

Evidence Based Practice Review

Designing home environments for people who experience problems with cognition and who display aggressive or self-injurious behaviour.

**PEER
REVIEWED**

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Abstract

Background: People who experience problems with cognition have many adverse behavioural symptoms. Incidences of aggressive or self-injurious behaviours can occur and environmental factors seem to affect these behaviours.

Objectives: To determine the physical design features of a home environment that would impact aggressive or self-injurious behaviour in people with cognitive deficits.

Search Methods: Systematic research through the HMInfo Library, Google Scholar and Standard Electronic Databases to retrieve 581 publications.

Data Collection and analysis: 30 studies were analysed and included in the review.

Results: Little specific information pertaining to the design requirements of the physical home environment for people who experience problems with cognition who display aggressive or self-injurious behaviour exists with only 30 reference materials meeting inclusion requirements. Of those that were included, the majority were from the USA, pertaining to people with dementia displaying aggressive behaviours. Nine design principles have been identified and are discussed.

Authors Conclusions: Nine guidelines have been highlighted to assist in the design of optimum home environments. However, not a great deal of literature pertaining to physical home design for people who experience problems with cognition exists, particularly pertaining to those who display self-injurious behaviour. Further research in the home environment is clearly needed.

Keywords

Aggressive behaviour; self-injurious behaviour; agitation; home environment; design principles

Publication History

1st edition: Evidence Based Research: Designing home environments for people who experience problems with cognition and who display aggressive or self- injurious behaviour, by Hodges, L., Bridge, C., Donnelly, M., Chaudhary, K. 2007.

Contribution of Authors

This is the 2nd edition of Evidence Based Practice Review: Designing home environments for people who experience problems with cognition and who display aggressive or self- injurious behaviour, replacing the original publication, authored by Hodges, L., Bridge, C., Donnelly, M. and Chaudhary, K. (2007) for the Home Modification Information Clearinghouse, UNSW Sydney.

Prof. Catherine Bridge developed the content.

Konstantina Vasilakopoulou formatted this edition.

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An important part of the material of the first edition of this Evidence Based Review has been kept in its original form. The purpose of the second edition was to update the literature and to review and provide design recommendations, where available. More studies referring to nursing/group homes have been included.

HMInfo have a policy of undertaking a review process prior to the publication of research documents. The reviews are performed by Specialist Review Panels in accordance with the HMInfo Specialist Review Panel: Terms of Reference, available at the HMInfo website: www.homemods.info.

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Contents

Background	7
Cognitive impairment and conditions	7
Aggressive and self-injurious behaviour	7
Prevalence	7
Importance of the Review	8
Prior Review	8
Objectives	9
Methods	9
Research Question	9
Question Refinement Strategy	9
Search Terms	10
Search Strategy	12
Outcomes of Search	13
Studies Analysed	14
Nationality of literature	14
Quality of evidence	15
Cognitive populations identified in the literature	16
Target behaviours identified in the literature	17
Home environments identified in the literature	17
Analysis outcomes	18
Discussion	19
Reduction of known stressors	19
Balance between over-stimulation and under-stimulation	21
Facilitating use of preventive and reactive support strategies	22
Must be flexible and afford opportunities for choice and control	22
Environment and features must be safe and durable	24
Accommodate staff/family support	24
Home-like design needs to blend in with the community	25
Design recommendations	26
Conclusions	27
References	29
Appendix 1	33

Figures

Figure 1. Review process flow	13
Figure 2. Nationality of literature	14
Figure 3. Quality of research	15
Figure 4. Cognitive populations	16
Figure 5. Target behaviours	17
Figure 6. Home environment types	18
Figure 7. Identified variables for home design	19

Tables

Table 1. Question refinement strategy	9
Table 2. Search Terms	11
Table 3. Design guidelines for home environments for people with dementia	26
Table 4. Design guidelines for home environments for adults with autism	27

Background

Cognitive impairment and conditions

People who experience problems with cognitions have a myriad of conditions which may affect their cognitive functioning. These conditions may have been present since birth, such as intellectual disability, or may be experienced only later in life, such as dementia or traumatic brain injury (TBI). Many adverse behavioural symptoms are experienced by the person with a cognitive deficit. These behaviours can be, in some instances, one of the few ways in which the person with a cognitive impairment may communicate their feelings or their experiences of their environment (McVilly *et al.*, 2002).

Aggressive and self-injurious behaviour

Some conditions that impact upon cognitive functioning are correlated with incidences of aggressive or self-injurious behaviours.

Self-injurious behaviour involves repetitive motoric movements that result in either tissue damage or the potential for self-inflicted tissue damage. Common manifestations include headbanging, face slapping and hand biting (Wacker, Northup and Lambert, 1997).

Aggressive behaviour has various definitions, often depending on intent, however, it has been suggested that when working with a population who experience problems with cognition, these definitions may not be appropriate (Patel and Hope, 1993). Aggressive behaviour is a form of agitated behaviour, however, not all agitated behaviours are aggressive (Carlson *et al.*, 1995). Aggression also falls under the umbrella terms “challenging behaviour” and “problem behaviour” (Sigafoos, Arthur and O’Reilly, 2003), but, again, other behaviours are included in these definitions.

In the case of those with dementia or developmental disability, aggressive and self-injurious behaviours may be adaptive and functional, usually an attempt to communicate whatever the person feels that they need or want, eg, removal from the unpleasant environment, attention, etc (Fisher and Swingen, 1997; McVilly *et al.*, 2002). However, the behaviours are ultimately problematic due to the risk of physical harm to either themselves or to others. It has been noted that, pertaining to people with dementia, aggressive behaviours is one of the most common reasons for carers to place their loved one in institutional care (Patel and Hope, 1993; Forbes, Peacock and Morgan, 2005).

Prevalence

The prevalence of aggressive and self-injurious behaviours in people who experience problems with cognition varies according to the impacting condition. Aggression is one of the most common behavioural manifestations of dementia (Hagen, Sky and

Grossberg, 1992; Bhana and Spencer, 2000), while self-injurious behaviour can often be seen in developmentally delayed children (Hagen, Sky and Grossberg, 1992) and adults (Singh *et al.*, 2004). It has been estimated that 8.9-24.4% of people with an intellectual disability display aggressive behaviour (Borthwick, Meyers and Eyman, 1981). O'Connor, Pollitt, Roth, Brook and Reiss (O'Connor *et al.*, 1990) noted that aggressive behaviour in dementia appears to be positively related to the severity of the dementia, being displayed in 4% of those with mild, 14% of those with moderate and 42% of those with severe dementia.

Aggressive behaviours has been noted to be one of the most disruptive consequences of TBI, impacting on the family, engagement in neurorehabilitation and community integration (Tateno, Jorge and Robinson, 2003; Sloan, Winkler and Callaway, 2004; Alderman, 2007). However, the reported prevalence of the behaviour in this group varies greatly (Tateno, Jorge and Robinson, 2003).

