Evidence-based Design in Coordinated Health Treatment

John Zeisel



John Zeisel, Ph.D.

Dr. Zeisel is president of Hearthstone Alzheimer Care, a company with its headquarters in Lexington, Massachusetts that manages assisted living treatment

residences for people with Alzheimer's disease and related dementias. He received the 1998 EDRA/Places research award for examining the effects of the physical environment on health and wellbeing of people with Alzheimer's disease. The same year he was honored with the Environment Design Research Association's Career Award for his contributions to design research. Dr Zeisel received his Ph.D. in sociology from Columbia University and a Loeb Fellowship from Harvarad University, School of Design. He is author of "Inquiry by Design", a standard reference in many architecture, design and social science courses. Dr. Zeisel, chair of the advisory board of the International Academy of Design and Health, is chair of the 3rd world congress on design and health.

What is "treatment"

The term "treatment" is often used and seldom understood to mean the same thing by those who employ the word and those who hear it. Treatments are often confused with cures. Generally and historically treatments for a certain illness or disability are those actions that are aimed at reducing negative side effects of those conditions—related symptoms. A symptom of a cold is a runny nose, of a broken leg is difficulty walking, and of arthritis is difficulty with fine motor skills. Actions taken to reduce runny noses, help people walk, and be able to do fine things with hands, are 'treatments." Confusion arises when people use the term "treatment" for Alzheimer's disease because, as everyone knows that at present Alzheimer's is incurable. Even more confusion occurs when the term treatment is applied to actions that pharmaceutical don't include drugs. Treatments for colds, AIDS, bi-polar manic depression, a swollen knee, and arthritis all focus on symptom reduction, and all include more than merely drugs. To take the example of a broken leg or swollen knee, treatments would include modifications to the physical environment such as a ramp or mechanical lift, objects including a cane or crutches, hot baths and rapidly moving water (hydro-therapy), and a knee brace. It would be difficult not to see such environmental modifications as symptom reducing treatments.

Changes in behavior and lifestyle are also treatments, in that they reduce symptoms. Treating a broken leg or swollen knee would include avoiding rough sports, raising the leg above the hip, perhaps lying down frequently, as well as walking treatments to rehabilitate muscles and nerves. Of course, certain pharmaceuticals might also be prescribed in limited quantities such as an anti-inflammatory, pain killer, or even a sleeping pill.

The following three-part coordinated treatment approach seems advisable to treat any disease or physical condition:

- Change the physical context
- Modify behavior and communication
- Prescribe pharmaceuticalshods and findings

Such an approach does not imply that scientists ought to stop looking for a cure for chronic diseases. This certainly would make no sense for Alzheimer's, Parkinson's, cancers of all sorts, bi-polar and manic-depression, arthritis, or Lupus. But in the same vein, the search for cures ought not to prevent people suffering from these conditions to be treated so that their symptoms are reduced and their quality of life improved.

For people living with Alzheimer's, indications for what are the most appropriate treatments environment, behavior/communication, and drugs—can be found in a better understanding of the brain. Elsewhere (Zeisel, 1999; Zeisel & Raia, 2000) the specific brain dysfunctions associated with Alzheimer's have been described and how responding to them can lead to appropriate environmental and communication treatments. All such treatments are based, however, on two basic premises.

First, the brain is a complex and rich organ, containing about 100 billion cells. Even if plaques and tangles associated with Alzheimer's disease destroy a large minority of these cells, there are a great many cells and capacities left, throughout the disease. Although the brain weight at autopsy of a person who has died with Alzheimer's may be as much as 40% less than that of someone without the disease, during the disease process there may be only a 10% or 20% reduction in brain weight. With 80 or 90 billion cells left, a great deal can be done, especially if the changes can be located and the particular deficits dealt with. (Zeisel & Raia, 2000)

Second, animal studies have taught us that certain memories and skills are hard-wired in the brain. Certain birds hatched away from any other members of their breed begin to sing the traditional birdsongs of that breed without coaching. Nobel prize winner Konrad Lorenz showed us that geese and ducks attach themselves for life to the person or object they first see when they hatch from the egg. This "maternal" attachment is automatic—hard-wired, inherited, not learned. And hatchlings of certain breeds of birds who fly south in the winter, when put into a planetarium with the winter sky artificially created, begin to fly south although they have never been taught this by an adult bird. Hard-wired memories are well documented in the animal kingdom.

