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A review of the empirical literature on the design of physical environments for people with dementia

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Translating dementia research into practice

A review of the empirical literature on the design of physical environments for people with dementia.

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Important notice

The views expressed in this work are the views of its author(s) and not necessarily those of the Commonwealth of Australia. The reader needs to be aware that the information contained in this work is not necessarily endorsed, and its contents may not have been approved or reviewed by the Australian Government Department of Health and Ageing.

Executive summary

In summarising the literature up to 2001 on designing environments for people with dementia Professor Mary Marshal of the Dementia Services Development Centre in the University of Stirling, Scotland recommended that dementia specific residential facilities should be:

- small in size;
- domestic and home like;
- providing scope for ordinary activities (unit kitchens, washing lines, garden sheds);
- include unobtrusive safety features;
- have rooms for different functions with furniture and fittings familiar to the age and generation of the residents;
- provide a safe outside space;
- have single rooms big enough for a reasonable amount of personal belongings;
- with good signage and multiple cues where possible; eg. sight, smell, sound;
- use of objects rather than colour for orientation;
- enhance visual access; and
- control stimuli, especially noise.

This advice forms the basis of the guidelines offered by the Alzheimer's Australia and has been taken up by many aged care providers.

This report reviews the literature relevant to these guidelines with a view to ascertaining the strength of the empirical evidence supporting them. Of 148 relevant articles located, 57 were considered to have a sufficiently strong methodology to be included in this review. The strength of the evidence was systematically assessed so that attention could be drawn to those recommendations that have strong empirical support and to identify areas of uncertainty and gaps in knowledge that may benefit from further research.

The available research supports Marshal's schema and offers substantial backing for the provision of unobtrusive safety features, a variety of spaces including single rooms, the enhancement of visual access and the optimization of levels of stimulation. The schema is a sound summary of the consensus of the opinion of researchers and practitioners.

The review identified several gaps in the available knowledge and recommended that particular attention be given to the investigation of:

1. How to overcome the obstacles to the implementation of the knowledge that we already have.
2. The question of the relative contribution of the physical and the psycho-social environment.
3. The environmental aspects of providing care to people in the later stages of the disease characterized by immobility, lengthy periods in bed and end of life issues.
4. Optimising the relationship between the facility for people with dementia and the local community.
5. The possible advantages of designing for particular cultures, including the indigenous cultures.
6. Providing environments that meet the needs of younger people with dementia.
7. The special needs of people with Down's syndrome who develop Alzheimer's disease.

Introduction

The history of the development of environments specifically designed for people with dementia began in earnest in Australia with the work of Lefroy in Western Australia (Lefroy, Hyndman et al. 1997), Moss in Victoria (Moss 1983), Kidd in South Australia (Kidd 1987) and Fleming in New South Wales (Fleming 1987). At that stage the designs were based as much on avoiding the obvious errors that could be seen in the prevalent institutional approach to the care of people with dementia (Moss 1983) than on the few examples of systematic approaches to designing for people with dementia (Lawton, Fulcomer et al. 1984).

Over the last 20 years a considerable amount of research has been carried out to identify the essential components of good design for people with dementia. A comprehensive survey of Special Care Units (SCUs) in Minnesota (Grant, Kane et al. 1995) showed that SCUs for people with dementia could be distinguished from other types of aged care by the presence of:

> " the following environmental features: physical barriers; special floor finishes; wall treatments; special colors; anthropometric enhancements; homelike setting; designed social spaces for various activities; social spaces separated from persons without dementia; secure outdoor areas; low visual stimulation; low auditory stimulation; and policies for reduced radio or television use. Special lighting and special safety enhancements were also more likely in SCUs (significant at the .001 level). Less marked but still significantly different at the .05 level, SCUs were more likely to have special signage and to have special visual surveillance methods".

However it has also been noted that:

> "In response to the proliferation of SCUs, design guidelines have been developed that include recommendations for both the physical and social environments … Because of the lack of empirical data, SCU design manuals are based mainly on clinical experience and extrapolations from research conducted with other populations" (Morgan and Stewart 1997).

Marshall in her review of the literature on designing dementia specific facilities (Marshal 2001) concluded that aged care accommodation for people living with dementia should:

- compensate for disability;
- maximise independence, reinforce personal identity, and enhance self esteem/confidence;
- demonstrate care for staff;
- be orienting and understandable;
- welcome relatives and the local community; and
- control and balance stimuli.

Marshal listed a number of design features that need to be incorporated in a facility to provide quality accommodation for people living with dementia. Marshal drew heavily on her knowledge of the Australian experience (Fleming 1987; Kidd 1987; Fleming 1991; Kidd 1994; Judd 1998) and this list was taken up by the Alzheimer's Australia (Alzheimers_Australia 2004)) as the basis for the publication of a position paper intended to guide those intending to build a facility for people with dementia.

The list comprises the following design features:

- small size;
- domestic and home like;
- scope for ordinary activities (unit kitchens, washing lines, garden sheds);
- unobtrusive inclusion of safety features;
- rooms for different functions with furniture and fittings familiar to the age and generation of the residents;
- a safe outside space;
- single rooms big enough for a reasonable amount of personal belongings;
- good signage and multiple cues where possible; eg. sight, smell, sound;
- use of objects rather than colour for orientation;
- enhancement of visual access; and
- control of stimuli, especially noise.

This list is used here as a framework for the examination of the empirical investigations into the design of facilities for people with dementia that have been carried out since 1980. It is hoped that the ordering of the evidence in this way will help us to see how confident we can be about the most common recommendations made to people in Australia who are involved in building, or modifying, environments for people with dementia.

More formally the objectives of this review are:

- To identify the principles that will assists designers, architects and planners to provide environments that reduce disability and enhance the quality of life of people with dementia.

- To provide a foundation for the discussion of a coherent strategy for encouraging the application of the design principles.

Criteria for considering studies for this review

The relevance of studies was assessed by the following criteria which were modelled on the examples given by Forbes (Forbes 1998) and followed by others in their review of psycho-social interventions for people with dementia (Opie, Rosewarne et al. 1999).

1. Published after 1980
2. Evaluated an intervention utilising the physical environment
3. Focused on the care of people with dementia over 50 years of age
4. Incorporated a control group, pretest-posttest, cross sectional or survey design.

Physical environment in this review is defined as the area relevant to architects, facility managers, interior designers and outdoor designers. The interventions may be the building of a new facility, renovation or remodelling of an existing facility, the introduction of a new environmental feature or the manipulation of existing features, e.g. light levels. Aspects of the physical environment such as fittings and furnishings are included.

Search methods for identification of studies

The major databases (Medline, Cinahl, PsycInfo, Embase, Central, ProQuest, Pubmed, Google Scholar and Cochrane), were searched electronically and reference lists in earlier reviews, related published articles and books were checked.

The search terms, which were based on those compiled by Day et al (Day, Carreon et al. 2000), were 'dementia', 'physical environment', 'home', 'nursing home', 'assisted living', 'day care', 'hospital', 'residential care', 'public places', 'resident room', 'SCU', 'privacy', 'security', ' safety' , 'behavioural changes' and 'behavioural modifications'.

The reference lists of studies that were identified were also scanned for additional articles of relevance.

Selection of articles: The titles, key words, abstracts and where necessary the methodology, discussions and/or conclusions of the papers identified by the electronic and hand searches were screened for potential relevance by one of the researchers. This was an over inclusive process designed to eliminate only papers that were obviously irrelevant. 332 papers were identified as potentially relevant. The over inclusiveness was tested by both researchers assessing the first 39 papers available to both of them. They agreed that 32 of them were relevant. All 7 of those for which there was disagreement were rated as relevant by the junior researcher, who was carrying out the screening, and judged as being not relevant by the senior researcher. There was no occasion in which the screening researcher excluded an article that would have been included by the senior researcher. On completion of the screening 242 articles remained.

Evaluation of the strength of the research

The papers that remained after the screening process were assessed for relevance by both researchers resulting in the identification of 148 articles were identified as relevant. Papers that were identified as relevant were then subjected to an assessment of their validity using the model provided by Forbes (Forbes 1998). This resulted in the identification of 57 articles which were considered sufficiently strong in their methodology to be included in the review comprising 9 articles that were considered as strong, 14 moderate and 34 weak. Papers rated as poor were not reviewed; they tended to be qualitative and descriptive in nature.

The Forbes approach to the validation of the papers (see appendix 1) was chosen in the absence of any well accepted alternative contender. The Forbes approach involves an assessment of external validity (design, inclusion, attrition), internal validity and statistical validity resulting in the allocation of a rating of strong, moderate, weak or poor. The most recent comprehensive review of the environmental design literature (Day, Carreon et al. 2000) did not attempt any systematic validation while in the area of psycho-social research the Forbes approach has been used in recent reviews (Opie, Rosewarne et al. 1999); (O'Connor 2007). While the Forbes approach is not finely tuned to the methodologies used in the environmental design literature an adaptation of it was used in the Cochrane review on bright light therapy (Forbes, Morgan et al. 2004) and its use provides an opportunity for a comparison between the strength of the environmental design literature and the psychosocial intervention literature.

In practice the Forbes approach required a great deal of discussion between the two raters to come to a consensus on the ratings and resulted in the description of some important work, particularly that of Namazi, as weak because of the descriptive nature of the statistical analysis and/or because of high attrition rates which are sometimes impossible to avoid in research on very elderly people. The ratings are therefore offered with a degree of caution.

The quality of the environmental design literature on the whole is not high. There is not an extensive literature on this subject. It was therefore decided to report on the weak papers included in the final 57 while putting them in the context of the stronger articles to allow the readers to form their own opinion on how much credibility to put on the findings and therefore whether or not to apply them to their situation. This strategy protects the heuristic value of some of the studies that would be lost if they were not discussed as a contribution to an emerging literature and recognises the uncertainty around some of the Forbes ratings.

Each item in Marshal's list will be discussed in the light of the available research with the strongest research referred to first and the weaker research reported in relation to it. This order is varied occasionally where a weaker article has a direct relevance to a stronger article and is therefore inserted before other stronger articles to maintain the flow of the argument. Strong research that does not fit comfortably into Marshal's list is reported on in an additional section and its implications for Marshal's schema is explored.

Small size

Size may be defined in terms of the number of beds per facility or by the area available per person.

The effects of having fewer beds in a facility was investigated by comparing a Special Care Facility (SCF) with 'traditional institutional facilities (Reimer, Slaughter et al. 2004)(Forbes rating = strong).

> "The SCF, which received a new-construction design award from the Society for the Advancement of Gerontological Environments, featured a decreased density of residents, with 10 people living in each of six separate and self-contained semi-attached bungalows…"

A Special Care Facility is described as being the next step in the evolution of the SCU, a facility that is "more comfortable and more like home and offers more choice and more privacy than traditional setting. It also includes more personal contact and meaningful activity. The vision requires a different physical environment with enhanced knowledge and skills of caregivers."

The comparison showed that SCF residents experienced

> "Less decline in activities of daily living, more sustained interest in the environment, and less negative affect than residents in the traditional institutional facilities. There were no differences between groups in concentration, memory, orientation, depression, or social withdrawal".

However the SCF also had

> "… enhanced staffing ratios, which enable the integration of personal care, leisure, and rehabilitation activity into the role of the staff caregiver (rather than an expert model of episodic therapist intervention); and a biodiverse environment (e.g. multigenerational, live-in pets, plants). The physical environment and daily activities were arranged like a typical home, with residents able to help in the kitchen, sweep the floor, sit by the fireplace, or go outside into a small enclosed garden area".

and there was no way to evaluate the separate impact of these interventions.

A study which controlled for most of these factors (Zeisel, Silverstein et al. 2003) (Forbes rating = strong) resulted in a positive finding for larger facilities

> "The larger the facility - the more residents there are in the SCU - the lower the social withdrawal scores tend to be".

No significant correlation was found between facility size - large or small - and physically aggressive behaviours in a sample of 695 residents of SCUs and traditional nursing homes (Leon and Ory 1999) (Forbes rating = moderate). However this study defined large facilities as those with more than 150 beds, a definition that may have swamped the effects of genuinely small facilities.

A comparison of residents of small, group living facilities and residents of traditional nursing homes, rated as moderate using the Forbes criteria, (Annerstedt 1993) showed that smaller size makes it easier for residents and staff to work together as a group and is associated with higher levels of competence and job satisfaction. However the additional staff training provided in the smaller units was not controlled for. The study also reported better motor functions, slightly improved or maintained activities of daily living and smaller doses of both antibiotics and psychotropic drugs.

A similar result was reported in a later paper by the same author (Annerstedt 1997), comparing life for 28 people with dementia in a Group Living (GL) environment with life in a nursing home (NH), for 29 people matched on age, diagnosis, physical and social dependency. The GL environment was deliberately made small (9 beds) but also incorporated features to make it familiar, homelike and safe.