Importance of the Review

The importance of well-designed environments for people who experience problems with cognition has been noted in the literature. McVilly (McVilly *et al.*, 2002) asserted that people with a developmental delay may use challenging behaviours to express their wants and needs pertaining to stressors in their environment, while Day, Carreon and Stump have noted that the well-designed physical environment can be a therapeutic resource for the person with dementia (Day, Carreon and Stump, 2000). The AHURI positioning paper "Sustaining tenants with demanding behaviour: A review of the research evidence" (Atkinson *et al.*, 2007) reported that community-based living arrangements are positive when compared to hospitalisation, however, appropriate supports are required and often lacking. It is therefore the aim of this systematic review to identify features and guidelines that can contribute to the creation of an optimum home environment that supports positive behaviours, supporting people who experience problems with cognition to remain in their home environment for as long as possible (Yuhas *et al.*, 2006).

Prior Review

The first edition of this publication used 15 reference materials to identify the main environmental parameters that affect people with cognitive impairments and might lead to aggressive or self-injurious behaviour. Only 12% of the studies were for people living in group homes while 35% of the studies did not specify the type of living environment they were referring to. The result was the identification and analysis of nine main design principles that can help reduce the agitated behaviour of people with cognitive impairments.

The current edition of this publication added 15 scientific papers to the review. The main difference to the first edition is the inclusion of more studies performed in group homes (40% group homes, 37% private homes, 23% not specified). The authors tried to include the environmental parameters of the group homes that also exist in private

homes, the appropriate design and/or regulation of which would benefit every individual. An attempt to include practical advice on the reduction of specific stressors has also been made.

Objectives

The identification of the physical environment parameters that affect people who experience problems with cognition and who display aggressive or self-injurious behaviour.

Methods

This publication presents the results of the collection and review of the literature relevant to the effects of elements of the physical environment on the aggressive and/or self-injurious behaviour of people with cognitive impairments. The objective of this review is to identify potential guidelines for modifications that would make the home environment a safe and enjoyable place both for the people with a disability, as well as their carers.

Research Question

Which are the physical environment features that might affect the aggressive or self-injurious behaviours of people with cognitive impairments.

Question Refinement Strategy

A systematic review, guided by the *Protocol guidelines for systematic reviews of home modification information to inform best practice* (Bridge and Phibbs, 2003) was implemented in this study. The research question was refined into an operational format that could be researched systematically by application of appropriate criteria.

Problem	Intervention	Outcome	Comparison	Target population
Aggression and self-injuries	Home modifications	Decreased levels of agitation	Behavioural and pharmacological interventions	Cognitively impaired

Table 1. Question refinement strategy

Search Terms

The terms included in Table 2 were used to search for relevant materials on electronic databases and the World Wide Web. These terms pertained to the behaviours of the people with cognitive impairments, the target populations and possible interventions to the physical environment. Comparison search terms were also identified to remove strategies that were not relevant to the physical environment.

Problem	Intervention	Outcome	Comparison	Target population
Aggression	Time out	Reduced aggressive behaviour	Drug therapies	Cognitively impaired
OR	OR	OR	OR	OR
aggressive behaviour	size large enough to accommodate two people	Reduced self-injurious behaviour	Pharmacological intervention	Developmentally disabled
OR	(decision making and choice)	OR	OR	OR
self-injury	OR	OR	restraint	Developmentally impaired
OR	OR	Reduced destructive behaviour	OR	OR
self-injurious behaviour	home-like exterior	OR	punishment	Dementia
OR	OR	OR	OR	Demented
violence	reduced noise (sensory processing)	Approaches for managing	Over-correction	OR
OR	OR	OR	OR	Autistic
violent behaviour	reduced crowding	frameworks for managing	Negative reinforcement	OR
OR	OR	OR	OR	Autism
physically aggressive	adequate exercise space	OR	Hospital (if residential)	OR
OR	OR	Process for managing	OR	Alzheimer's Disease
verbally aggressive	personal space	OR	Institution (if residential)	OR
OR	OR	Guidelines for managing	OR	Mentally retarded
destructive	non-pharmacological	OR	Nursing care facility (if residential)	OR
OR	OR	Rationale for managing	OR	Mental retardation
history of being damaged	Snoezelen (sensory processing)	OR	Nursing home (if residential)	Cognitive impairment
OR	OR	OR	OR	OR
challenging behaviour	unlocking doors	Standards for managing	OR	Learning disability
OR	OR	OR	Rest home (if residential)	OR
agitation	cues	Strategies for managing	OR	Alzheimer's
OR	OR	OR	OR	
agitated behaviour	prompts	Criteria for managing	Specific Behavioural interventions, eg, token economy	
	OR			
	environment			

Problem	Intervention	Outcome	Comparison	Target population
	OR environmental OR ecocultural OR ecological OR temperature OR thermal comfort OR humidity OR smells OR light OR lighting OR glare OR visual comfort	OR Design for managing OR Principles for managing OR Fundamentals for managing OR Solutions for managing OR Outcome		

Table 2. Search Terms

Search Strategy

The databases that were used in both editions of this publication, are:

- Ageline
- Web of Science
- AEI Informit
- ERIC
- EMB Reviews
- Medline
- AMED
- Cinahl
- Psycinfo
- Social Work Abstracts
- ARCH: Australian Architecture Database

Outcomes of Search

The material of the first edition of this Review was also included in the second edition. The added material for the second edition meets specific inclusion and exclusion criteria, developed to ensure that only the most relevant reference materials were included in the review. Material was only included if it was (a) accessible through the University of New South Wales Library or the World Wide Web and (b) written in English. Materials which did not meet the inclusion criteria or were conference abstracts, unpublished conference papers or whole of subject books were not included in the review. No restrictions on the date of publication were made.

Forty-five new studies were added to the 536 studies of the first edition. The publications that were actually included in this version are 30, compared to 19 of the first edition. The review process, with the number of relevant studies and other documentation, is outlined in Figure 1.