Barry Reisberg's well-reasoned retrogenesis theory (Reisberg et al, 2002) argues convincingly that, with minor exceptions, those skills a person with Alzheimer's loses, she loses in the inverse sequence to the sequence in which she gained them. A baby develops the skill of grasping hands early in life. This is an instinct lost very late in the disease. Language centers develop later in childhood. These are damaged earlier in the disease, and so on. It follows that hard-wired memories and skills, acquired even before birth, may never be lost in the brain and mind of a person living with Alzheimer's.

Neuroscience research into the types of memories that are hard-wired in the human brain is in its infancy. Hypotheses need to be generated, methods developed, and research carried out. From observing and interviewing people living with Alzheimer's, certain environments appear to be better and more naturally understood than others. These include kitchens and fireplaces. This indicates that these "hearth related" memories may well be hard-wired or at least deeply embedded in a profound bank of memories.





In order to develop a coordinated treatment approach for Alzheimer's disease symptoms, it would be prudent to first classify relevant symptoms treatment is aimed to reduce. A useful symptom taxonomy is:

Alzheimer's Symptoms

- Behavioral
- Functional
- Cognitive
- Physical

Behavioral symptoms include verbal and physical agitation, aggression (although this is often caused by inappropriate care), and walking nervously (generally misnamed as wandering). Functional symptoms are primarily instrumental-the difficulty people living with Alzheimer's face in organizing and carrying out everyday tasks such as bathing, dressing, brushing their teeth, eating, and using the toilet. They would also include more complex tasks such as bill paying, cooking a meal, or packing a suitcase. Cognitive deficits generally refers to memory tasks such as remembering a name or a phone number, calculating tasks such as balancing a checkbook or paying bills, and wayfinding tasks such as finding ones way to an appointment or back home from a walk. As people live longer with this disease, they face physical difficulties somewhat related to the disease including the loss of balance and risk of falling and difficulty standing up or getting out of a chair, along with normal aging losses of eyesight and hearing.

Any intervention—be it behavioral, environmental, or pharmaceutical—that increases the ability of a person with Alzheimer's to carry out such tasks or inversely to have fewer of the problems listed above, can be considered a "treatment" for the disease.

Coordinating treatment

Given that a mix of non-pharmacological treatments—communication, behavior, and environment—along with pharmaceutical treatments for such things as anxiety, depression, and cognitive ability seem to be most effective in treating Alzheimer's disease, it would be useful to have a logical approach to their coordination. Clinical experience suggests the following strategic sequence: after identifying and assessing the symptoms, first apply non-pharmacological approaches, assess improvements, and end with pharmacological interventions to reduce remaining symptoms.

Before treating a symptom, it must be identified, analyzed, and assessed in order to determine what to do to take to reduce it. The first step is therefore essentially one of describing the symptom and assessing the context within **ci** which it occurs. Identifying a symptom and its **itCc b** elements means looking at it closely enough to **i&C n** understand what might be done to reduce it.

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- Coordinate both non-pharmacologic & pharmacologic approaches
- First employ non-pharmacologic ones
- Second employ lowest possible dosages of pharmacologic to make up the difference, if needed at all

For example just to say someone living with Alzheimer's disease is anxious is not enough. To decide whether a pill is the best treatment, or quiet music, a hug from a friend, or getting her involved in a pastime that was formerly part of her daily life would be a better treatment, requires a deeper and more precise understanding of her anxiety. Observing sufficiently to identify and describe the symptomatic behavior in detail is the first step in this effort. Does she look worried or cry out? Does she get so paralyzed with fear that she refuses to get out of bed or does she get out of bed and then worry about everything all day long?

Just as necessary for determining the appropriate treatment is thoroughly understanding the contextual events that might have triggered or set off the symptom. Do observations or records show that she gets anxious more around certain people or in particular places? Are there situations—like having taken a trip or a certain visitor—that makes her more anxious? And what about a related illness or discomfort—an excess disability—that she can't describe, but that if treated, might reduce her anxiety—such as a urinary tract infection or maybe just poor eyesight?