> "During the first year of observation there was a positive development in the GL patient compared to the NH group. However in the more severely impaired patients less effects of the environmental engineering were observed, i.e. (a) the GL patients preserved intellectual and motoric abilities and practical abilities better which was reflected in ADL performances; (b) the GL patients ?exhibited less aggressiveness anxiety and depression; (c) the use of neuroleptics and tranquilizers was lower In GL care and (d) the numbers of fractures and Incontinent patients were fewer in GL (non-significant). There was a time related decline of the difference between the groups. After 3 years there were no differences to be noticed between the GL and NH groups in physical and mental dependency" (Annerstedt 1997).

The lack of statistical analysis, including the reporting of statistical significance, contributed to this study being rated as weak using the Forbes criteria.

In a survey of 53 special care units for people with dementia (Sloan 1998) (Forbes rating = weak, lack of control over resident mix in each unit) found strong associations between larger unit sizes and higher resident agitation-levels, increased intellectual deterioration and greater emotional disturbances.

> "…larger unit size is associated with higher agitation supports the popular design concept that small units, or the division of large units into smaller functional subunits, will minimize resident agitation by reducing the potential for overstimulation"

However the multivariate analysis used in this study was able to show

"Summary indexes of the quality of the physical environment and of staff-resident interactions exerted strong, similar influences on unit agitation levels. Indeed, the two measures were so intercorrelated that one served practically as a proxy for the other, and the two effects could not be separated analytically. These findings suggest that not only are both the physical and the human environments important in managing agitation in Alzheimer's disease, but, in practice, quality in one domain is usually accompanied by quality in the other".

This study highlights the difficulties of separating out environmental factors from the other factors that go to make up the 'environment'.

A qualitative comparison in which a specialised dementia unit with 11 beds (Fairhaven) was compared with a 4 storey nursing home suggests that small size is associated with better community life but it is clear that the author was unable to separate out the effects of the size of the unit from the other factors that were active.

"The social model of care practiced at Fairhaven, including staff continuity in resident care and an encouragement of staff relationships with individual residents, appears to have encouraged community formation. Also of importance was the small scale of the facility as well as the residents' ready access to a range of environmental settings, including areas that are conducive to community-like behavior such as kitchens, small spaces for informal interaction, and outdoor spaces that can be used by residents on their own. The design of formal activities at Fairhaven, including attempts to engage residents in a round of expressive activities and to adapt activities to their changing needs and competencies, was another key factor. Underlying and supporting these environmental and programmatic features was an institutional philosophy that promoted flexibility, freedom of choice, and a focus on the continuation of the individual's functional abilities and independence" (McAllister and Silverman 1999.).

The qualitative nature of this study contributed to its poor rating using the Forbes criteria.

A quantitative comparison between 10 large facilities (16 or more beds) and 12 small facilities (Quincy, Adam et al. 2005) (Forbes rating = weak, because of cross sectional nature of study) indicated no relationship between the size of the facility and quality of life of residents with dementia or their neuropsychiatric symptoms (delusions, hallucinations, agitation or aggression, dysphoria, anxiety, euphoria, apathy, disinhibition, irritability, aberrant motor behaviour, sleep and appetite and eating disorders). Quality of life was measured using the ADRQL (Rabins, Kasper et al. 2000), an observer rating scale that is not particularly sensitive.

Contrary findings came from another cross sectional study (Torrington 2006) (Forbes rating = weak) involving 38 residential and care homes in the UK. In this study small was defined as having fewer than 31 beds, medium as 31-40 and large as greater than 40. Small homes scored best in terms of comfort, normalness, choice and control. "The overall well-being scores [as measured by Dementia

Care Mapping] were consistently lower in the large homes (13%) than in the small and medium ones, which scored 38% and 33% respectively."

Another cross sectional comparison of large and small facilities (Kuhn, Kasayka et al. 2002), added to the confusion. In this investigation

> "Key differences were noted between residents living in small, dementia-specific sites (10 to 28 residents) and those living in large sites that were not dementia-specific (40 to 63 residents). The latter group fared better overall with respect to quality of life and diversity of interactions and activities".

No attempt was made to control for levels of dementia or different care practices. The results are therefore severely limited and at best illustrate the inability of cross sectional studies to provide information on causality.

These studies clearly illustrate the problems associated with coming to a conclusion on the effect of the size (number of people living in a unit). Size has never been varied while all other conditions are kept constant and purpose designed small units are very likely to be homelike, familiar and safe. So while there is a range of evidence that supports the view that small numbers of people in dementia units are better than large numbers, it is not conclusive. The evidence also suggests that the combination of small size with the other attributes of specialised units is not demonstrably beneficial in the later stages of dementia.

The relationship between behavioural disturbance and the size of the space in which the group lives has been investigated in two studies (Bowie and Mountain 1997; Elmstahl, Annerstedt et al. 1997)(Forbes rating = weak) and the findings suggests a lack of association between the amount of space available in a ward and the level of behavioural disturbance.

> "It has been assumed that GL (Group Living) units should be small, to prevent disorientation or confusion. However, we found no relation between confusional reactions and total area, total activity area, or proportion of activity area out of total area" (Elmstahl, Annerstedt et al. 1997).

Elmstahl et al go on to observe that units with 'a smaller proportion of communication area' tended to have higher levels of disorientation and lack of vitality in their residents'. This may be taken as evidence of a minimum size beyond which negative effects begin to be shown.

A comparison of behaviour and use of spaces before and after transfer from traditional nursing home to an SCU (Kovach, Weisman et al. 1997) (Forbes rating = weak) showed increased social activity which was attributed to the small physical and numerical size of the unit. Contrasting results from a qualitative study of staff and family members views (Morgan and Stewart 1997) (Forbes rating = weak

qualitative) indicated that while there were positive effects in providing additional space for wanderers in a lower density environment in a new unit, which resulted in less noise and general activity, the increased space and smaller number of residents decreased social interaction. A combination of small numbers of residents in a compact design was recommended to overcome this problem.

A study that compared behaviour problems before and after transfer to a unit where the dining area was both physically and numerically smaller (Schwarz, Chaudhury et al. 2004) (Forbes rating = weak) demonstrated beneficial effects:

> "The new dining spaces served eight to 10 residents compared with the 25 to 30 residents who had their meals in the large dining area before the renovation. Behavioral mapping data indicated that there were fewer incidents of disruptive and agitated behaviors in the new dining areas than in the larger dining space that served the residents prior to the renovation. Staff members seemed to be having more sustained conversations with the residents in the new dining spaces than they were having in the old dining space. The reduction of group size in the new dining areas reduced the possibility of the chain reaction of disruptive behaviors during mealtimes."

A qualitative comparison between a purpose built Alzheimer's facility and a traditional nursing home (McAllister and Silverman 1999.)(Forbes Rating = Weak, qualitative) suggested that the small scale of the special unit contributed to the higher level of community formation and social interaction found there. An interesting association between large homes and an emphasis on health and safety issues resulting in lower enjoyment of activities and ability to control the environment has been found in a recent UK study" (Torrington 2006).

In summary there is a range of evidence supporting the proposition that small size, in the sense of number of people living together, is associated with a variety of positive outcomes for people with dementia. These include slower decline in ADL skills, more sustained interest in the environment, less aggressiveness, less anxiety, less depression, less use of psychotropic medication and a higher level of community. Yet, in the best controlled study (Zeisel, Silverstein et al. 2003) larger numeric size was associated with less social withdrawal and there was no significant relationship with agitation, aggression, depression or psychotic symptoms. However it is impossible to quantify the contribution that the size of the unit makes in comparison with the other environmental factors that are commonly associated with a purposely designed, small unit e.g. homelikeness, safety and familiarity.

Domestic and homelike

The rigorous assessment of the effects of providing a homelike environment have taken two basic forms, a comparison of care in a homelike facility with care in the community and comparisons between facilities that vary in their level of homelikeness.

The first randomised control trial of admission to a purpose designed, homelike environment was conducted in Australia (Wells and Jorm 1987) (Forbes rating = strong). The nature of the environment was described :

> "The interior and garden areas are as secure as possible and reflect a homelike atmosphere. Most rooms are single and residents bring their own beds and small items of furniture. There are several multi-purpose living or activity areas and a kitchen/dining room. Where possible domestic furnishings and fittings have been used including carpet tiles in all but the bedroom and bathrooms. The care programme involves all staff working in the unit and is based on the philosophy of normalisation. It includes continuing assessment and individual program review".

Residents showed no difference in their rate of deterioration when compared with a matched group of community dwelling people with dementia who accessed community services such as respite care. This is described as a successful outcome as the trauma and difficulties associated with admission to residential care were thought to be likely to accelerate decline. An important benefit was found is that the carers of those admitted showed improvements in their stress levels.

However it is clear from the description of the environment that the contribution of the care staff in the form of undertaking systematic assessments and developing individual programs was seen as central to the provision of appropriate residential care. There is no suggestion that this was provided for the community sample. The results therefore reflect the impact of a range of interventions that include the provision of a homelike environment.

In a similar vein a comparison between the Quality of Life (QoL) of 62 people with dementia living in a SCF which is "more comfortable and more like home and offers more choice and more privacy than traditional setting" (Reimer, Slaughter et al. 2004)(Forbes rating = strong) and 123 matched people living in a number of traditional nursing homes showed positive results for people in the mid to late stages of dementia

> "The SCF … featured a decreased density of residents, with 10 people living in each of six separate and self-contained semi-attached bungalows; enhanced staffing ratios, which enable the integration of personal care, leisure, and rehabilitation activity into the role of the staff caregiver (rather than an expert model of episodic therapist intervention); and a biodiverse environment (e.g., multigenerational, live-in pets, plants). The physical environment and daily activities were arranged like a typical home, with residents able to help in the kitchen, sweep the floor, sit by the fireplace, or go outside into a small enclosed garden area".

While it proved impossible for the authors to allocate residents randomly to these settings the matching of residents on age, sex, Global Deterioration Scale results and co-morbidities provided a firm foundation for comparison.

"This is the first study to directly compare SCF with traditional institutions using prospective follow-up and data collection. Taken as a whole, the findings of the study suggest that QoL for adults with middle- to late-stage dementia is the same or better across time in a SCF than in traditional institutional facilities. This is the first longitudinal study of its type to demonstrate positive effect on QoL over time in these later stages of dementia. Specifically, the group living in the SCF had significantly better ADL function over time than the two control groups, as measured using the FAST. In addition, affect for the residents living in the SCF was better, with increased interest and less anxiety/fear. ..This study suggests that a purposively designed physical and social environment has a positive effect on QoL."

The reduction in anxiety (p=0.003) and an increase in interest in their surroundings (p=0.017) were sometimes accompanied by an increase in agitation (p=0.087). The increase in physical agitation was described as not necessarily "a negative finding, because it may indicate that residents had the environmental and biochemical freedom for such activity."

This study again demonstrates the positive impact of a complex collection of interventions and leaves open the question of how much the physical environment contributed to the improvement and how much was contributed by the "enhanced knowledge and skills of caregivers."

A serious attempt to control for these variables has been made in a very sophisticated study involving comparisons between 15 special care units (Zeisel, Silverstein et al. 2003). Statistical controls were included for the influence of, among others, cognitive status, need for assistance with activities of daily living, prescription drug use, amount of Alzheimer's staff training and the staff-to-resident ratio. This study extended the boundaries of experimental design beyond the traditional randomised control trial.. A hierarchical modelling technique was used to emphasise the variability between settings that would not have been apparent in a random sample and overcomes the problems associated with studies of intervention effects when SCUs are assigned to experimental or control conditions, but the individual is the unit of analysis. For this reason the study has been able to be rated as strong in the Forbes ratings even though the sample is not random.

While the study is exciting in its design, the findings in relation to homelikeness are not dramatic

"Persons living in SCUs with a more residential, less institutional environment expressed lower levels of overall aggression than those living in more institutional settings".

There was no relationship of homelikeness with agitation, depression, social withdrawal or psychotic symptoms.

Perhaps the most obvious features of a domestic environment are the 'homelike' furnishings and fittings. A very well controlled investigation of the effects of introducing a few of the most basic elements of a homelike environment into a very institutional nursing home (Cohen-Mansfield and

Werner 1998) (Forbes Rating = Strong) showed that residents chose to spend time in a corridor containing comfortable chairs, pictures, coffee table, books and the aroma of citrus in comparison with a normal corridor. There was a weak trend to reduced agitation, pacing and exit seeking in comparison to behaviour in a normal corridor but this positive trend was stronger when instead of a domestic setting being provided a setting reminiscent of a natural outdoor setting was provided. The differences between the two enhanced settings were small. This study is probably best interpreted as supporting any and all steps available to break the institutional character of nursing homes with long hospital style corridors and shiny floors. It does have the advantage though of controlling for staff skills and knowledge and other features of the social environment.

Does a homelike environment have any effect on the rate of functional decline of people with dementia? If it can be assumed that homelikeness is a feature of SCUs in the USA, and there is some doubt about this (Chappel and Reid 2000), then the findings of the 4 State study of 800 facilities (Phillips 1997.) (Forbes rating = strong) are relevant. This showed that SCU residents declined at the same rate as non-SCU residents matched for base line cognitive status, behavioural problems, age, sex and length of stay.