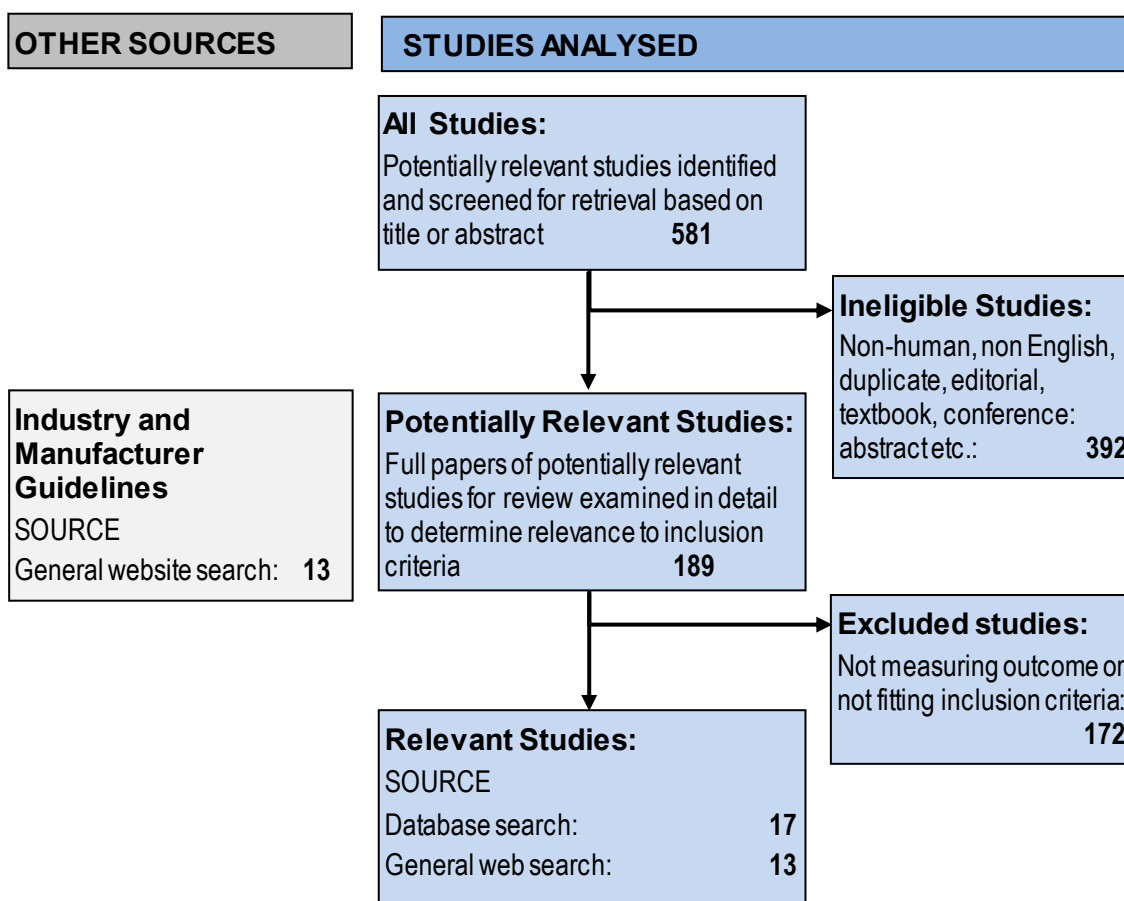


Figure 1. Review process flow

Studies Analysed

Thirty reference materials from the search were included in the analysis. See Appendix 1 for a matrix of the included publications and information on each one.

Nationality of literature

Two thirds of the included studies have been performed in the United States. 14% of the included material is from Australia and 10% from the UK. The majority of the teams investigating the effect of the physical environment on people with cognitive impairments had a background in medicine, geriatrics or psychiatry/psychology. Only two publications were authored by teams with members from both health and built environment fields and only one study was done by people that were not directly associated to health science.

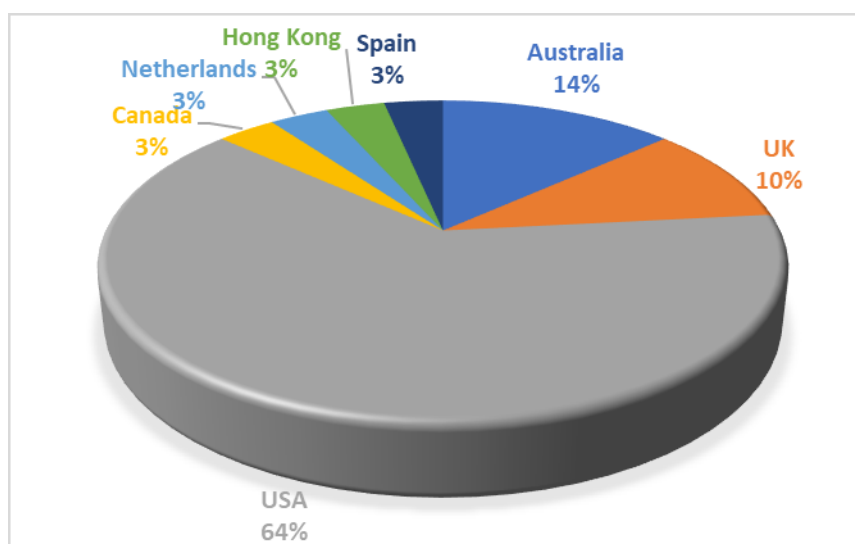


Figure 2. Nationality of literature

Quality of evidence

The search yielded few research-based reference materials and those that it did were not the most robust of designs. The study further indicated that over 65% of the relevant material was a literature review, an expert opinion in a journal or a book chapter rather than a scientific methodology. Although the authors of these documents are generally regarded as experts in the field, this type of methodology does not enforce the same reliability and validity parameters on the findings stated as those based on empirical findings. Therefore, although from an experienced and learned viewpoint, a limitation of the current literature is the dearth of findings founded on a strong evidence base.

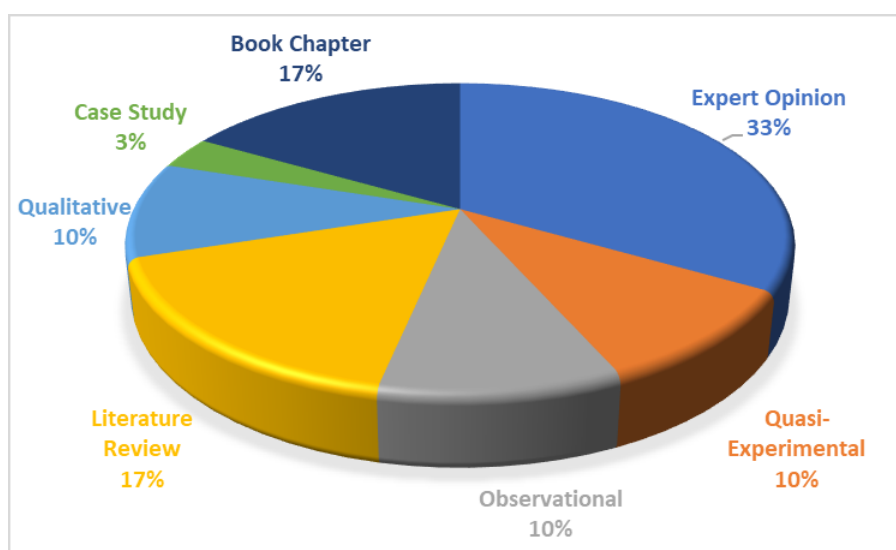


Figure 3. Quality of research

Cognitive populations identified in the literature

The cognitive populations from the articles retrieved were those with dementia, intellectual disabilities, autism, cognitive impairments in older people (people with various disabilities), Alzheimer's disease and traumatic brain injury. Several articles pertaining to the management of people with intellectual disabilities referred to behavioural rather than physical environmental interventions, while those which addressed the physical environment often pertained to congregate care and educational environments. Information pertaining to designing home environments for people with traumatic brain injury who displayed aggression was also very limited compared with other environments. Although articles pertaining to behavioural interventions and long term care in the dementia populations were also highlighted by the search, there appeared to be more reference materials relating to the home environment with regards to this group.