Once an understanding is reached, the first action step is possible. Change the context identified as triggering the symptomatic behaviors—whether this is the caregiver, the physical environment, or medications. This non-pharmacologic approach can be considered treatment if it is applied systematically and if it measurably reduces symptoms. Of course once these treatments have been acted on, there may well be a condition that a medication might reduce. Clearly, medications are then advised—as long as they are applied carefully, with knowledge of their particular effects and side effects, and in as low a dosage as is required to have the desired effects.

Pharmacological treatment

Pharmaceuticals—pills, drugs, and medications deal with the chemistry of the body and the brain. Many types of drugs are employed in treating Alzheimer's symptoms. Among them are medications for excess disability illnesses or conditions, anti-psychotics, anti-depressants, anxiolytics, sedatives, and cognitive enhancers. Illnesses and conditions for which treatment may avoid excess disability reactions include pneumonia and urinary tract infections that can cause agitation, or ear and sinus infections that may cause dizziness and pain. Agitation can also be caused by the unmonitored interaction among several medications or even by uncorrected visual and hearing loss.

According to the Nursing Drug Handbook (Kelly, 2004), anti-psychotics including such drugs as Zyprexa and Resperdal, are indicated for treating hallucinations, delusions, aggression, hostility, and "uncooperativeness." Since this last dimension of anxiety can easily be reduced employing communication approaches and environmental design or rather such treatments can encourage cooperation—it would seem well advised to apply these before prescribing medications for this behavior. The same lesson can be applied to most of the following types of medications and their applications.

Anti-depressants such as Prozac, Paxil, Celexa, and Zoloft, are indicated for treatment of low mood and "irritability." Since environment and communication can achieve these goals as well, it would be prudent to apply approaches that may help avoid irritating the person in the first place. The same is true for anxiolytics such as Ativan and Serax. These medications are indicated to treat anxiety, restlessness, verbally disruptive behavior, and "resistance." It would make sense and reduce any possibility of side effects to use appropriate communication and environment to encourage agreement, and only then employ the drugs.

The same responsible use of drugs is necessary for cognitive enhancers that include and have included in the past Cognex (Tacrine), Reminyl (Gelantamine), Exelon, (Revastigmine), Aricept (Donepezil), and Namenda (Memantine). Each medication has some degree of side effects and is also indicated for different situations. Current research indicates, for example, that Donepezil is indicated for mild / early stage Alzheimer's while Memantine is more appropriate for late stage/advanced Alzheimer's and perhaps for a milder stage of the disease if taken with Donepezil. Medications clearly are a reasonable treatment when applied after other treatments, and when applied with full understanding of their effects.



Many people including medical professionals receive their information about such drugs from news reports, print advertisements, and the media. These have a tendency to use terms and statistics that in a medical journal such as the New England Journal of Medicine or the Journal of the AMA, might have a different meaning. If an article appears in The New York Times with a headline announcing a new drug with "significant" effects, people are likely to believe the drug makes a meaningful difference to people's lives. In a professional journal, however, "significance" has a specific meaning-that a statistical difference has been found that is more likely to have occurred because of the intervention than by chance. This has little to do with the "meaningfulness" of the difference found.

In general, preliminary findings about food and life style are emerging in professional journals indicating that what is good for your heart is also good for your brain. The message is eat fewer fats and foods rich in antioxidants such as leafy green vegetables, exercise regularly, and keep your mind active.

Communication treatments

The second major treatment for Alzheimer's in this coordinated treatment approach is appropriate and responsive communication geared to mediate the effects of the brain losses associated with the disease. This approach has been thoroughly described in a previous article authored jointly with Paul Raia, Director of Patient Care and Family Support at the Massachusetts Alzheimer's Association (Zeisel & Raia, 2000). This approach stresses the skills and aptitudes of people living with the disease, especially those that relate to their emotional centers of the brain—the amygdala. The following table from the earlier article (Zeisel & Raia, 2000) represents this approach.