In summary the strongest evidence specifically on the provision of homelike environments supports the idea that they reduce aggression and may have a beneficial effect on levels of agitation. When the homelikeness is part of an intervention that includes enhanced staff skills and knowledge there is strong evidence of beneficial effects on quality of life, anxiety and interest in surroundings. People with dementia living in such surroundings can be expected to do as well as those living at home with the type of community supports available in 1987, i.e. access to respite and day care. However there are no grounds for believing that a homelike environment will slow functional decline.

Additional, usually supportive, findings are to be found in several studies with weaker methodologies. These studies also throw light on the nature of a homelike environment.

Annerstedt and her colleagues in Sweden demonstrated that in comparison to a reference group living in traditional nursing homes people with dementia living in purpose designed and staffed Group Living units showed, after 6 months, significantly better motoric and emotional functions (P < (.001), and intellectual function and symptoms common in dementia, but not defined, (P < 0.01). After 12 months there were no significant statistical differences. (Annerstedt 1993)(Forbes rating = moderate) However it should be borne in mind that 6 months of improvement is very valuable to a person in the latter stages of dementia. The GL units were designed to be small and homelike. Unfortunately this study did not control for different levels of staff training, concentrating on the results of the 'outcome of the intervention as a whole'.

In a study using samples matched on age, diagnosis, social and physical dependency (Annerstedt 1997) (Forbes rating = weak because of poor description of statistical analysis) small homelike group living units were shown to be effective during a certain stage of deterioration "when the person is able

to act as a social individual". During this period "GL care can act therapeutically to reducing secondary symptoms and preserve independence." However Annerstedt is clear that the physical environment is only part of the intervention. "Prerequisites are a homogenous group of residents according to type and level of dementia, a well-educated, empathetic staff whose competence is maintained and a small home-like setting providing safety and cues."

In a related study (Elmstahl, Annerstedt et al. 1997) (Forbes rating = weak,) the findings of Reimer et al (Reimer, Slaughter et al. 2004) regarding higher levels of agitation were corroborated. Elmstahl reported that "The degree of restlessness was significantly higher among patients staying in GL (Group Living) units classified as very homelike than among patients living in moderately homelike GL units."

A number of cross sectional studies have tried to assess the relationship between homelikeness and various aspects of the life and symptomatology of people with dementia. The very nature of cross sectional studies renders them incapable of assigning causality and they often seem to raise more questions than they answer.

A systematic attempt to define homelikeness (Quincy, Adam et al. 2005) (Forbes rating =weak, cross sectional) used the Hopkins Homelike Environmental Rating Scale (HHERS) in a comparison of 22 facilities. "This 14-item measure was designed to capture the overall homelike climate of each facility. It consists of two subscales: family-like social climate (e.g., "Facility caregivers interact socially with the residents") and homelike physical environment (e.g., "Residents' rooms are tailored to their personal taste")."

The study concluded with the observations that:

> "Contrary to our hypotheses, environmental factors, specifically size and homelike setting, were not significant correlates of quality of life. Homelike environment and size also did not appear to moderate many of the affects of agitation, depression, apathy, or irritability on quality of life".

A similarly negative finding concerning the relationship between homelikeness, as measured by the Therapeutic Environment Screening Scale (TESS-2+), and agitation, measured by the Resident and Staff Observation Checklist (RSOC) (Sloane, Mathew et al. 1991) was found in a cross sectional survey of 53 special care units for people with dementia (Sloane, Mitchell et al. 1998)(Forbes rating =weak). While low stimulation, characterised by having residents in bed for part of the day, and small size predicted lower level of agitation, homelikeness did not.

A recent Australian qualitative investigation of the views of staff and relatives on a new purpose designed (Cioffi, Fleming et al. 2007) (Forbes rating = weak, qualitative) suggested that homelikness

is related to concepts such as a pleasant milieu, looking homely, a home-like eating environment, feeling homely, like a kitchen at home, tranquility, light and airy, serene, unrestricted, inviting for relatives and comfortable for children. The authors concluded that:

> This study has shown that an improved environment, such as an SCU, can enhance the QOL for residents, the 'nursing home' experience for relatives and the working environment for staff. For residents, the QOL improved as a result of decreased agitation, better sleeping patterns, greater freedom and increased appetite. For the relatives, the nursing home experience was improved as the lighter airy home-like atmosphere with garden access increased their comfort with visiting and with having their family member in care. For staff, their work environment was improved by better access to equipment, and greater ability to monitor residents and provide better care. They were able to feel more comfortable about the safety of the residents.

> The main features of SCU design that relatives appreciated were the home-like family environment and tranquil atmosphere; these design features resulted in a SCU that was conducive to visitors. The SCU kitchen and dining room were described as very homely and this resulted in residents gaining weight.

It is clear that there is little evidence to support the idea that the provision of a homelike environment in itself will bring about positive results for people with dementia. It has to be combined with appropriate philosophies of care, well skilled staff and good management practices (Atkinson 1995; Rosewarne, Opie et al. 1997; Moore 1999.).

Scope for ordinary activities

The appearance of domesticity, ie the 'homelikeness' of the environment, is only part of a domestic environment. As well as looking like home a truly domestic environment must provides residents with opportunities to engage in the ordinary activities of daily living that characterise life at home. Many of these activities centre on the kitchen and dining room. The fundamental idea behind these activities is that the resident should not be a passive recipient of services but should be afforded the opportunity of making a contribution, however small. In other words, to be seen as a competent partner (Kihlgren, Hallgren et al. 1994).

The strongest evidence to support this approach (Reimer, Slaughter et al. 2004) (Forbes rating = strong) comes from a study of a special care facility where "The physical environment and daily activities were arranged like a typical home, with residents able to help in the kitchen, sweep the floor, sit by the fireplace, or go outside into a small enclosed garden area." The results included less decline in ADL functions than in the control groups (p=0.16), less anxiety (p=0.003) and increased interest (=-

0.017). However this environment was also designed to be smaller and more domestic than those it was compared with and the effects of these characteristics cannot be extracted from the findings.

In what may be the most basic demonstration of the positive impact of engaging patients in an ordinary activity, a familiar dining experience around a table, as compared with providing meals to patients in their chairs in corridors, was linked with increased social interaction and improved eating behaviour. (Melin and Gotestam 1981.) (Forbes rating = moderate) The authors note …

> "However, changes in the patient's environment do not automatically lead to increased activity. To ensure a positive effect on the patient behavior, contingency analyses have to be made. The ward milieu has to be created to increase the possibility to communicate and to obtain reinforcers, not just by putting the patients close together but also <u>by making them dependent on each other</u> if possible. In the present study this was done by changing the meal situation so that the patients had to communicate to get what they wanted from the table" (Melin and Gotestam 1981.) (underlining added).

Ordinary activities can also include more personal care, such as grooming. There is clear evidence of the beneficial effects on QoL of engaging residents in these activities in a rich environment that included the opportunity to engage in activities such as food preparation (Wood, Harris et al. 2005) (Forbes rating = weak). However, this study indicates the need for the active and focused intervention of staff for the environmental provisions to have an effect.

> "The most enabling environmental presses occurred when staff managed activity situations in ways that continually supported residents' positive behaviors and affect. ADL times and some activity groups constituted such situations". (Wood, Harris et al. 2005)

Wood et al conclude that

> "Perhaps most importantly, therefore, attention must be paid to how therapeutically designed, beautiful, and homelike architectural spaces can best be transformed into alive occupational spaces, as well as to what personal and institutional contributions and commitments are needed to make such transformations a reality".

The CADE units in NSW were designed to provide the opportunity for the involvement of residents in domestic activities and staff were trained and encouraged to do this (Atkinson 1995). The evaluation of the first 15 months of operation of the first of these units (Fleming 1989) (Forbes rating = weak) indicated significant improvement in self help skills, social interaction and behaviour when compared to baseline measurements established in a long stay ward in a psychiatric hospital.

Supportive evidence of the significance of ordinary activities in establishing social networks and a sense of community has been found in a well executed qualitative study (McAllister and Silverman 1999.) (Forbes rating = weak, qualitative) comparing a small, homelike facility with a traditional nursing home. One of the residents remarked:

> " 'They cook your meals; sometimes I do the dishes—I don't have to but I help out'. She also told me she's glad she doesn't have to cook here, though 'it was OK cooking at home because you knew what they liked'" (McAllister and Silverman 1999.).

Highlighting the fact that not only do environmental characteristics and staff practices influence the effectiveness of interventions but resident perceptions and wishes are also very important.

In summary it may be said that the evidence supporting the importance of the provision of the opportunity to engage in ordinary activities is not strong. The best study involves too many variables to be certain that the ordinary activities are central to the positive effects. The study that shows a positive effect when ordinary activities were introduced did not have an active control group (Melin and Gotestam 1981.). The positive responses shown may have been gained by the introduction of any of a variety of types of change to the boring ward environment. The other studies are methodologically weak.

Safety features

Safety/security is defined in the Professional Environment Assessment Protocol (PEAP) (Lawton, Weisman et al. 2000) as

> "The extent to which the environment both minimizes threats to resident safety and maximizes sense of security of residents, staff, and family members. It includes ease of monitoring residents; control of unauthorized exiting; support of functional abilities; provision of specialized equipment".

The level of safety and security in facilities designated as providing care to people with dementia is higher than in other facilities (Morgan, Stewart et al. 2004).

One of the most common problems associated with caring for people with dementia in an environment that has not been designed for their use is that of keeping them safe from the danger of wandering away and perhaps getting lost or run over (Rosewarne, Opie et al. 1997). The most obvious response to this problem is to provide a secure perimeter, preferably one that allows for safe wandering and access to an outside area.

Positive effects have been found when unobtrusive means are used to provide a secure perimeter

> "Depression was negatively correlated with another environmental factor exit design. Residents in facilities whose exits were well camouflaged and had silent electronic locks rather than alarms tended to be less depressed. A hypothesis to explain this correlation is that residents try to elope less in such settings and that caregivers - tending to consider such environments safer - afford residents greater independence of movement. Residents who experience this greater freedom, and hence have less conflict about trying to leave the SCU, feel a greater sense of control and empowerment, leading in turn to less depression. Until further research is carried out measuring personal state-of-mind variables that might be implicated in such a process, this explanation remains only a hypothesis" (Zeisel, Silverstein et al. 2003) (Forbes rating = strong).

This feature is mentioned as one of the central characteristics of the special nursing home unit evaluated by Wells and Jorme (Wells and Jorm 1987) (Forbes rating = strong) which found that residents did as well as those cared for at home.

Security features are also central to the group living facilities developed in Sweden and Italy (Annerstedt 1993; Bianchetti, Benvenuti et al. 1997) (Forbes rating = moderate and weak respectively). However none of these studies attempts to define clearly "what is meant by security "or to quantify its provision.

Annerstedt clarified the purpose of providing a safe environment as enabling the resident to have the opportunity to focus on the identity preserving features of group living:

> "The safety provided in GL makes environmental barriers easy to overcome. Energy can be used to extend the territory and the demented can benefit from everyday activities, the accessibility of cues in social life and the external memory aids built into the setting" (Annerstedt 1997)(Forbes rating = weak).

But again there is no attempt to quantify or fully describe the safety and security features.

The provision of hidden or subtle locks on doors may have some beneficial effects but it does raise the question of wouldn't it be better if residents could go outside and be safe. This question was answered elegantly (Namazi and Johnson 1992a) (Forbes rating = weak) in a study involving 22 residents with probable Alzheimer's disease who were observed for 30 minutes after trying outside doors leading to a safe area. In one condition the doors were locked in the other open. While the authors make no attempt to calculate the significance of the results it is clear that there was a dramatic, positive difference in agitation, aggression and wandering following an encounter with an open door as compared with a locked door.

There is a suggestion that establishing a secure perimeter may have the unwanted side effect of restraining people with dementia who while confused, are not likely to abscond. In a cross sectional study of 11 nursing homes Low found that harmful behaviours, particularly risk taking and passive self harm were associated with better security features and an increased number of special design features for frail residents and residents with dementia (Low, Draper et al. 2004) (Forbes rating =weak, because of lack of control over allocation of residents to facilities). The possibility that an emphasis on safety has unwanted side effects is supported by a recent study carried out in the UK (Torrington 2006) (Forbes rating = weak)

> "Safety and health was the only domain in the DICE study that had a negative association with the quality of life scores. The low dependency group of residents had lower scores for enjoyment of activities and ability to control the environment in buildings with higher scores for safety and health. Large buildings had consistently high scores in this area with median scores of 79% as against 66% and 65% for small and medium homes".

A small study (Chafetz 1991) (Forbes rating = weak) comparing decline in a special care unit and a normal nursing home provided information on two safety features, the securing of exits and the securing of drawers and cupboards which were the major environmental changes made in establishing the special care unit. The study results suggest that these interventions have no significant effect on the rate of cognitive decline or the presence of behavioural disturbance.

In summary the evidence supports the use of unobtrusive safety features but warns against over-emphasis on safety.

Rooms for different functions that are equipped with familiar fixtures and furnishings

This principal combines factors such as familiarity, variety, specific function and personalisation. It suggests the need for spaces that range from the public to the private. The presence of separate social spaces has been shown to differentiate SCUs from non-SCUs in a statewide survey involving 436 Minnesota nursing homes (Grant, Kane et al. 1995). The strongest evidence for its importance comes from Zeisel's well controlled study that provides some certainty about the contribution of the individual factors to the well being of the residents (Zeisel, Silverstein et al. 2003)(Forbes rating = strong). It contains findings of direct relevance to the principle as the following three quotations demonstrate.