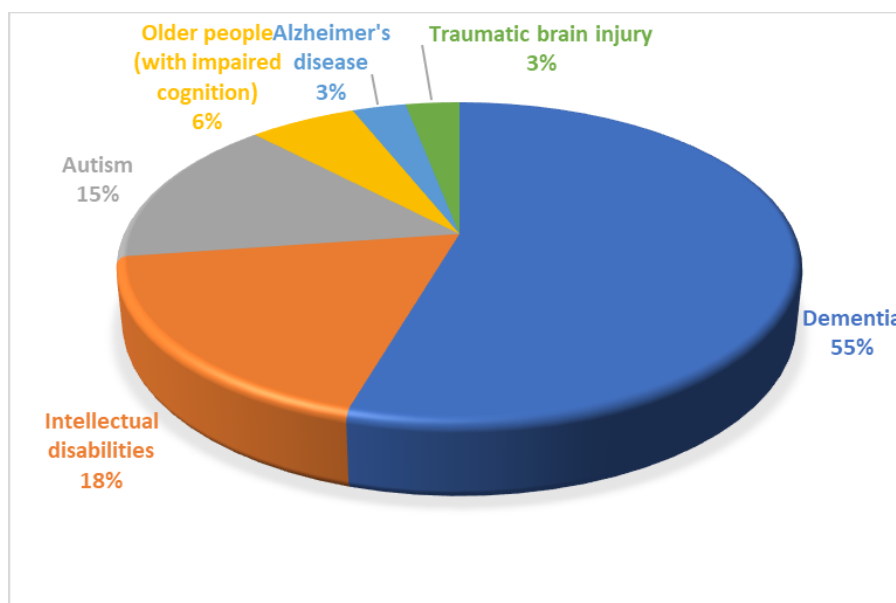


Figure 4. Cognitive populations

Target behaviours identified in the literature

As indicated in the chart below, aggressive behaviour was most often identified by the reference materials included in the analysis when compared with self-injurious behaviour. The literature also indicates that although aggressive behaviour can be a common behaviour displayed by people with dementia, comparatively self-injurious behaviour is rarely documented in this population (Hagen, Sky and Grossberg, 1992; Patel and Hope, 1992). As discussed above, there appears to be more information pertaining to physical environmental interventions in the home of those with dementia, compared with people with intellectual disabilities and autism. Consequently, a greater proportion of articles pertaining to aggressive behaviour was expected. It should be noted that many articles referred to agitated behaviour. As noted above, aggressive behaviour is a form of agitated behaviour, however, not all agitated behaviours are aggressive (Carlson *et al.*, 1995). Therefore, if the article did not specify some form of aggressive behaviour, the researchers could not be certain that the behaviour being discussed was aggressive or self-injurious and consequently these articles were not included for review.

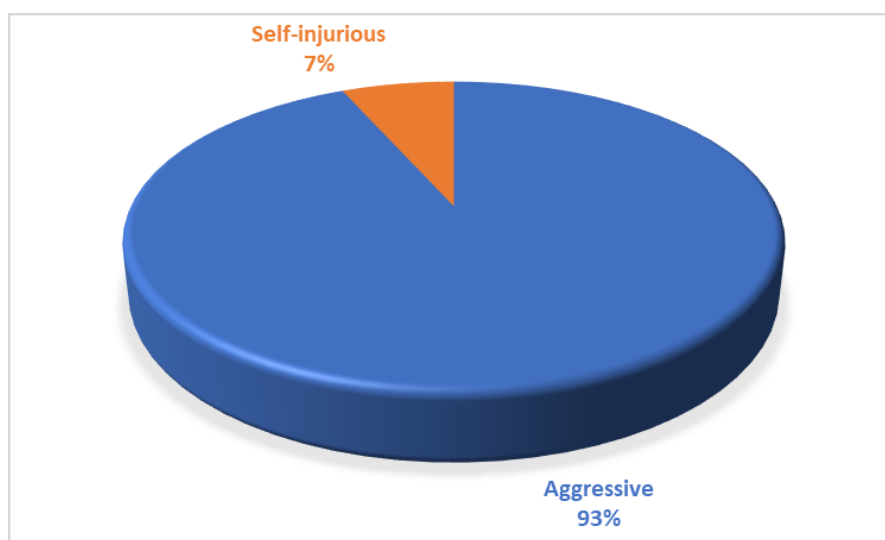


Figure 5. Target behaviours

Home environments identified in the literature

The number of studies investigating the effect of a (private) home environment on the behaviour and/or mood of people with cognitive disabilities is small. So, contrary to the studies selected for the first edition of this publication, the current edition included more studies for people living in group (nursing) homes. The reason for this change is that even though the type of environment is different to that of the research question, the environmental parameters that appear to affect the mood of people with cognitive impairments exist both in group and private homes. However, the degree to which these parameters affect people living in private homes needs to be further investigated.

In the second edition of this publication the amount of the studies referring to group homes is approximately the same with that of the studies for private homes. Reference materials that did not specify to which type of living environment they were referring were included in the study and they account for approximately 23% of the included studies.

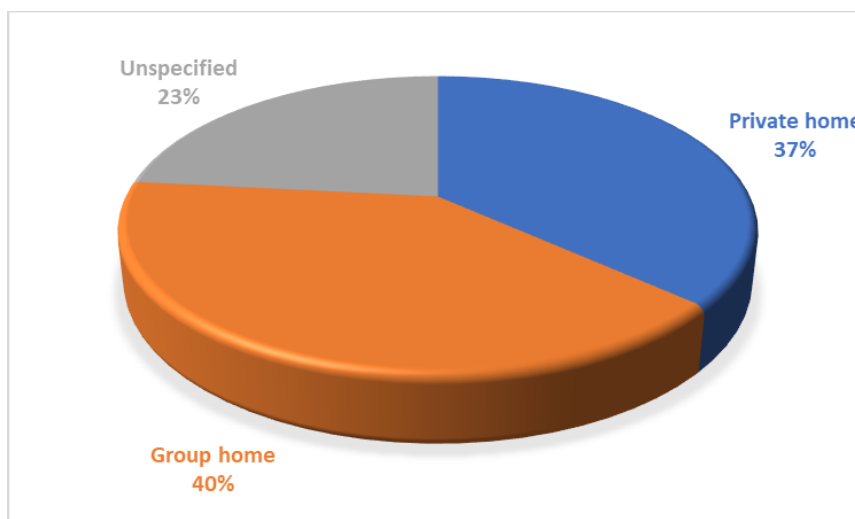


Figure 6. Home environment types

Analysis outcomes

The analysis done by the authors of the first edition of this document highlighted nine guiding principles relevant to design of the homes of people with aggressive or self-injurious behaviours due to cognitive impairments. These principles are consistent with the research performed for the second edition. However, two of the principles have been merged with others (the “Keep the environment free of complexity” has been included in the “Effect of the known stressors” and “Features with a history of being damaged need to be made durable or removed” is now included in “Environments and features must be safe and durable”).

