accompanied by changes in care plans to reduce demanding tasks (e.g., bathing) in the evenings, when most falls occurred. Full research methods are not reported for this study.
16. Most of these studies are reported in a series published in 1991-92 in the *American Journal of Alzheimer's Care and Related Disorders and Research*.
17. Calkins (1997) provides an excellent example of stage-appropriate design guidance in her recommendations for design strategies to enhance care for people with late stage dementia.

Received May 19, 1999

Accepted January 19, 2000

Decision Editor: Vernon L. Greene, PhD

## Appendix A

### Notes

1. A small sample of design guidance includes Coons (1987), Hiatt (1987), Hyde (1989), Lawton (1979), Pynoos, Cohen, and Lucas (1988), Regnier (1997), and Zeisel, Hyde, and Levkoff (1994).

2. MAGS is the magazine and journal article database of over 1,500 scholarly and popular journals. CAT is the catalog of the holdings of the entire University of California library system. Search terms included "dementia" or "Alzheimer's" and the following: home, nursing home, special care unit, SCU, day care, assisted living, design, environment, safety, dignity, homelike, independence, security, wandering, activities, toilet, incontinence, kitchen, dining, resident room, privacy, bathing, continuum of care, aging in place, non-institu-

## Appendix B

### Recommendations for the Therapeutic Design and Planning of Dementia Environments

- Incorporate small size units.
- Separate noncognitively impaired residents from people with dementia.
- Offer respite care as a complement to home care.
- Relocate residents, when necessary, in intact units rather than individually.
- Incorporate noninstitutional design throughout the facility and in dining rooms in particular.
- Moderate levels of environmental stimulation.
- Incorporate higher light levels, in general, and exposure to bright light, in particular.
- Use covers over panic bars and door knobs to reduce unwanted exiting.
- Incorporate outdoor areas with therapeutic design features.
- Consider making toilets more visible to potentially reduce incontinence.
- Eliminate environmental factors that increase stress in bathing.

### ENDOWED CHAIR IN NURSING RESEARCH

Applications and nominations of internationally renowned nurse scholars with a record of research excellence in geriatric nursing are sought for this endowed research chair. An earned doctorate in nursing or a related field, a record of interdisciplinary research, demonstrated excellence in teaching and mentoring junior colleagues, and qualifications for the rank of Professor are required. The individual selected for the Katz Chair in Geriatric Nursing must be committed to an active program of interdisciplinary research, collaborating with colleagues at the Baycrest Centre for Geriatric Care and the University of Toronto. The professorship is for a period of five years and is renewable. A competitive salary and research stipend will be offered.

### APPLICATIONS

Applications and nominations will be accepted until the position is filled. Letters of application or nominations, along with curriculum vitae and a list of references should be sent to:

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