> "The degree of privacy-personalization in the SCUs studied was negatively correlated with patient scores on the Cohen-Mansfield total aggression scale. Residents in facilities with more

privacy - more rooms that are individual and more opportunities for personalization - generally scored lower on this scale, representing less anxiety and aggression".

"The amount of variability among common spaces in a facility was negatively correlated with patient social withdrawal scores. The degree of social withdrawal among residents decreased as the variability among the common spaces in a facility increased".

"Those living in environments scoring high on privacy-personalization tended to have lower scores on the psychotic problem scale".

"Characteristics of the environment associated with reduced depression, social withdrawal, misidentification, and hallucinations include common areas that vary in ambiance".

The principle is embedded in the design of special environments investigated by others, e.g.

"Most rooms are single and residents bring their own beds and small items of furniture. There are several multi-purpose living or activity areas and a kitchen/dining room" (Wells and Jorm 1987) (Forbes rating = strong).

which showed that residents rate of decline was no different to that measured in a control group of people with dementia living at home.

In a weaker study where the environment was also described as including

"own belongings in his private living area, usually a combined living room/bedroom and [shares] the common living area, kitchen and laundry" (Annerstedt 1997) (Forbes rating = weak).

the residents in the Swedish group living unit were found to maintain intellectual, motoric and practical abilities (as reflected in ADLs) and to be less aggressive, anxious and depressed than comparable people in a traditional nursing home. However, there is no way to know what contribution staff attitudes and training or other environmental features of the group living units contributed to this result.

An early study emphasising the need for a familiar environment (Greene, Asp et al. 1985) (Forbes rating = weak) suggested that improvements in behaviour were measurable in 50% of the residents. In a paper full of clearly described hints on creating environments that are thought to be helpful to people with dementia, Hoglund et al (Hoglund, Dimotta et al. 1994) (Forbes rating = weak) stated that

"…one thing that works well is having a variety of rooms and allowing them to have a definite purpose, rather than being a multipurpose space".

It is possible that environments that have well defined spaces with different functions are easier for people with Alzheimer's disease to navigate (Passini, Pigot et al. 2000) (Passini, Rainville et al. 1998.) (Forbes rating = weak).

In summary there is good evidence for the provision of a variety of spaces in environments for people with dementia as they assist in reducing anxiety and depression while improving social interaction and may assist the resident to find their way around.

Outside space

A secure out door area has been shown to be one of the defining features of an SCU (Grant, Kane et al. 1995). The beneficial effects on levels of agitation of being able to get outside have been well demonstrated (Namazi and Johnson 1992a) and described in the section on security however there is very little empirical evidence of the effect, beneficial or otherwise, of being outside. It is unfortunate that an attempt to include access to a garden in a very well controlled study (Zeisel, Silverstein et al. 2003) was thwarted by lack of information on whether residents could actually access the gardens that had been identified as being present.

There have been studies of environments that have outside areas incorporated into their design as an amenity to be used by residents (Wells and Jorm 1987) (Forbes rating = strong) but it is impossible to identify the relative contribution that the outside area has made to the beneficial effects, in this case of maintaining the function of the residents.

An Australian study was the first to demonstrate empirically an increase in pleasure associated with being in a landscaped garden (Cox, Burns et al. 2004) (Forbes rating = moderate) This study examined how effective two types of multisensory environments were in improving the well-being of older individuals with dementia. The two multisensory environments were a Snoezelen room and a landscaped garden. These environments were compared to the experience of the normal living environment. The observed response of 24 residents with dementia in a nursing home was measured during time spent in the Snoezelen room, in the garden, and in the living room. Both the Snoezelen room and the garden decreased the signs of sadness shown by residents in comparison with the living room and significantly increased the signs of pleasure. However there was a significant increase in pleasure in the three environments when the residents were approached by staff. The authors concluded that

> "… in terms of the relative effectiveness of each environment in improving well-being of participants, the quantitative data indicate few differences between them. Qualitative data obtained by interviewing staff and caregivers indicated that 'No matter which of the three environments was being spoken of, it was the opportunities of a one-to-one relationship, quality time, and to feel closer, that was valued…"

The provision of access to an outdoor area is not in itself sufficient however. If the space is unfriendly, too large or too complicated it is unlikely to be used. A systematic approach to developing a 'therapeutic garden' is required to encourage patients to use it. The availability of a garden area, whether well designed or not, appeared to reduce aggression and falls in comparison to a facility without a garden (Mooney 1992.) (Forbes rating = weak).

The enrichment of the experimental facility by the provision of an outside patio (in conjunction with improving security features) had no differential impact on the behavioural or cognitive course of the dementia of residents when compared to the non-enriched, control environment (Chafetz 1991) (Forbes rating = weak).

A U.S. wide survey of long term care facilities with outdoor areas investigated the characteristics and features of these areas and how they related to the perceived impact on their users. (Cohen-Mansfield and Werner 1999) (Forbes rating = weak, survey) Most respondents rated outdoor spaces as very useful and as having a great benefit for users. The perceived benefit was related to the presence of design features, such as the presence of gazebos; and to the number of activities offered in the area. Despite these positive findings respondents stated the areas were not used as much as possible.

The lack of access to outside areas when they are present is usually associated with staff practices. In common with other architectural features of the facility the presence of a pleasant, safe outside space had no affect that could be attributed to it that was not secondary to the impact of the relationships with the staff (Wood, Harris et al. 2005).

So while

> "gardens are a lovely and interesting way to provide a source of sensory stimulation and avoid monotony - a virtual symphony of sight, sound, light, color, fragrance, birds, and small animals. Outdoor spaces offer unique opportunities for a wide range of stimulating, potentially life-enriching activities such as assisting someone who has been a lifetime gardener to maintain some form of small outside gardening spot" (Brawley 2001).

the empirical evidence for their utility in the absence of staff interventions is lacking. Nevertheless, if staff time is available they do provide an opportunity for enhancing staff/resident interactions.

Single rooms of an adequate size

The postulated advantages of single rooms have been summarised as including the opportunities to choose between privacy and socialisation; to personalise the space, providing familiarity and continuity with the past; support a sense of security and individual identity and to allow residents to control levels of stimulation (Morgan and Stewart 1998).

While not being able to tease out the characteristics individually there is strong evidence that:

> "The degree of privacy-personalisation in the SCUs studied was negatively correlated with patient scores on the Cohen-Mansfield total aggression scale (p=0.019). Residents in facilities with more privacy - more rooms that are individual and more opportunities for personalisation - generally scored lower on this scale, representing less anxiety and aggression"(Zeisel, Silverstein et al. 2003) (Forbes rating = strong).

A negative correlation (p=0.023) with psychotic symptoms was also found in this study.

The availability of private rooms has been shown to reduce irritability, increase time spent alone and improve sleeping patterns in people with advanced Alzheimer's disease and other related disorders (Morgan and Stewart 1998) (Forbes rating = moderate). Time spent alone was seen by staff and relatives as a positive opportunity to 'have their own space' not as a problem.

Studies in which the provision of single rooms is part of the environmental and psycho-social package under investigation but in which it is not possible to partial out the specific affects of single rooms or the provision of privacy (Wells and Jorm 1987; Wood, Harris et al. 2005) cannot directly support the provision of single rooms but their overall positive results do not provide any reason for believing that single rooms have negative affects.

Uncooperative behaviors have been found to be associated with shared rooms (Low, Draper et al. 2004)(Forbes rating = weak). No empirical studies dealing with the size of residents' rooms were located.

In summary there is some strong evidence in support of the provision of single rooms for people with dementia and no empirical evidence to contradict that conclusion.

Good signage and multiple cue-ing

The provision of signs and aids to wayfinding is integral to the design of many special environments for people with dementia (Grant, Kane et al. 1995).

> "Signs may help to recognize places when architectural and interior design features are not sufficient in passing the message. They may provide directional information to remind the patients of where facilities are located and of how to return to their points of origin".(Passini, Pigot et al. 2000).

Evaluation of an Italian approach to the design of SCUs incorporating the use of signs, associates them with reductions in behavioral symptoms (Bianchetti, Benvenuti et al. 1997) (Forbes rating = moderate). As in other studies reported here, there is no possibility of teasing out its effect from those of the other environmental manipulations and changes in staff practices.

Some signs and cues can have a negative impact, e.g. the exit signs and panic bars on exit doors which appear to cue residents to try to leave the facility. These can be countered in a number of ways. Placing a horizontal grid of black tape in front of an exit reduced contact with the door by up to 97% in 4 people with Alzheimer's disease (Hewawasam 1996) (Forbes rating = moderate). The presence of a mirror in front of an exit cues the response not to touch, reducing exit attempts by 50% (Mayer and Darby 1991) (Forbes rating = moderate). In a study with a similar intent (Dickinson and McLain-Kark 1998) (Forbes rating = weak) methods of reducing the cues for exiting provided by a door in a residential unit were investigated. Residents were exposed to three test conditions: a mini-blind that concealed the view from the door, a cloth panel that concealed the panic bar of the door, and both the mini-blind and the cloth panel. The findings indicated that hiding the panic bar behind a cloth panel reduced the number of attempts to exit.

The best place for the signs is not at the top of the door but low down, even on the floor, to compensate for the downcast gaze of many people with dementia (Namazi and Johnson 1991b) (Forbes rating = weak). This study indicated that the best results, for getting residents to use a publicly available toilet on their unit, were obtained by using the word toilet on an arrow on the floor pointing to the toilet. The placing of a graphic depicting a toilet on the toilet door at eye level was also effective but not as effective as the arrow on the floor.

The use of picto-grams for people with dementia has not received much empirical investigation although the use of a handmade sign depicting a pair of scissors enabled a resident with dementia to find the hairdressers when she was unable to find any other location other than her own room (Passini, Pigot et al. 2000) (Forbes rating = weak, qualitative).

The signs must be large enough to be seen by people with poor vision. In a study with an exceptionally small sample it has been shown that large signs combined with orientation training were be effective but not when simply put up without drawing residents attention to them (Hanley 1981.).

> "Signposts alone then do not seem to be generally effective in facilitating improvement in ward orientation. However, in combination with a preceding ward orientation training or more especially an accompanying ward orientation and signs training, improvements are effected, which for two of the four patients above, are maintained fully at three month follow up".(Hanley 1981) (Forbes rating = weak).

The debilitating effects of normal signs in public buildings are carefully and considerately described in an analysis of the wayfinding problems encountered by people with Alzheimer's disease trying to find locations in a hospital (Passini, Rainville et al. 1998.) (Forbes rating = weak). The descriptions of the frustration of trying to read textual signs and the strange perseveration of searching behavior that continued after a sign had been read indicating that the destination had been reached highlight the problem of depending on conventional signage.

> "One of the major recommendations emerging from this research is to clean up information clutter on circulation routes. The non-discriminatory reading of information by DAT patients is among the most confusing interferences in the wayfinding process. Graphic wayfinding information notices along circulation routes should be clear and limited in number and other information should be placed somewhere else. It is quite feasible to create little alcoves specifically designed for posting public announcements, invitations and publicity, and these areas could even become small gathering places encouraging social interaction.

> The graphic information provided would be of consistent design and systematically located so that the user knows what to look for and where to look for information. This rule facilitates graphic communication and also reduces chances of the user being overloaded by information" (Passini, Rainville et al. 1998.).

There is some evidence that the use of color to distinguish the doors to residents rooms has a beneficial effect (Lawton 1984.) (Forbes rating = weak) but the experimental design makes it impossible to be certain about the contribution of contrast to the positive and negative outcomes.

If the idea of multiple cueing is extended into the area of cues for the date, time, place etc, i.e. reality orientation cues, it has been found (Bowie and Mountain 1997) (Forbes rating = moderate) that inappropriate behaviour was more frequent on a psychiatric ward which was comparatively impoverished for RO cues when the effects of ward condition, space availability, facilities available, institutional practices and activities were controlled for.

In summary there is limited evidence of the effectiveness of signs in environments for people with dementia. Those that have some beneficial effect, e.g. large arrows on the floor along with the word 'toilet' (Namazi and Johnson 1991b) seem to be in conflict with other principles of design, e.g. the provision of a familiar, homelike environment.

Use of objects rather than colour for orientation

Signs and cues in the form of text and graphics are not the only way in which information about the location of spaces can be made available

> "The physical environment not only creates the wayfinding problems people have to solve but it can also provide information to solve these problems. ... Information should be presented by different means to allow for personal preferences and redundancy. … Attention has to be paid to avoid distracting patients by non relevant information displays. The environment has to speak a language that the user, the Alzheimer's patient, can understand" (Passini, Pigot et al. 2000).