The design variables that have been identified by the review, are:

1. The reduction of known stressors (including environment complexity);
2. Achieving balance between over and under stimulation;
3. Facilitating use of preventive and reactive support strategies;
4. Providing flexible environments and opportunities for choice and control;
5. Environment and features must be safe and durable;
6. Accommodating staff/family support;

7. Environments with home-like design.

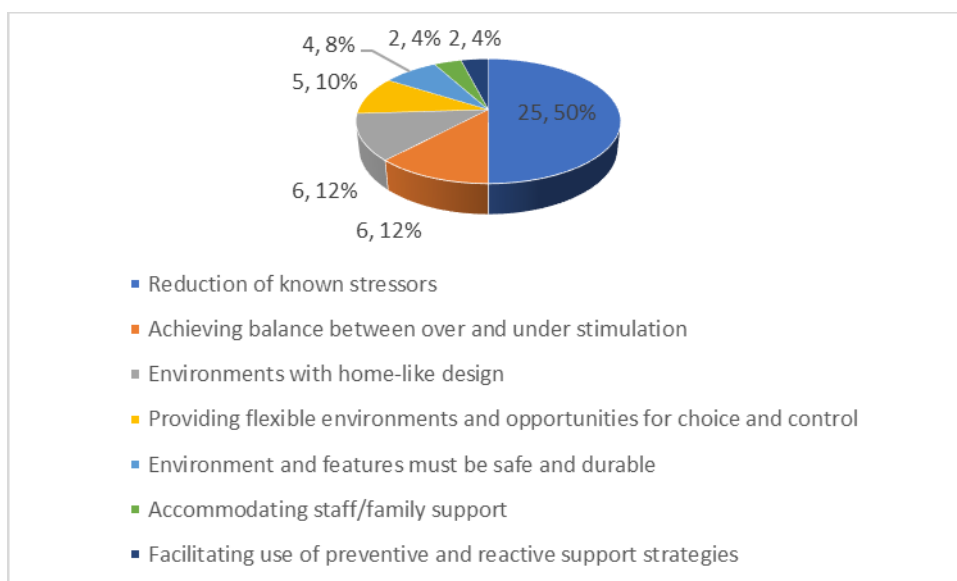


Figure 7. Identified variables for home design

Discussion

The following paragraphs include an analysis of the main environmental parameters that appear to affect the aggressive or self-injurious behaviour of people with cognitive impairments, as found by the reviewed material.

Reduction of known stressors

Aversive environmental stimuli have been known to result in self-injurious behaviour (Beare, Severson and Brandt, 2004) and aggressive behaviour (Banazak, 1996; Raskind, 1999). The progressively lowered stress threshold (PLST) model suggests that a person who experiences problems with cognition is less able to effectively receive and process stimuli in the environment and is less tolerant of stimulation than a person who does not experience such problems (Hall and Buckwalter, 1987). Consequently, environments designed for this group of people need to be designed in such a way as to minimise known stressors within the environment (Zentall and Zentall, 1983; Ryden, 1988; Mintzer *et al.*, 1993; Schreibman, 1994; Sloane *et al.*, 1995; Banazak, 1996; Kovach, 1997; Matson and Duncan, 1997; Raskind, 1999; O'Boyle, 2000; Kunik *et al.*, 2003). These stressors include: glare, too dim or too bright lighting, noise, clutter, inappropriate temperature and crowded spaces (Sloane *et al.*, 1995; Carr, Reeve and Magito-McLaughlin, 1996; Matson and Duncan, 1997; Morgan and Stewart, 1999; Kovach, 2000; Hall and O'Connor, 2004; Pulsford and Duxbury, 2006; van Hoof *et al.*, 2010; Garre-Olmo *et al.*, 2012; Tate, 2014; Wong *et al.*, 2014; Nelson, 2014; Sloane *et al.*, 2015; Fleming *et al.*, 2016).

The effect of crowded spaces and of the “invasions” in people’s personal space is investigated in many studies (Carr, Reeve and Magito-McLaughlin, 1996; Matson and Duncan, 1997; Morgan and Stewart, 1999; Kunik *et al.*, 2003; Pulsford and Duxbury, 2006; Nelson, 2014; Tate, 2014). Even though crowding is considered a problem of group housing, private homes can sometimes be small and/or cluttered, causing over-stimulation which might lead to aggressive behaviours. It has been suggested that people with an intellectual disability may behave aggressively if the situation requires skills or tolerance above their abilities (McVilly *et al.*, 2002) and that complex situations may cause frustration and escalate behaviour problems in those with dementia (Elder Care Online, 2000). An example of this is a room with busy decorations, constant noise from a television and too much furniture (Warner, 2000). Literature noted that reducing the demands of the environment is positively correlated with a reduction in aggressive behaviours (Zentall and Zentall, 1983; Draper and Browne, 1993; Elder Care Online, 2000). By keeping the environment easy to understand and negotiate, the person with problems with cognition is less likely to feel overwhelmed and confused and may be less likely to express frustration at the environment in a behavioural way.

During the last few years, scientists’ interest has shifted to the effect of environmental parameters like lighting, temperature and quality of the indoor air on people’s mood and behaviour. Pulsford and Duxbury (Pulsford and Duxbury, 2006) claim that colour and lighting that aids perception can help people with dementia and reduce challenging behaviours. A study about the effect of environmental parameters on people with dementia living in residential care homes in Hong Kong (Wong *et al.*, 2014), showed that people with dementia prefer not too dim but also not too bright light. Too dim lighting in rooms has been found to cause negative affective mood (Garre-Olmo *et al.*, 2012). Glare or reflections of bright objects on room surfaces were also found to provoke hallucination and emotional disorders (Wong *et al.*, 2014). Bright light treatment for people with dementia is also widely investigated, as it might regulate the circadian rhythms and modify mood, however, adequate scientific evidence is probably not available yet (van Hoof *et al.*, 2010).

An observational study by Cohen- Mansfield (Cohen-Mansfield and Werner, 1995) showed that agitated behaviours of people with cognitive impairments and Alzheimer’s disease were more probable to occur when the environment was perceived as cold, but requests for attention would be more frequent when the temperatures were high. The temperature levels combined with the time spent in rooms were found to affect the quality of life of people with severe dementia (Garre-Olmo *et al.*, 2012).

Poor ventilation and stuffiness (Wong *et al.*, 2014) as well as odours in public areas and bedrooms (Sloane *et al.*, 2015), have also been associated to agitated behaviours. The control of these environmental parameters so that comfortable lighting, thermal and air conditions are provided for everyone might be a difficult task in nursing homes but is rather easy in private homes.

See Warner (2000), (Nelson, 2014), (Brand, 2010), (Tate, 2014) and (Wong *et al.*, 2014) for more comprehensive lists of modifications to reduce aggressive behaviour.