The recognisability of personally familiar objects can be used to aid orientation. Displaying personal items, selected by relatives because of their significance, in cases outside residents' rooms is a more effective approach than displaying distinctive, but non-personal items (Namazi, Rosner et al. 1991) (Forbes rating = weak, small sample size leading to use of descriptive statistics). Personally significant memorabilia were most useful for people with moderate dementia; higher functioning residents were able to orient with familiar but non-personal memorabilia as well. Sadly the findings suggest that neither approach was helpful for lower functioning residents. In a replication of this study which more carefully focused on the precise nature of the memorabilia (Nolan, Mathews et al. 2002)(Forbes rating = weak, small sample size leading to the use of descriptive statistics) some improvement in the location of rooms was found when photographs of the person in their youth were prominently displayed. This effect was contrasted with the ineffectiveness of current photos. The 6 residents in the small sample were moderately demented.

Additional benefits have been suggested as accruing from the display of personal objects :

> "Special glass cases installed outside residents' rooms enable a display of favorite personal objects and pictures. Having personal memorabilia in the shared spaces would provide the possibility of remembering the stories, events, people, and places associated with them. The items also provide an opportunity for the staff to know more about the residents, understanding the individuals as persons with preferences, attitudes, and values" (Kovach, Weisman et al. 1997).

but no empirical research is available to support this attractive idea.

In summary there is some weak evidence to support the use of personal memorabilia as an aid to orientation for people with mild to moderate dementia.

Enhancement of visual access

The observation that people with dementia stand a better chance of finding something if they can see it from where they are led to the idea of 'Total Visual Access' which was incorporated into the design of the NSW Health units for the confused and disturbed elderly CADE units (Fleming 1987). It resulted in a very simple, corridor free environment.

The evaluation of the first of the CADE units suggested that the main impacts of this style of environment were to be found in improvements in self help, socialisation and behaviour (Fleming 1989) although it is clear that these changes were brought about by the combination of both the environmental and psychosocial factors in operation in specialised units for people with dementia.

More recent research has shown that a simple building 'where patients should be able to proceed from one decision point to the next as they walk along without having to plan for future decisions' is associated with resident orientation but it suggests that the simple environment must be supplemented with a certain amount of explanation or training for the residents to function better (Passini, Rainville et al. 1998.) (Forbes rating = weak).

Disorientation has been found to be less pronounced in L, H and square shaped units where the kitchen, dining room and activity rooms were located together, which may indicate good visual access for most activities and times. Environments with a single central corridor were associated with higher degrees of restlessness and with reduced vitality and identity (Elmstahl, Annerstedt et al. 1997) (Forbes rating = weak).

Evidence of the importance of being able to see what you need to see when you need to see it is provided in a study that investigated the effects of making the toilet visible rather than hiding it away (Namazi and Johnson 1991a) (Forbes rating = weak, because of descriptive nature of statistical analysis). When the toilet was visible to residents with dementia it was, on the average, 8 times more likely to be used than when it was hidden by a curtain. This is described as having a significant effect on the management of incontinence and to be useful to mobile residents with mild to severe dementia. The visibility of the toilet did however result in the residents using the toilet every 9.8 minutes!

In summary, the evidence for the incorporation of good visual access on the broad, unit level scale is not strong but the dramatic effect of making an important amenity, the toilet, easily seen provides good supporting evidence for the concept.

Control of stimuli

People with dementia have difficulties in dealing with high levels of stimulation. Their ability to screen out unwanted stimuli appears to be reduced. They can become more confused, anxious and agitated when over stimulated (Cleary, Clamon et al. 1988.). Common causes of overstimulation are busy entry doors that are visible to patients, clutter, p.a. systems, (Cohen 1991.; Brawley 1997.), alarms, loud televisions (Hall 1986.; Evans 1989.), corridors and crowding (Nelson 1995.).

Stimulus control may be broken down into 2 main areas, the reduction of disturbing stimulation and the enhancement of useful stimulation (Fleming 1987). The control of levels of stimulation by environmental manipulation and staff practices have become defining features of Special Care Units (Grant, Kane et al. 1995; Morgan, Stewart et al. 2004).

There is strong evidence from the Zeisel et al study indicating that residents are less verbally aggressive

> "where sensory input is more understandable and where such input is more controlled" (Zeisel, Silverstein et al. 2003) (Forbes rating = strong).

A smorgasbord of relationships between various behaviours and types of stimulation has been described

> "Most behaviors decreased when there was noise around, with the exception of requests for attention which increased with high levels of noise in the environment, and aggressive behaviors, which increased at night when there were high levels of noise. There was a tendency for behaviors to increase when the environment was perceived as cold, with the exception of pacing which tended to occur more frequently under conditions of normal temperature, and requests for attention, which increased when the environment was hot" (Cohen-Mansfield and Werner 1995) (Forbes rating = strong).

and an approach that includes environmental changes and psychosocial (rather than medical) interventions is recommended.

An approach of this kind, resulting in a reduction of behavioral disturbance, was used in a Reduced Stimulation Unit housing 11 patients

> "…where the doors could be easily closed and camouflaged. Small tables for eating and for small group activities were set up in four of the rooms. Visual aspects of the unit (for example, pictures and wall colors) were neutral in design and color. There were no potential sources of stimulation from televisions, radios and telephones except one telephone for emergencies. Patients were free to ambulate anywhere as well as eat and rest whenever they wished on the

unit. A planned, consistent daily routine scheduled rest and small-group activity periods" (Cleary, Clamon et al. 1988.) (Forbes rating = moderate).

Three months after admission the residents were significantly more involved in ADLs and required significantly less restraint than 3 months prior to admission. Agitation and wandering had decreased (non significant) while medication usage had not changed. Improved relationships between residents and between residents and staff were noted but not measured. The results were modest and whether they were the effect of better care practices or by the environment or a combination of these, could not be determined.

Busy entry doors pose particular problems for staff and patients. They are a constant source of over stimulation and a temptation to escape. The positive results of ways to avoid these problems by hiding the door or door handle, i.e reducing disturbing stimulation, ((Namazi 1989.; Dickinson, McLain-Kark et al. 1995) have been described in the section on security. When the door offers tantalising views of the outside world it can be useful to head off escape attempts by installing blinds (Dickinson, McLain-Kark et al. 1995; Dickinson and McLain-Kark 1998). (Forbes ratings = moderate and weak respectively). These studies show that the attraction of a view to the outside is very strong. It can be sufficient to overcome the aversive effect of dazzling and confusing patterns painted on the floor (Namazi 1989.; Chafetz 1991) indicating that there is likely to be an advantage to reducing the stimulation provided by these views by using blinds or curtains than to add to it by painting grids on the floor.

Some of the decision making problems experienced by people with dementia can be explained in terms of the effects of unnecessary stimulation. They commonly have problems in choosing what to wear from the variety of clothes hanging in a wardrobe. This problem can be alleviated by having two wardrobes, one obvious and one hidden, with the obvious wardrobe containing only one or two sets of clothes. The overwhelming choice is then reduced to manageable proportions. This can be taken a step further by designing the wardrobe to enable staff to display clothing in a pre-selected order (underwear first, shirt, trousers, etc). This has been found to increase residents' independence in dressing and reduce the amount of physical help the person with dementia required (Namazi 1992)(Forbes rating = weak)

Non specific studies involving the combination of reduced stimulation with other environmental and care practice manipulations has been shown to reduce behavioural disturbance (Bianchetti, Benvenuti et al. 1997; Bellelli, Frisoni et al. 1998) (Forbes ratings = moderate).

The reduction of stimulation must not be taken too far. Care must be taken in reducing light levels, for example, as it has been demonstrated that low light levels reduce wayfinding (Netten 1989.). Indeed there has been a great deal of interest in the potentially beneficial effects of increasing light levels to overcome the exceptionally low exposure to bright light experienced by many people with dementia living in institutions (Ancoli-Israel, Clopton et al. 1997) which lead to sleep disturbance.

A very well constructed RCT (Ancoli-Israel, Gehrman et al. 2003) (Forbes rating = strong) involving a comparison between morning and evening bright light sessions (mean of 105 minutes exposure to 2,500 lux) with similar exposure to dim red light and normal, baseline light exposure showed that:

> "…the effect of light treatment on sleep and circadian activity rhythms in patients with AD suggest that increased bright light exposure, whether in the morning or in the evening, consolidates nighttime sleep by lengthening the maximum sleep bouts during the night. There was, however, no effect of light treatment on total sleep time nor on wake time during the night or day. In other words, sleep was consolidated but overall time asleep did not change as there were longer but fewer sleep bouts. The magnitude of this effect was also clinically meaningful. Morning light increased the maximum sleep bout length by over 30 min while evening light increased the maximum sleep bout length by over 20 min. As nighttime sleep disruption is detrimental to caregivers as well as to patients, the patient's more consolidated sleep may decrease both caregivers' sleep disruption and their concerns about the patient during the night. Therefore, even though the patient's total sleep time is not increased, both the patient and caregiver are likely to sleep better when the patient's sleep is more consolidated".

Early work (Satlin 1992) (Forbes rating = moderate) supports the use of light therapy but is marred somewhat by having the people with dementia restrained in gerry chairs in front of the light box for 2 hours. This work was extended (Mishima 1994) (Forbes rating = weak) to show that 2 hours of light box therapy, providing 3,000 to 5,000 lux, not only improved sleep but also reduces behavioural disturbance.

The application of this approach in a more naturalistic way, i.e. avoiding the restrictions inherent in getting people with dementia to sit beside light boxes for extended periods by providing elevated light levels in public areas, has been well investigated (Sloane, Christianna et al. 2007) (Forbes rating = strong).

> "Analyses of data from this cluster-unit intervention trial of persons with dementia in two care facilities indicate that high-intensity ambient light therapy in the morning or throughout the day resulted in a small but statistically significant increase in nighttime sleep minutes and inconsistent effects on nighttime sleep consolidation and daytime sleepiness. …The study also demonstrated that bright light was well tolerated and was not associated with adverse effects. The light delivery method used in this study involved remodeling the activity and dining areas of institutional settings, thereby providing passive light exposure. Data on intervention fidelity indicate that this method produced median light intensities close to the target level of 2,500 lux. Furthermore, mean participant exposure was comfortably above the target of 1 to 2 hours per treatment day, and more than 85% of participants received at least 1.5 hours of exposure regardless of treatment. …These results suggest that environmental modification may be superior to light boxes, the current therapeutic standard, as a light delivery method.

Although statistically significant, the clinical significance of the finding that total sleep time was 11 minutes longer under morning or all-day light is unclear".

Sloane et al go on to provide a standard by which the significance of these changes can be assessed.

"To better gauge the clinical significance of this finding, the results were compared with those of published clinical trials of commonly prescribed sleep medications. Zolpidem and temazepam, the most commonly prescribed sleep medications in 2005, produce approximately 30 minutes of additional sleep in young adults and healthy elderly volunteers, but the favorable effect of hypnotic medication appears attenuated in older persons. One randomized trial in 72 elderly persons with chronic insomnia, for example, reported only 4.4 more minutes of sleep with temazepam than with placebo. Furthermore, in long-term care populations, the risks of (adverse effects from) sedative–hypnotic medications are particularly high".

Unlike the light box therapy approach this approach does not appear to involve any additional staff resident interactions. The positive results are therefore more likely to be due to the increase in light levels than to the beneficial effects of spending time with staff.

The possibility that the improvements are due to a placebo effect or extra/different staff attention was shown to be unlikely in a study that provided high light levels (approximately 1100 lux) in the public areas of a geriatric ward (van Someren, Kessler et al. 1997) (Forbes rating = weak, largely because of high attrition rate). Patients with visual impairment and dementia did not show the positive changes in the stability of the rest – activity rhythm experienced by the other non-visually impaired people with dementia. Both groups being exposed to the extra light and the same staff interactions.

Supportive evidence comes from a study (Rheaume, Manning et al. 1998) (Forbes rating = weak) where exposure to intense light (2,500 lux at eye level) was provided in a pleasant room when residents had difficulty in sleeping. This approach is illustrated with reference to positive outcomes in 3 case studies of people with dementia, but not statistically analysed.

In addition to beneficial effects on sleep patterns the provision of very high light levels (10,000 lux) during a 30 minute breakfast period has been shown to have positive effects on behavioural disturbance as measured by the Cohen Mansfield Agitation Index (Thorpe, Middleton et al. 2000) (Forbes rating = moderate). The brightness of this illumination may be gauged by comparing it to the 1000 lux which is approximately equivalent to being outside on a cloudy day.

The provision of simulated dawn/dusk variations in light produced similar consolidation in sleeping patterns (Gasio, Kräuchia et al. 2003) (Forbes rating = weak). Significant improvement in MMSE scores ($p=0.0012$) was obtained in a group of 9 nursing home residents with either Alzheimer's disease or vascular dementia given 2 hours of bright light therapy (3,000 lux) each day for 10 days. No

improvement was observed in the randomly allocated control group (Graf, Wallner et al. 2001) (Forbes rating = weak because of high attrition rate).

The effects of enriching the environment by providing multi sensory stimulation (MSS) in a Snoezelan room and through activity therapy have been investigated in a carefully implemented RCT (Baker, Bell et al. 2001) (Forbes rating = strong). Both methods of increasing the level of stimulation were effective. Immediately after MSS and Activity sessions patients talked more spontaneously, related better to others, did more from their own initiative, were less bored/inactive, and were more happy, active or alert. Both groups were more attentive to their environment than before, with a significantly greater improvement from the MSS group. Members of the activity group interacted more appropriately with the objects around them than those in the MSS group (p=0.001), the only significant difference between the groups when differences in baseline assessments were statistically controlled. The effects were short lived.

The relative benefits of providing stimulation via artificial and natural environments has been investigated (Cox, Burns et al. 2004) (Forbes rating = moderate). This two-stage project examined how effective two types of multi sensory environments were in improving the well-being of older individuals with dementia. The two multi sensory environments were a Snoezelen room and a landscaped garden. These environments were compared to the experience of the normal living environment. The observed response of 24 residents with dementia in a nursing home was measured during time spent in the Snoezelen room, in the garden, and in the living room. In the second part of the project, face-to-face interviews were conducted with six caregivers and six visitors to obtain their responses to the multisensory environments. Both the Snoezelen room and the garden decreased the signs of sadness shown by residents in comparison with the living room. However there was a significant increase in pleasure in the three environments when the residents were approached by staff. The authors concluded that

> "in terms of the relative effectiveness of each environment in improving well-being of participants, the quantitative data indicate few differences between them. Qualitative data obtained by interviewing staff and caregivers indicated that 'No matter which of the three environments was being spoken of, it was the opportunities of a one-to-one relationship, quality time, and to feel closer, that were valued…"

In summary there is good evidence to show that the area of stimulus control is important to the well being of people with dementia. When levels of stimulation are optimum residents with dementia sleep better, are less verbally aggressive, less behaviourally disruptive and more able to dress themselves. While it is often impossible to tease out the effects of staff attention in the studies there is sufficient evidence to suggest that the levels of stimulation themselves have an effect which can be either positive or negative.

Additional research and its implications for Marshal's schema

In the consideration of specific design principles there were no papers that met the criteria set for relevancy and achieved a strong or moderate Forbes rating that could not be fitted into Marshal's schema. However there are a number of studies that do not sit comfortably within 1 or 2 design principles because they take the whole concept of the special care unit (or a variation on it) as the object of study.

The results of these studies are not easy to combine into a coherent picture. Sometimes the whole concept of the SCU is called into question (Chappel and Reid 2000) (Forbes rating=weak)

> "…on the whole, this study was not supportive of the SCU approach. It showed that there is very little clustering of dimensions of care in SCUs. They are virtually indistinguishable from non-SCUs in terms of 5 key dimensions of care - assessment and diagnosis, staff specialization and ongoing education, non-use of restraints, flexible care routines, specialized environmental design and adaptation. In addition the authors conclude that none of the dimensions is 'highly predictive of resident outcome. Environmental features and flexible care are related to one outcome each: change in cognitive function and change in social skills, respectively. In the latter instance, the effect is opposite to that predicted. Assessment is related to two outcomes: change in cognitive function and change in affect; those with the worse assessment procedures show less deterioration in their residents. In other words, the individual dimensions have little overall predictive value and, in some instances, are related opposite to what would be expected.
>
> … this study does not support the common belief that dimensions of care cluster with SCUs. It also adds to a growing body of literature that suggests the existence of weak relationships between SCUs and quality outcomes and, more generally, between facility characteristics and quality outcomes… It confirms research in the United States that neither SCUs nor dimensions of care that are believed to reflect best practices are related to resident outcomes" (Chappel and Reid 2000).

Care must be taken to understand the definition of Special Care Unit. In one paper (Chafetz 1991) (Forbes rating = weak) a SCU environment differed from a traditional nursing home, the comparison unit, only by having a 'dedicated' patio, locks on the exits and some secure drawers in the bedrooms. There was however differences in staff training and activities provided. There were only trivial differences in the decline of the residents in both units over a 13 month period.

One explanation of this type of finding is, of course, that the majority of SCUs in North America are simply not very good and that positive effects in the few good ones are being swamped by the mediocrity of the rest. Some support for this idea is to be found in an investigation of a Special Care Facility (Reimer, Slaughter et al. 2004)(Forbes rating = strong) , in contrast to a Special Care Unit. This well designed study had some positive findings:

"This is the first study to directly compare SCF with traditional institutions using prospective follow-up and data collection. Taken as a whole, the findings of the study suggest that QoL for adults with middle- to late-stage dementia is the same or better across time in a SCF than in traditional institutional facilities .. This is the first longitudinal study of its type to demonstrate positive effect on QoL over time in these later stages of dementia. Specifically, the group living in the SCF had significantly better ADL function over time than the two control groups, as measured using the FAST. In addition, affect for the residents living in the SCF was better, with increased interest and less anxiety/fear. These findings are congruent with the person-environment model initially proposed and previously reported and extended by others to describe the needs of residents with dementia in relation to the physical and social environments. This study suggests that a purposively designed physical and social environment has a positive effect on QoL".

While this study lends support to the idea that the better the physical environment the better the outcomes it leaves unanswered the question of the relative effects of the physical and social environment.

The best attempt to control for key aspects of the social environment involved the comparison of 15 SCUs selected to maximize the opportunity for comparison on the key variables – exit control, individual space, walking paths, common space, outdoor freedom, residential character, autonomy support and sensory comprehension – while using a sophisticated statistical model that enabled controls for cognition, activities of daily living skills, length of stay, prescription drug use, staff ratio, facility size, dementia friendliness and organization. The study investigated the relationships between the key variables and outcomes measure of aggression, agitation, social withdrawal, depression, and psychotic problems (Zeisel, Silverstein et al. 2003) (Forbes rating = strong, if the hierarchical linear modelling statistical technique is given the same weight as an RCT).

The findings are consistent with Marshal's schema and have been reported against the relevant principles above. In summary they indicate that the degree of privacy and personalisation was negatively correlated with aggression, anxiety and the presence of psychotic problems; the amount of variability among common spaces was negatively correlated with social withdrawal; well camouflaged exits were associated with less depression; residents in environments with a residential rather than institutional environment were less aggressive overall and less verbally aggressive in environments in which stimulation was controlled.

An investigation of what on the face of it appears to be an excellent physical environment by Marshal's standards provides some food for thought about the limits to the benefits that may be achieved (Wood, Harris et al. 2005).

"…selected site, which was part of a for-profit life-care community, housed seven residents and was chosen because of its many social and physical environmental features identified as desirable for SCUs…. Desirable social features included dedicated staff for the unit; a restraint-free policy; a policy ensuring daytime outdoor access; and a well-established activity program offering music, exercise, various word and memory games, and religious devotion. Desirable physical features included private bedrooms and bathrooms; common areas of a kitchen, living room, activity space, and outdoor patio and gardens; a homelike quality to décor, furnishings, and the dress of staff; and exit controls consisting of a camouflaged door, locking device, and opening to a safe area. Design features to support way-finding and spatial orientation consisted of directional carpeting, personalized entrances to and furnishings in bedrooms, picture cues for bathrooms, and a well-demarcated wandering path outdoors. Prosthetic supports included handrails, raised toilet seats and grab bars in bathrooms, chairs as rest spots, and raised garden beds. Commonplace objects filled the SCU, including food and cooking and eating implements in the kitchen; a television and VCR in the living room; and puzzles, games, cards, books, magazines, balls, videotapes, plants, and writing materials throughout the living areas. Sensory stimulation and aesthetic features included artwork, a hanging mobile, an ambient sound maker, and attractive gardens and patio area".

This 7 bed special care unit appears to offer practically all of the features deemed to be desirable. Yet

"residents … appeared asocial for 10.5 hours out of a 12-hour day, and noninteractive with their physical environs for 8.5 hours. Residents demonstrated an engaged gaze 60 percent of the time, or approximately seven hours daily, and an unengaged gaze or closed eyes 40 percent of the time, or approximately five hours daily" (Wood, Harris et al. 2005).

This study, limited though it is by the small sample of 7 residents in 1 unit and the correlational nature of its design, may give us the clearest example of the best we can hope for. If we are to improve on its findings it appears unlikely that the improvement will be due to a better physical environment, rather it will be because the staff will be enabled to provide more support.

"The most enabling environmental presses occurred when staff managed activity situations in ways that continually supported residents' positive behaviors and affect. ADL times and some activity groups constituted such situations. During ADLs, staff prompted conversations with residents and, to a lesser extent, facilitated their participation in grooming activities they could neither self-initiate nor self-execute. During some activity groups, staff provided special materials and adapted performance demands to compensate for residents' impairments and enable their participation in relatively difficult activities like making music, playing games, or taking communion. In both situations, residents thereby received needed environmental supports to enact activities that would have exceeded their competency levels, had they been left to their own devices. Additionally, in the small therapeutic music groups, residents'

pleasurable experiences appeared to be maximized along with their participation in music-making activities" (Wood, Harris et al. 2005).

It may be that "the physical environment cannot compensate for deficiencies in the social environment" (Morgan and Stewart 1999) (Forbes rating = poor, qualitative). Appearing to be asocial for 10.5 out of 12 hours does not seem, on the face of it, to be a very good result but perhaps it is. How many hours a day does a person with dementia who is living at home spend without social engagement. It is clearly time to compare the results of the best Australian SCUs with the best of community care to see which comes closest to, or exceeds, this standard.

Summary

While there is evidence supporting the proposition that small size is associated with a variety of positive outcomes for people with dementia it is impossible to quantify the contribution that the size of the unit makes in comparison with the other environmental factors that are commonly associated with a purposely designed, small unit e.g. homelikeness, safety and familiarity. In a study where a strong attempt was made to control for these factors (Zeisel, Silverstein et al. 2003) larger numeric size was shown to be positive in that it was associated with less social withdrawal and there was no significant relationship with agitation, aggression, depression or psychotic symptoms.

The same problems of an intricate relationship between the social/professional environment, i.e philosophy of care, staff skills, good management practices, and the physical environment make it difficult to conclude that a homelike physical environment has a broad impact, especially in the case of people with advanced dementia. However there is good evidence that it reduces aggression.

The evidence for the beneficial effects of involving people with dementia in ordinary activities of daily living is weak.

While an over emphasis on safety may have a detrimental effect there is good evidence that unobtrusive safety features improve resident well being, especially depression.

There is good evidence for the provision of a variety of spaces in environments for people with dementia as they assist in reducing anxiety and depression while improving social interaction and may assist the resident to find their way around. However specific evidence for benefits of gardens per se, without enhanced staff interaction, is weak.

There is some strong evidence in support of the provision of single rooms for people with dementia and no empirical evidence to contradict that conclusion.

The evidence of the effectiveness of signage in environments for people with dementia is not strong and the evidence for the use of personal memorabilia and objects as aids to orientation is limited.

The evidence for the incorporation of good visual access on the broad, unit level scale is not strong but the dramatic effect of making an important amenity, the toilet, easily seen provides good supporting evidence for the concept.

The careful optimisation of levels of stimulation is well supported. The evidence extends to increasing levels of illumination beyond what is usually considered to be normal.

Designers and architects may therefore be confident about using unobtrusive safety measures; varying the ambience, size and shape of spaces; providing single rooms; maximizing visual access to important features and providing for stimulus control with the periodic availability of high levels of illumination. Indeed these features could be seen as essential attributes of all physical environments that have a claim on being designed specifically for people with dementia.

Table 1: Summary of strong and moderately strong papers

Study	Methodology	Forbe's rating	Sample	Strongest relevance to Marshal's design features	Intervention	Outcomes
Ancoli-Israel, S., P. Gehrman, et al. (2003). "Increased light exposure consolidates sleep and strengthens circadian rhythms in severe Alzheimer's disease patients."	Randomized control trial with 3 treatment groups. Sleep patterns measured	Strong	92 patients nursing home residents with dementia	Control of stimuli	Morning bright light, evening bright light or morning dim red light.	Increasing light exposure throughout the day and evening is likely to have the most beneficial effect on sleep and on circadian rhythms in patients with dementia.
Baker, R., S. Bell, et al. (2001). "A randomized controlled trial of the effects of multi-sensory stimulation (MSS) for people with dementia	Randomised control trial	Strong	Fifty patients with diagnoses of moderate to severe dementia .	Control of stimuli	Multi-sensory stimulation compared with activity group.	Both interventions brought about improvements. MSS significantly better in increasing attentiveness to environment, mood and behaviour.

Study	Methodology	Forbe's rating	Sample	Strongest relevance to Marshal's design features	Intervention	Outcomes
Cohen-Mansfield, J. and P. Werner (1995). "Environmental influences on agitation: An integrative summary of an observational study."	Time-sampling recording of behavior in various locations and conditions.	Strong	24 residents from three units Unit 1 was an Alzheimer's unit and the other two units included a mixture of cognitively impaired and physically ill residents.	Control of stimuli	Physical environmental, social environment, activities and level of stimulation varied naturally during the course of the day and evening.	Increasing strange movements in the dark, pacing more frequently under normal lighting. Increasing agitation behaviours with high levels of noise, perceived cold, and being physically restrained.
Cohen-Mansfield, J., & Werner, P. (1998.). "The effects of an enhanced environment on nursing home residents who pace.	Multiple single subject, pre test post test design with measures of agitation, mood and exit seeking.	Strong	27 nursing home residents who were rated as pacing /wandering at least several times a day.	Domestic and homelike,	Visual, auditory, and olfactory stimuli were added to the nursing home corridors to simulate a home environment and an outdoor nature environment.	Residents spent more time in the enhanced environments and showed increased pleasure.