Balance between over-stimulation and under-stimulation

Just as over-stimulation has been associated with problem behaviours, so has under-stimulation (Kovach, 2000; Beare, Severson and Brandt, 2004; Fleming *et al.*, 2016). When in an under-stimulated environment, people with intellectual disabilities may self-stimulate, forms of which may actually be a self-injurious behaviour (Taylor and Chamove, 1986; McVilly *et al.*, 2002), while people with dementia may display agitated behaviours (Kovach, 2000; Fleming *et al.*, 2016), a symptom of which is aggressive behaviours (Pulsford and Duxbury, 2006). Consequently, when designing a home environment for people who experience problems with cognition, features need be designed to encourage a state of sensoristasis (a state of sensory balance). An example of an environmental feature to encourage sensoristasis in those with problems with cognition is the use of specific, calming sensory experiences and the use of multi-sensory environments (Slevin and McClelland, 1999; Singh *et al.*, 2004).

There has been suggestion in the literature that implementing multi-sensory strategies may assist in the calming of people who experience problems with cognition and ultimately lead to the reduction of incidences and/or severity of self-injurious and aggressive behaviour (Barber, 1999). Sloane and colleagues (Sloane *et al.*, 1995) have suggested that the use of music (calming and individual favourites) and memory evoking aromas may be effective in calming agitated people in the home. Kovach (Kovach, 1997) asserts that a balance between sensory stimulation and sensory calming experiences may be used to treat aggressive behaviour, while Barber (Barber, 1999) asserts that carefully chosen music and colours can induce calm in those displaying aggression. There appears to be a dearth of information pertaining to the impact of multi-sensory stimulation in the home on self-injurious behaviour, however, the effects of light and vibration in deterring self-injurious behaviour in a person with developmental disability in an institutional setting has been demonstrated (Taylor and Chamove, 1986). Further investigation into the use of vibration and light could indicate if this effect generalises to the home environment.

Snoezelen environments (dedicated space providing multi-sensory experience) have been used to improve the behaviour and quality of life of people who experience problems with cognition (Singh *et al.*, 2004). They have been effective in lowering incidences of aggression and self-injurious behaviour in people with intellectual disability and in people with dementia (see Burns, Cox and Plant (2000) for a review). Slevin and McClelland (Slevin and McClelland, 1999) demonstrated that, although still present, the aggressive and self-injurious behaviours displayed by a

man with autism and intellectual disability living in a staff supported group home were markedly reduced following completion of a Snoezelen therapy program.

It should be noted that the majority of the literature pertaining to the use of multi-sensory environments is within long term congregate care facilities and there is limited information pertaining to the effectiveness of Snoezelen in the home environment, although as noted above, there is support for multi-sensory therapies in the community environment. See Slevin and McClelland (Slevin and McClelland, 1999) for a literature review on multi-sensory therapy. A criticism of Snoezelen in a home environment is that the activity itself is not very meaningful compared with engaging in activities within the community. The conclusions drawn by the information highlighted by the systematic review suggest only that multi-sensory experiences have been demonstrated to provide a calming effect for those with a cognitive impairment displaying self-injurious and aggressive behaviours. It is for this end that multi-sensory experiences have been included as an element of design, rather than as a source for meaningful activity.

Facilitating use of preventive and reactive support strategies

The literature revealed a number of ways in which the self-injurious and aggressive behaviour of people with an intellectual disability and people with autism has been addressed. A number of these strategies have implication for the design of the physical environment. Active support strategies, which include the provision of direct staff support for engagement, may require additional physical space in task areas in order for staff to provide a variety of prompting strategies including modelled prompts and physical guidance rather than relying exclusively on verbal prompts (Close and Horner, 1999; Stancliffe *et al.*, 2007). The use of time out techniques in the context of applied behaviour analysis (ABA) (Schreibman, 1994; Matson and Duncan, 1997) also has design implications. Although this technique has been noted to be successful in moderating aggressive (Matson and Duncan, 1997) and self-injurious behaviours (Wacker, Northup and Lambert, 1997), there are a number of factors that are important for this to be an effective technique including the duration of the time out and the motivation for the behaviour (i.e., it will only be effective if the time in setting is more reinforcing of the behaviour than the time out setting) (Schreibman, 1994). The relevance and applicability of timeout to a community living environment has been questioned (Lovett, 1996).

Must be flexible and afford opportunities for choice and control

It has been documented that the home is most effective when specified to meet the needs of the individual(s) who live there (Close and Horner, 1999). As we are all individuals, so are our needs and wants from the home environment. Close and Horner (Close and Horner, 1999) contend that a home should include design features that are of particular importance to the individual the home is being

designed for. For example, if an individual enjoys baths and sitting by a window, these features should be made available in the design of the home. Consideration of the unique wants and needs of the person to live in the house is preferable if not essential in the design process (Close and Horner, 1999).

As is the case with everyone, the needs and wants of the individual(s) who will live in the home will change and the environment must be flexible in order to accommodate these changes, such as an increased need for personal space (Draper and Browne, 1993) and to have somebody live with them if desired (McVilly *et al.*, 2002).

The current literature suggests that providing an element of choice to people with dementia, intellectual disability and autism leads to positive outcomes in a variety of settings (Johnson and Namazi, 1992; Bambara *et al.*, 1995; Newman *et al.*, 2002) while McVilly (McVilly *et al.*, 2002) noted that a chronic lack of choice in many significant life areas can contribute to the experience of stress in the everyday life of people with an intellectual disability. Warner (Warner, 2000) notes that to suddenly lose the freedom to access all areas of the home may result in the person with dementia becoming aggressive. In their study of residents with dementia, Namazi and Johnson (Johnson and Namazi, 1992) observed a reduction in aggressive responses when the doors of the centre were unlocked. They attributed this change in behaviour to choice, while Elder Care Online (Elder Care Online, 2000) also assert that providing people with dementia with a sense of control can contribute to the prevention of problem behaviours. Although not addressing duty of care issues, this article does suggest the positive implications of providing people who experience problems with cognition choice (Hodges, Bridge and Chaudhary, 2006).

However, as noted above, people who experience problems with cognition have a lower threshold for stressors including too much choice (Kunik *et al.*, 2003) and respond better to a simple environment (Zentall and Zentall, 1983; Draper and Browne, 1993; Elder Care Online, 2000). Therefore, an environment must not only provide opportunities for choice making but also avoid overwhelming the person with cognitive impairment. Providing a limited choice based on the needs and wants of the individual may be the resolution of these two seemingly conflicting issues. Fleming, Forbes and Bennett (Fleming, Forbes and Bennett, 2003) found a balance between these two issues when designing a wardrobe for people with dementia in special care units. They suggested two wardrobes, one containing one or two outfits and the other containing the remainder of the resident's clothes. The latter is designed so that it does not grab the attention of the resident. By doing this, the person with dementia is afforded the opportunity to make choices presented in a manageable way.