Study	Methodology	Forbe's rating	Sample	Strongest relevance to Marshal's design features	Intervention	Outcomes
Phillips, C. D., Sloan, P.D., Howes, C., & Koch, G. (1997.). "Effects of residence in Alzheimer disease special care units on functional outcomes.	One year longitudinal study with multiple measurements, using MDS, of locomotion, transferring, toileting, eating, dressing, ADLs, continence and weight.	Strong	Data on 841 nursing home residents in 4 states with 48 SCUs	Domestic and homelike,	Life in a variety of residential aged care settings including SCUs.	No statistically significant difference was observed in the speed of decline for residents in SCUs and traditional units in cognitive and behavioural status.
Reimer, M. A., Slaughter, S, et al. (2004). "Special Care Facility Compared with Traditional Environments for Dementia Care: A Longitudinal Study of Quality of Life.	A prospective, matched-group design with assessments of QoL every 3 months for 1 year	Strong	185 residents From 24 long-term care centres and 4 designated assisted living environments 62 in the intervention SCU group and 123 in the traditional groups.	Small size, Domestic and homelike, scope for ordinary activities,	The provision of an environment that encompasses a vision of long-term care that is more comfortable, more like home, and offers more choice, meaningful activity, and privacy than traditional settings.	The SCU group demonstrated fewer declines in ADL, more sustained interest in the environment, and less negative affect. There were no differences between groups in concentration, memory, orientation, depression, or social withdrawal.

Study	Methodology	Forbe's rating	Sample	Strongest relevance to Marshal's design features	Intervention	Outcomes
Sloane, Philip D, M. M., P. Christianna S. Williams, et al. (2007). "High-Intensity Environmental Light in Dementia: Effect on Sleep and Activity."	A cluster-unit crossover intervention trial measuring night time sleep and day time activity	Strong	66 residents	Control of stimuli	Ambient bright light delivered through a low-glare lighting system installed in the dining and activity areas. Participant exposure averaged 2.5 to 3.0 hours for the morning and evening interventions and 8.4 hours for the all-day intervention.	Night-time sleep increased significantly in participants exposed to morning and all-day light. The overall strength of day and night activity rhythms did not change significantly under any treatment condition.
Wells, Y. and A. F. Jorm (1987). "Evaluation of a special nursing home unit for dementia sufferers: a randomised controlled comparison with community care.	Randomized control trial measuring cognitive status, behaviour, QoL, psychological problems of caregivers pre-admission and at 3 month follow upi.	Strong	12 people with dementia admitted to dementia specific facility, 10 in community care control group.	Domestic and homelike, safety features, , rooms for different functions, outside space, single rooms of an adequate size	Applicants for a newly opened special unit for dementia sufferers were randomly allocated to full-time care in the unit or placed on a waiting list and offered periodic respite care in the meantime.	Admission of dementia sufferers to full-time care in a special unit appears to be of great benefit to the psychological health of their care-givers and has no adverse effects on the dementia sufferers themselves.

Study	Methodology	Forbe's rating	Sample	Strongest relevance to Marshal's design features	Intervention	Outcomes
Zeisel, J., N. M. Silverstein, et al. (2003). "Environmental correlates to behavioral health outcomes in Alzheimer's special care units.	Cross sectional survey utilizing hierachical liner modeling controlling for cognitive status, ADLs, medication use, amount of Alzheimer's staff training, and staff-to-resident ratio. Measurement of aggression, agitation, social withdrawal, depression, and psychotic problems	Strong	427 residents from 15 SCUs	Small size, domestic and homelike, rooms for different functions, single rooms of an adequate size, and control of stimuli	Life in various forms of SCU.	Privacy and personalization in bedrooms, residential character, understandable environment associated with reductions in aggression, agitation and psychological problems. Camouflaged exit doors and rooms that vary in ambience associated with reduced depression, social withdrawal, misidentification and hallucinations.
Annerstedt, L. (1993). "Development and consequences of group living in Sweden : A new mode of care for the demented elderly.	One year follow-up of residents in a group living unit and a control group in traditional care. Measurements made of motoric functioning, intellectual and emotional ability, symptoms of dementia, behavioral disturbance and ADLs.	Moderate	28 group living patients 31 patients living in traditional institutional care	Small size, domestic and homelike, and safety features	Homelike group living housing; supervision by trained registered nurses; staff training, and relatives' active role in the caring task	Group Living environment produced better motoric, emotional and intellectual functions, and less Psychotropic medication; less psychological strain among the relatives; improved competence and satisfaction among staff ; and decreased the total cost of care

Study	Methodology	Forbe's rating	Sample	Strongest relevance to Marshal's design features	Intervention	Outcomes
Bellelli, G., G. Frisoni, et al. (1998). "Special care units for demented patients: a multicenter study."	Pre-admission, 3month and 6 month post admission assessment of health status, medication and restraint use.	Moderate	55 patients with dementia transferred to 8 SCUs	Control of stimuli	Admission to SCU.	In 6 months follow-up, behavioural disturbances progressively improved despite the psychotropic drug load and physical restraints use decreased.
Bianchetti, A., P. Benvenuti, et al. (1997). "An Italian model of dementia special care unit: Results of a pilot study."	Pre-admission, and 6 month post admission assessment of functional status, cognitive status, behavioral symptoms, medication and restraint use.	Moderate	16 patients transferred from traditional ward to a SCU.	Safety features, good signage and control of stimuli	Admission to SCU	Significant reduction in behavioural disturbances after relocation in SCU; no improvement in cognitive status or functional ability.
Bowie, P. and G. Mountain (1997). "The relationship between patient behaviour and environmental quality for the dementing.	Cross sectional survey comparing 5 environmental characteristics and patients behaviour in wards paired to systematically maximize differences in environmental characteristics.	Moderate	All patients with a dementing illness on 7 wards.	Small size and good signage	Life on wards with varying characteristics	Institutional character and lack of RO cues associated with behavioral abnormalities, Poor ward condition paradoxically associated with better self care and fewer behavioral problems. Small versus large physical size not associated with differences in behaviors.

Study	Methodology	Forbe's rating	Sample	Strongest relevance to Marshal's design features	Intervention	Outcomes
Cleary, T. A., C. Clamon, et al. (1988.). "A reduced stimulation unit: Effects on patients with Alzheimer's Disease and related disorders."	Pretest / Posttest measurements of functional ability, agitation, food consumption, continence, sleep, use of restraints, weight amd medication use taken before and 3 months after admission.	Moderate	11 low stimulus unit residents with dementia.	Control of stimuli	Admission to low stimulus unit.	Reducing patients weight loss, agitation, physical restraint use. Increased relative's satisfaction.
Cox, H., I. Burns, et al. (2004). "Multisensory environments for leisure: promoting well-being in nursing home residents with dementia."	Cross over (within subjects) design with measurement of affect under 3 conditions.	Moderate	24 residents with dementia	Outside space and control of stimuli	Residents experienced three activities (living room, garden, Snoezelen room) during three individual 16-minute sessions.	Some evidence of increased pleasure in the Snoezelan room and garden.
Dickinson, J. I., J. McLain-Kark, et al. (1995). "The effects of visual barriers on exiting behavior in a dementia care unit."	Pre-test post test measuring exit attempts	Moderate	7 residents with dementia and history of exiting attempts.	Control of stimuli	Installation of a blind and cloth cover panel over panic bar on door.	Visual barriers serving to camouflage the panic bar or door knob are effective and cost-efficient controls for wanderers' exiting.

Study	Methodology	Forbe's rating	Sample	Strongest relevance to Marshal's design features	Intervention	Outcomes
Hewawasam, L. C. (1996). "The use of two-dimensional grid patterns to limit hazardous ambulation in elderly patients with Alzheimer's disease."	Pre-test post test measuring exit attempts.	Moderate	10 patients with dementia	Good signage	Black insulation tapes in two different grid configurations were laid out in an attempt to prevent patients ambulating through exit doors.	The use of a horizontal grid reduced exit door contact up to 97% for four of these patients.
Leon, J. and M. G. Ory (1999). "Effectiveness of Special Care Unit (SCU) placements in reducing physically aggressive behaviors in recently admitted dementia nursing home residents."	Stratified cluster samples entering SCUs and traditional nursing homes compared on levels of agitation over the 6 months post admission.	Moderate	695 residents; 495 entered SCUs and 200 were admitted to non-SCU facilities.	Small size,	Admission to SCU.	SCU placement showed no positive or negative effect on the frequency of aggressive behaviours. A reduction in physical aggression attributed to increased use of psychotropic medications and the reduction in the use of physical restraints.

Study	Methodology	Forbe's rating	Sample	Strongest relevance to Marshal's design features	Intervention	Outcomes
Mayer, R. and S. J. Darby (1991). "Does a mirror deter wandering in demented older people?"	Pre-test post-test measurement of exiting behavior.	Moderate	9 severely demented residents	Good signage	3 experimental conditions, a full-length mirror placed in front of the door, the mirror reversed and no mirror.	The presence of mirror in front of an exit cues the response not to touch, reducing exit attempts by 50%..
Melin, L. and K. G. Gotestam (1981). "The effects of rearranging ward routines on communication and eating behaviors of psychogeriatric patients."	Pre-test post test measurement of communication and eating behaviors in control and experimental groups.	Moderate	21 patients on a psychogeriatric ward	Scope for ordinary activities,	Introduction of eating at tables rather than from trays attached to chairs set around the walls.	The frequency of communication increased in the experimental group.

Study	Methodology	Forbe's rating	Sample	Strongest relevance to Marshal's design features	Intervention	Outcomes
Morgan, D. G. and N. J. Stewart (1998). "Multiple occupancy versus private rooms on dementia care units."	Pre-test post –test measurement of time spent in various locations plus qualitative observations from staff and family.	Moderate	46 SCU residents 9 staff caregivers and 9 family members	Single rooms of an adequate size	Residents moved from 2-bed or 4-bed rooms to private rooms in SCUs .	Following the move to the new SCUs with private bedrooms, residents spent more time in their rooms during the day and required fewer interventions (including medications) to promote sleep at night. Perceptions of staff and family members about person-environment interaction model were positive.
Satlin, A., L. Volicer, et al. (1992). "Bright light treatment of behavioral and sleep disturbances in patients with Alzheimer's disease."	Pre-test post test measurement of agitation, sleep patterns, restraint use and PRN medications.	Moderate	10 residents with sundowning behaviour and sleep disturbances.	Control of stimuli	Patients received 2 hours/day of exposure to bright light for 1 week.	Clinical ratings of sleep-wakefulness on the evening nursing shift improved with light treatment in 8 patients. The relative amplitude of the circadian locomotor activity rhythm increased.

Study	Methodology	Forbe's rating	Sample	Strongest relevance to Marshal's design features	Intervention	Outcomes
Thorpe, L., J. Middleton, et al. (2000). "Bright light therapy for demented nursing home patients with behavioral disturbance."	Repeated measures ABA design measuring agitation and disruptive behaviours.	Moderate	16 residents with dementia	Control of stimuli	Bright light (2,000 lux) administered for 30 minutes during breakfast.	Bright light therapy has modest efficacy in reducing agitation, with possible concurrent improvement in positive behaviours.

The limitations of the research

It is easy to point to the limitations apparent in most of the available research. The small sample sizes, the absence of adequate control groups and the lack of clear hypotheses linking design features to expected outcomes can be easily seen. However the basic limitation on research in this area is the complexity of the task. Lawton captured the problem of the complexity almost 25 years ago in his post occupancy evaluation of the pioneering Weiss Institute ward for people with dementia (Lawton, Fulcomer et al. 1984). This involved a comparison of the patients' behaviours and condition before and after transfer to the new unit.

> "The independent variable itself was distressingly gross, in that the change in treatment locale subsumed an immense variety of components whose effects are unquestionably related to one another in very complex ways: overall building structure, hall to centre space change, increased bedroom privacy, proximity of staff offices, location of the nurses' station, color coding, transfer of staff, mixing of residents with different sets of fellow residents – the list is clearly too long to continue.

> We suggest that the so-called independent variable problem is intrinsic to the POE (Post Occupancy Evaluation). There is no way of separating each component from the other. In order to learn more about each component, separate studies must be done where the change is limited to one or a few features, in the absence of major system change… The limited study should not, however, supplant the multigoal study that attempts to represent indicators that sample the proximal-to-distal and micro-to-macrolevels. The important conclusions are, first, that we need both types of studies and, second, that our ability to plan a good POE depends on having a clear conception of the type of study most appropriate for a particular situation" (Lawton, Fulcomer et al. 1984).

It is the difficulty of teasing out the relative contributions of the physical environment and the staff-resident interactions which is most central to the problem. In practice attention to providing a good physical environment usually goes hand in hand with providing good staff-resident interactions through the provision of additional training and attention to appropriate philosophies of care. This is clearly seen in an investigation of the environmental correlates of agitation (Sloane, Mitchell et al. 1998) (Forbes rating = weak).