The option to access the outdoor spaces of the home (Cohen-mansfield, 2004) as well as the availability of spaces (corridors) for people to wander (Fleming *et al.*, 2016) have also been found to be effective methods for reducing agitation.

Environment and features must be safe and durable

It is worth noting that the safety of all in the home is imperative, so elements of environmental design to ensure this are of primary importance (McVilly *et al.*, 2002). These may be as simple as removing breakables and small hard objects that the person with cognitive impairment may throw, softening hard edges and ensuring that floors are slip resistant (Close and Horner, 1999; Warner, 2000).

Considering the safety needs of the individual(s) who live in the home is helpful in designing an optimum environment. For example, Close and Horner (Close and Horner, 1999) described how two homes were designed for two different individuals. In one the floors were hardwood to counter problems related to incontinence, in another, this was not possible as the resident had a history of self-injuring and therefore required a softer floor.

Features with a history of being damaged, such as windows, walls, doorframes, toilets, faucets, etc (Close and Horner, 1999), need to be made durable. Again, if a history of the individual(s) who the home is being designed for is available, the specific items that are targeted need to be made durable or removed if necessary and possible (McVilly *et al.*, 2002). Safe environments, tailored to the specific resident are important to people with autism who might have high tolerance to pain or may lack appropriate fear or danger (Brand, 2010).

Accommodate staff/family support

Space to accommodate a carer (be it in a group home or family home) needs to be considered when designing a home for an individual who experiences problems with cognition. Close and Horner (Close and Horner, 1999) noted that this is particularly important when designing areas often only designed for use by one person at a time, for example, bathrooms, utility rooms, kitchens, etc. People with dementia can react aggressively as a means of communicating a need (Cohen-Mansfield and Werner, 1995). It is thought that this often happens while bathing because the person does not want the carer touching them and feel that their privacy has been violated (Sloane *et al.*, 1995). Providing for the person with dementia to feel less violated by the bathing process would ultimately lead to fewer catastrophic reactions.

Home-like design needs to blend in with the community

When designing a home for people who experience problems with cognition, the home needs to be durable, as discussed above. However, this should not be to the detriment of the external appearance of the home. It has been noted when designing for this population that the external design of the home should be home-like and attractive and should fit with the community (Close and Horner, 1999). In addition, features of 'homelikeness' such as room size, type of lighting, finishes and aesthetic features and fewer exposed mechanical devices have been linked to less physical aggression and less stereotyped behaviour, participation in activities, positive interaction and choice (Thompson *et al.*, 1996; Cohen-mansfield, 2004; Pulsford and Duxbury, 2006; Sloane *et al.*, 2015; Fleming *et al.*, 2016).

Design recommendations

Only few of the studies reviewed included detailed design recommendations on how to eliminate stressors or how home environments can be safer for people with aggressive and/or self-injurious behaviours and their carers. Table 3 and Table 4 include more practical information and design guidance for people with dementia and adults with autism, respectively. These guidelines are general and non-exhaustive. Home environments can be tailored to the resident's needs and behaviours, whenever possible.

Lighting/Glare	Use mat upholstery and non-polished furniture / Avoid shiny floors
	Install curtains that will reduce glare (not transparent or light-coloured)
	Use consistent lighting: adjust lighting levels to person's preference, without making them too dim or too bright
	Use lighting equipment that will not flicker (use electronic ballasts, make sure that you buy appropriate lamps when dimmers are installed) or cause glare
	Reduce night-time light levels
Temperature	Provide comfortable room temperature and humidity levels
Space appearance	Provide subtle safety and protective features and equipment (locks)
	Provide opportunities for personalisation of space
	Avoid elements that cause overstimulation (clutter, alarms, loud TVs, etc)
	Avoid automatically moving elements (such as automated blinds)
Noise	Use silent artificial ventilation systems
	Limit noise from alarms and electronic equipment (TV, radios, cooking devices, vacuum cleaners, washing machines, etc)
	Install aesthetically pleasing acoustic panels in large spaces
Indoor air quality	Eliminate unpleasant smells (urine, strong cleaning products) using ventilation
Use of space	Provide free access to safe spaces, especially exterior spaces/gardens/courtyards - avoid locked doors
(van Hoof <i>et al.</i> , 2010)	
(Fleming and Bennett, 2017)	

Table 3. Design guidelines for home environments for people with dementia

Lighting/Glare	Assess visual and light sensitivities and add/remove colour and/or light
	Provide non-flickering lighting
Space appearance	Avoid protective features with institutional appearance, as they can become targets of agitated behaviour
	Incorporate pinboards or magnetic boards to affix visual information
	Use durable and easily cleaned materials that can withstand heavy or self-injurious behaviours and unintended use
Use of space	Use features that can be removed or de-activated
	Windows should have locking features and constrained opening
	Provide opportunities for stimulation calibration by resident
	Consider remote controls for blinds when ordinary controls (chords, handles, etc) are likely to be misused
	Use curtains/blinds that residents cannot reach/touch (for example integrated or interstitial blinds)

Table 4. Design guidelines for home environments for adults with autism
Source: (Brand, 2010)

Conclusions

As noted by Close and Horner,

“architectural support for people with severe problem behaviours is much more than simply hardening walls and windows; it is carefully building physical designs that promote successful accomplishments” (Close and Horner, 1999).

The principles as well as the design recommendations above are intended to assist in the design of an optimum home environment that prevents or minimises aggressive or self-injurious behaviours in people who experience problems with cognition, supporting them to remain in the community. The objective of the review was “to determine the physical design features of a home environment which would impact aggressive or self-injurious behaviour in people with cognitive deficits”. It should be noted however, that the effectiveness of many of the design elements discussed depend on the effective management of the features, such as utilising curtains appropriately to prevent glare while ensuring that the room remains lit with natural light at appropriate times of day.

In a preliminary critique of this review it was suggested that the many differences between people with dementia and those with other cognitive impairments renders the group of people who experience problems with cognition who display aggressive or self-injurious behaviours too broad. The authors of the review have no doubt that

this group is made up of many different cognitive populations and that each of these populations are made up of many individuals with vastly different needs, wants and manifestations of challenging behaviour. Consequently, the design variables identified by the review are intended to be a starting point for environmental design, however, a very strong emphasis is placed on catering to the individual. Indeed, the most comprehensive interventions for these behaviours appear to be those which combine environmental, behavioural and educational interventions that focus on combining methodological design knowledge and addressing the particular needs and wants of the individual (Close and Horner, 1999).

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Appendix 1

Reference	Nationality	Main findings	Process & issues	Design literature	Person	Behaviour	Environment	Method
				Keep the environment free of complexity				
				Reduction of known stressors				
				Facilitating use of preventive and reactive support strategies				
				Features with a history of being damaged made durable or removed				
				Physically safe				
				Accommodate /staff/family support				
				Must be flexible and afford opportunities for choice and control				
				Balance between over and under stimulation				
				Home-like design needs to blend in with the community				
				People with dementia				
				People with an intellectual disability				
				People with autism				
				People with traumatic brain injury				
				Older people with impaired cognition				
				Alzheimer's disease				
				Aggressive				
				Self-injurious				
				Home				
				Group home				
				Unspecified				
				RCT				
				Quasi-Experimental				
				Observational				
				Qualitative				
				Literature review				
				Case study				
				Book chapter				
				Expert article				

(Barber, 1999)	UK	Improvement in aggressive behaviour of adult with developmental disability and autism following an intervention involving music and colour to aiding calming	Authors noted that the scale of improvement was small and therefore, the findings inconclusive. The authors definition of aggressive behaviour included self-injury. Although they noted an improvement in aggressive behaviour, they did not specify if this was an improvement in aggressive behaviours toward others and toward self																															
(Carr, Reeve and Magiolo-McLaughlin, 1996)	USA	Crowding in the living conditions of people with developmental disabilities is associated with aggressive behaviour	Refers to "living environments" but does not specify which living environments.		■																													

(Close and Horner, 1999)	USA	Identified a set of basic principles for the design of the home, however, emphasised the importance of designing for the individual	Integrated information from different sources (eg, residents, family, support staff, etc). Could not attribute changes to environmental modifications as there was no control					■	■	■	■		■																			■
(Draper and Browne, 1993)	Australia	Suggested that a reduction in environmental demands is an important component of countering aggressive behaviour	Expert opinion – no empirical support to assertions	■									■																			■
(Elder Care Online, 2000)	USA	Notes that outside influences can modify behaviour so keeping things simple and allowing the person with dementia control is important	Expert opinion – no empirical support to assertions. Published by Elder Care Online, however, the specific author is not stated.	■									■																			■

(Kovach, 1997)	USA	Suggests preventing behaviour problems by: decreasing the amount of environmental stress and ensure that the person has a balance between sensory stimulation and sensory calming experiences (amongst other interventions)	Does not state which environment guidelines are intended for, although some language indicates institutional "eg, housekeeping, staff, etc".		■																											■
(Kunik et al., 2003)	USA	Notes triggers of disruptive behaviours (not all aggression): noise, floor pattern, colour of environment, mirrors, pictures, florescent lighting, temperature, television, boredom, too much choice, change, new roommate, "crowding may trigger aggression", traffic flow	Takes opinions from family and people with dementia as well as nursing home, etc, but environment might be referring to institution suggested by language, eg, "resident."		■																											■
(Matson and Duncan, 1997)	USA	The physical environment, eg, crowding, can contribute to the occurrence of aggressive behaviour. Notes "time-out" (including seclusion) may be a helpful strategy if behaviour is contingent on environmental reinforcement	What about when motivated by escape?		■	■																										■

(Mintzer <i>et al.</i> , 1993)	USA	Notes that home is often a very stimulating environment (eg, lights, television, furniture, etc) and that elimination of causes of over-stimulation in the home environment may reduce catastrophic reactions.	Refers to catastrophic reactions that manifest as agitated behaviours in section pertaining to home. Aggressive and self-injurious behaviours are noted as being forms of such. Expert opinion – no empirical support to assertions		■																													■
(O'Boyle, 2000)	USA	Advises a reduction of known stressors including shadowy lighting, mirrors, loud noises, changes to the environment and overwhelming or misleading stimuli (Television, mirrors, dolls, etc).	Article written for family care givers. Notes instances of person with dementia both in home and in a facility. Expert opinion – no empirical support to assertions		■																													■
(Raskind, 1999)	USA	Adversive environmental stimuli can lead to aggressive behaviour	Often uses the term "patient with dementia", however, indicates aim of reducing aggressive behaviours – "the most common behavioural precipitant for nursing home admission" p.45		■																													■

(Zentall and Zentall, 1983)	USA	Autistic children may respond to complex environments or excessive stimulation with aggressive or self-stimulatory behaviour	Does not define methodology, consequently where information was gathered from is unclear	■	■																													
(Hall and O'Connor, 2004)	Australia	Aggressive behaviour in people with dementia was found to be precipitated with noise, relocation to an unfamiliar place, darkness and physical restraints.	A literature review investigating mainly the association of health conditions/ personality/ cognitive impairments on aggressive behaviour. The effects of environmental parameters are mentioned.		■																													

(Cohen-mansfield, 2004)	US	Enhanced environment (corridors decorated to depict nature and/or family environment) - Natural environment (e.g., bird sounds, pictures, etc) during bathing - Access to an outdoor area were found to reduce agitation.	A literature review focused on nonpharmacological intervention studies, which utilized the following categories of interventions: sensory, social contact (real or simulated), behaviour therapy, staff training, structured activities, environmental interventions, medical/nursing care interventions, and combination therapies.																															
(Nelson, 2014)	US	Loud noises and crowded space had an effect on residents' agitation and disruptive behaviours,	Qualitative study including researcher's observations in a 59-bed nursing facility.	■																														

(Morgan and Stewart, 1999) ⁿ	Canada	Lower density/less invasions in personal space lead to lower levels of stimulation and less agitation/aggressiveness. Visual cues (views outside) can have a calming effect.	Study using findings from interviews with 9 staff and 9 family members of special care unit residents. The focus is on: safety, homelike setting, optimal stimulation, cues, and options for privacy and social interaction.	■																														
(Pulsford and Duxbury, 2006)	UK	Homely furnishings and decoration; colour and lighting that aids perception; minimization of stress-provoking background noise; space for people to not feel overwhelmed by others, and safe and stimulating areas for the person to walk about in are recommended.	Recommendations derived by literature.	■	■																													
(Brand, 2010)	UK	The recommendations indicate that the home environment should be made of safe, durable materials and objects, that are easy to maintain.	Study that used interviews, literature review and on-site visits as sources for the recommendations.																															■

(Wong <i>et al.</i> , 2014)	Hong Kong	High noise levels, too cool or too hot environments, poor ventilation and stuffiness, glare, light form night sources, too bright or too dim lights all seem to have an effect on behaviour.	The behavioural problems of people with dementia caused by IE were investigated by recording and studying the experiences of dementia residents' caregivers, RCH staff and/or registered nurses, and architects.	■																														
(Garre-Olmo <i>et al.</i> , 2012)	Spain	Temperature, noise, and lighting (low light levels in the bedroom for participants who spent many hours there) were associated with more signs of a negative affective mood.	Random sample of 160 nursing home residents with severe dementia participated in this observational study where environmental parameters were associated with the quality of life of residents.	■																														

(Sloane et al., 2015)	US	Low light intensity, large unit size, poor scores on a rating of homelikeness, poor scores in cleanliness of halls, poor maintenance of public areas and bathrooms, absence of non-glare, non-slip floors, presence of odours of urine and stool in public areas and bedrooms, absence of a public kitchen for activities and family use were found to increase agitated behaviour.	3723 observations of resident behaviours in 53 Alzheimer's disease Special Care Units. Observational data were gathered on the physical environment and staff treatment in these settings.	■																												
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