> "Multivariable analyses controlling for differences in resident case mix identified several measures of the caregiving environment that are associated with lower unit agitation levels. Summary indexes of the quality of the physical environment and of staff-resident interactions exerted strong, similar influences on unit agitation levels. Indeed, the two measures were so intercorrelated that one served practically as a proxy for the other, and the two effects could not be separated analytically. These findings suggest that not only are both the physical and

the human environments important in managing agitation in Alzheimer's disease, but, in practice, quality in one domain is usually accompanied by quality in the other".

The response to this problem was anticipated by Lawton and delivered by researchers like Zeisel, working at the unit level but controlling key variables through the use of sophisticated statistics, and Namazzi, carefully changing one variable at a time. These approaches have resulted in a body of knowledge that gives us some certainty that Marshal was correct in giving us a list of features which are important.

The development of a method of evaluation of the research that is finely tuned to the methodologies and issues commonly found in the environmental design literature could assist in guiding researchers to better designs. The approach developed by Forbes (Forbes 1998) was found useful in this review but it is clearly more applicable to smaller scale, clinical trials than the larger scale, statistically sophisticated studies that are emerging as a way to improve the issues surrounding the control of variables.

Gaps in the research

It is clear that in all the areas covered by this review there is room for more and better quality research. There is no doubt that there is a strong consensus of opinion on the features of good environmental design but a close examination of the literature quickly leads to the conclusion that there is little that is certain.

The most obvious gap remains the question of the relative contribution of the environment and staff – resident interactions to high quality outcomes. To put it another way – can high quality outcomes be delivered by staff in low quality environments. The investigation led by Chenoweth which has recently been funded by the NHMRC will go some way to answering this question in terms of a comparison between the impacts of environmental improvements and the strengthening of person-centred care practices.

This review identifies the need for better research into the questions of the effects of size, homelikeness and access to ordinary activities on people with dementia. As these are central to many of the approaches to design current in Australia it would be useful have a better understanding of their importance.

Cultural heritage is an integral part of the self-identity of older people, including, and perhaps especially, those with Alzheimer's disease and other dementias (Valle 1989) reported in (Day and Cohen 2000). When ignored it may be a barrier to the provision of high quality care. 'Culture has been largely neglected, however, in the design of environments for people with dementia.' (Day and Cohen 2000). The cosmopolitan nature of Australian society and the consequent increase in the number of people with dementia from a variety of cultural backgrounds demands that attention be given to the

investigation of culturally appropriate environmental designs. The elaboration and extension of the work on designing for Russian Jews (Day and Cohen 2000) to other cultures would seem to be a natural topic for research in Australia. The work of Bennett (Fleming, Forbes et al. 2003) on designing for Aboriginal people with dementia is almost unique in the attempt to understand and meet the needs of a culture in which a wall is not the side of a building but a provider of shade and a fence is there to keep people out not people in. The renewed interest in developing appropriate services for Aboriginal people may make this a timely topic for research.

Research on designing for remote indigenous communities might benefit from being placed within a broader category of design for rural and remote aged care services where the care of people with dementia forms part of the aged and healthcare services. The mix of residents and patients; difficulties in recruiting and retaining staff; accessing high quality assessment and management advice provide challenges for service delivery that may, in part, be addressed by the development of special physical environments.

Much of the research focuses on interventions that are useful to mobile people with dementia. No studies were located that specifically dealt with the environmental aspects of providing care to people in the later stages of the disease characterized by immobility, lengthy periods in bed and end of life issues. Are there environmental interventions that will assist staff and families to maintain communication with a person with dementia at the end of his or her life? Can the environment help to meet the spiritual needs of people at this stage? Can the environment be designed to keep the person involved with the 'household' for as long as possible, is this of benefit?

Towards the other end of the age spectrum younger people with dementia may require a variation on the environments that have been found to be successful for the typical person with dementia. The concept of a familiar environment suggests that the environment should be in keeping with the experiences of the person in their early adulthood. The early adulthood of a 55 year old with dementia was the 1980s while the early adulthood of an 80 year old was the 1950s. Environments changed quite a lot between the 50s and the 80s. Would younger people with dementia benefit significantly from the provision of a more familiar environment? Do they need an environment that encourages them to engage in more physical activity and/or provides access to recreational activities that were familiar to them in their earlier life, e.g. more modern sound systems and T.V. or computerised games?

People with Down's syndrome develop Alzheimer's disease if they live to a normal old age. More of them are doing so. The development of services for people with dementia owes a lot to the pioneering work on normalisation, social role valorization and behavior management (Wolfensberger 1972) carried out during the de-institutionalisation of people with developmental disability. However the links between the two fields are now very weak. Perhaps there is an opportunity to share the knowledge

gained on environmental design for people with dementia with the developmental disability services by investigating its application to elderly people with Down's syndrome.

The available research suggests that unobtrusive safety features, e.g. hidden exits, reduce depression. What would happen if the physical safety features were taken away altogether and replaced with additional staff attention and community awareness? This approach is being tried in Japan (Hasegawa 2007) where the original plan to provide 3,200 group homes for people with dementia by 2004 (Welfare 2002) was met.

In an early statement of the principles of good design for people with dementia (Fleming 1987) it was stated that facilities should be placed close to the community of origin of the person because the identity of a person who has lost their recent memories can be more easily supported by familiar sights and visits from friends and relatives when they are living close to that community. The relationship between the purpose designed unit and the local community has received very little attention in Australia and no systematic evaluation of environmental interventions to improve the relationship were discovered during the course of this review. The design of large retirement villages may well be improved by a better understanding of this relationship and of how to build environments that maintain links with the community without stressing either those with dementia or those living alongside them.

While 25 years worth of research is available there is some doubt about how much of it is applied in the building of new facilities for people with dementia. As well as encouraging new research it would seem to be sensible to investigate how much of the current research is being applied and, if it is not being applied routinely, to investigate the obstacles to its application so that they might be overcome. Stage 2 of this project will involve a detailed evaluation of recently completed, dementia specific aged care homes in Australia. It will examine their design to see which of the research findings that are clearly related to better quality environments have been implemented and then to identify the obstacles to their implementation (e.g. lack of knowledge, financial restraints, conflict with regulations, etc) . This will lead on to a set of recommendations for overcoming these obstacles.

Establishing priorities for research is a very difficult task if it is to be done in a systematic and rational manner. The first step would be to subject the list of topics given above to scrutiny and discussion so that a more comprehensive list could be established. This is beyond the scope of this review. However two of the topics identified would be close to the top of any list. There is little point in carrying out more research if we have not found out how to implement the findings of the research that has already been carried out. So investigations into the obstacles delaying implementation and how to overcome them should surely be a high priority.

A fundamental problem in much of the research is quantifying the relative contribution of the physical and psycho-social environments. The lack of clarity on this makes it impossible for certainty to be

reached on almost all of the questions regarding the impact of the physical environment. So it too should be at the top end of the priority list.

Table 2: Suggestions for the order in which the gaps in the research could be addressed.

1.	How to overcome the obstacles to the implementation of the knowledge that we already have.
2.	The question of the relative contribution of the physical and the psycho-social environment.
3.	The environmental aspects of providing care to people in the later stages of the disease characterized by immobility, lengthy periods in bed and end of life issues.
4.	Optimising the relationship between the facility for people with dementia and the local community.
5.	The possible advantages of designing for particular cultures, including the indigenous cultures.
6.	Providing environments that meet the needs of younger people with dementia.
7.	The special needs of people with Down's Syndrome who develop Alzheimers disease.

Table 2 contains a prioritised list of the areas requiring further research identified in this review. After the top 2 priorities the relative positions have been determined by subjective judgement and are offered simply as a starting point for discussion.

Knowledge transfer

As this review has been written as one of the activities of the Primary Dementia Collaborative Research Centre (PDRC) whose focus is on putting research into practice it is necessary to include some comments on knowledge transfer. An expert in this area is being employed in the PDRC to guide this vitally important aspect of the work. The following suggestions are offered to stimulate discussion with this expert and other members of the PDCRC.

Knowledge transfer in the context of a research organization is defined as "the process of engaging, for mutual benefit, with business, government or the community to plan, conduct, apply and make accessible existing and new research to enhance material, human, social and environmental wellbeing" (PhillipsKPA_Pty_Ltd 2006).

The framework of the knowledge transfer process has been described in terms of knowledge diffusion, knowledge production, knowledge relationships and knowledge engagement. Table 3, drawn from a report to the Department of Education, Science and Training (Howard_Partners 2005) expands on these labels.

Table 3: Framework of knowledge transfer

Knowledge diffusion
     Communication activities
     Capacity-building activities
     Extension and education activities
     Standard setting activities
     Industry output data

Knowledge production
     Academic publication activities
     Patenting and licensing activities
     Income streams relating to the above
     Spin-off company formation activities

Knowledge relationships
     Contract research and consultancy activities
     Income streams
     Staff and students working on interchange with industry
     Industry research staff with sessional and adjunct appointments in universities
     University-appointed 'visitors' from industry

Knowledge engagement
     Participation in non-academic community and economic activities
     Jointly owned and operated technology property infrastructure — technology and
          research parks, buildings, equipment, instruments etc.
     University-organised events for community and regional economic and social benefit
          (workshops, seminars etc.)
     University facilities available for non-academic purposes (for example, libraries, cultural
          centres, sportsgrounds)

The application of this framework to the transfer of the knowledge identified in this review gives rise to a number of suggestions which may be worthy of discussion in their own right or lead on to the identification of other strategies.

Knowledge Diffusion

- The engagement of the Dementia Training and Study Centres in the provision of workshops and guest lectures to disseminate the findings to academic and aged care industry opinion leaders.

- The engagement of the Dementia Training and Study Centres in the development of educational material for inclusion in the curricula of schools of architecture.

- The development of a proposal to the Department of Health and Ageing on the writing of standards or guidelines for the construction of dementia specific facilities.

Knowledge Production

- The publication of the review in an academic journal and the reporting of the findings in chapters in books related to the care of people with dementia.

- Carrying out a follow up from this review investigating the obstacles to the implementation of evidence based design in a sample of recently constructed dementia specific facilities.

Knowledge Relationships

- The provision, through the CRC and/or the Dementia Training and Study Centres of an auditing service that would 'accredit' dementia specific environments by comparing them with standards based on empirical research findings and assigning a rating, e.g. 1 to 3 stars. (This approach is currently under development in Scotland with the Stirling University based Dementia Services Development Centre carrying out the auditing.)

Knowledge Engagement

- The production of a lay man's guide to recognizing good design for people with dementia, probably as a video, that would be made available to the Alzheimers Association and community organizations such as Rotary, to assist in the education of those seeking information on services for people with dementia.

Conclusion

The available research supports Marshal's schema and offers substantial backing for the provision of unobtrusive safety features, a variety of spaces including single rooms, the enhancement of visual access and the optimization of levels of stimulation. The schema is a sound summary of the consensus of the opinion of researchers and practitioners. While there remains much work to be done to test the details it is a valuable guide to those wishing to develop environments that assist both residents and staff to make the most of their potential to improve the quality of life lived within facilities for people with dementia.

Appendix 1: Validity Rating Tool (based on Forbes 1998)

Relevance and Validity Rating Tool				
			Must all be YES	
			YES	NO
1. Published after 1980			YES	NO
2. Evaluated an intervention utilizing the physical environment			YES	NO
3. Focused on the care of people with dementia over 50			YES	NO
4. Incorporated a control group, pretest-posttest or a cross sectional design			YES	NO
Category	**Criteria**		**Rating**	
External Validity				
(a) Design and allocation to intervention	Random	Pass		
	Before/after or matched cohort		Moderate	
	No control or unknown			Fail
(b) Inclusion	(a) If consent to participate had been sought from subject, or legal guardian:			
	>80% participation in both groups	Pass		
	60-79% participation		Moderate	
	<60% participation or level of participation not stated.			Fail
	(b) If consent to participate had not been sought:			
	Subjects clearly described	Pass		
	Some detail provided but not conclusive		Moderate	
	Not described			Fail
(c) Attrition	<10%	Pass		
	11-20%		Moderate	
	>20%, did not indicate level of attrition, or not applicable			Fail
Internal Validity				
(d) Confounders controlled	All relevant confounders controlled (e.g. age, sex, functional ability, level of cognitive impairment)	Pass		
	At least three confounders controlled or subjects acted as own controls		Moderate	
	Two or fewer confounders controlled			Fail
Statistical Validity				
(e) Data collection	At least one data-collection method (self reported, assessment/screening, or medical records/vital statistics) had all of the following criteria rated as YES: Well described, Pretested, Investigator blinded to participant group allocation	Pass		
	At least one data collection method had most criteria rated as YES		Moderate	
	None of the data collection methods adequately addressed			Fail
(f) Statistical analysis	Multivariate	Pass		
	Bivariate		Moderate	
	Descriptive or unknown			Fail
Total in each category				

	Final rating (Circle)
Strong (4 ratings of pass, 0 fail)	**Strong**
Moderate (0 fail)	**Moderate**
Weak (1 or 2 fail)	**Weak**
Poor (>2 fail)	**Poor**

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