Environmental treatment

The third treatment included in the evidencebased coordinated treatment approach is physical environment. Research carried out in the last several years indicates that specific characteristics of the physical environment are associated with reduced symptoms, measured with the same outcome measurement tools used in studies of drug efficacy. In a multi year study (Zeisel et al, 2003) it has been found that several of the characteristics from the following table (Zeisel, Hyde, & Levkoff, 1994) were correlated with reduced symptoms of Alzheimer's disease.

Two factors that are fundamental to these environmental design characteristics are natural mapping and memory cues, both of which contribute to improved function & independence. Natural mapping refers to environments that are self-evident. In other words, a person using a naturally mapped object or setting needs no additional information to know how it is used-no instruction booklet or map. This concept, developed by Norman, was originally applied to objects such as car seat adjusters that are easy to use and video tape players whose "time and date" function are notoriously difficult to manipulate (Norman, 1988). For people living with Alzheimer's whose cognitive mapping ability has been compromised by brain dysfunction, naturally mapped gardens and residential settings with visible destinations and place identifiers give them the opportunity to find their way-to walk rather than wander. Wandering is often seen as a "symptom" of Alzheimer's, but it is more realistically seen as a natural tendency to look for something, to explore, but in a setting that has no self-evident layout.

Memory jogging physical environments are those that "cue' memories the person living with Alzheimer's has in their brains, but because of damage to the hippocampus and other brain regions they can't retrieve. Cues can be photos in the hallway of seascapes and urban streets that remind people of the places they spent their lives, "shadow boxes" with mementoes of people's lives and achievements, and photos of their children and grandchildren. Memory cues can also be the person's own furniture in their original home or in a group residential setting like an assisted living residence.

Both natural mapping and memory jogging underlie the effects that can be identified in appropriately designed social and common rooms for people living with Alzheimer's. In a "living room," "dining room," or "kitchen" designed to look like a room of that type, the décor makes evident the socially appropriate behavior that ought to take

place there. It is naturally mapped. In addition, the décor jogs the memory of people living with Alzheimer's in that it reminds them of memories they hold in their brain of appropriate behaviors such as asking for tea and coffee in the kitchen, chatting with others in the living room, and sitting down to a meal in the dining room.



The findings from the research on the correlates to these design and environment characteristics (Zeisel et al, 2003) clearly indicate fewer symptoms in carefully planned settings.

Anxiety and aggression are reduced in settings with greater bedroom privacy & with more personalization in bedrooms. Social withdrawal is reduced in settings with limited numbers of common spaces each of which has a unique character. Depression is reduced in settings with camouflaged exits with less visible electronic locks replacing Agitation-verbal and physical togetalarms. her-is reduced in settings that are more residential then institutional. Physical agitation does not appear to be affected by environmental design characteristics. Verbal agitation is reduced in settings where residents understand more of the sensory input they receive and where the sensory input is controlled. Psychotic symptoms were reduced where there was more privacy and personalization and where residents could understand the sensory environment. But to explain the fact that improved walking paths were correlated with increased psychotic problems will require more research to understand.

Next steps

The next steps in this journey of discovery to understand coordinated treatment approaches and specifically the role of environment in "treatment" must include designing the lessons from these findings into care settings—both for people with Alzheimer's and other chronic illnesses and evaluating the results. Replicating in other environments-in-use the research already carried out will establish environment as a legitimate treatment modality.

Exciting next steps also lie in the emerging field of neuroscience in architecture and related design disciplines. This new field—represented presently in the San Diego based Academy of Neuroscience for Architecture—can finally make the links between environment, brain, and behavior so urgently needed to fully understand environment as treatment. John Eberhard, President of the Academy, has written an introduction to the field (Eberhard, 2004) translating the findings of the recent research by Zeisel et al (2003) into a set of testable hypotheses for future neuroscientific study.

The following are Eberhard's translation of the Zeisel et al findings into hypotheses to be explored and tested with neuroscience. Each is associated with one of the findings summarized above.

Testable neuroscience hypotheses on Alzheimer's environmental treatment

• The visual perception of people living with Alzheimer's is such that they have little or no ability to discriminate between foreground objects and near background context, or

• the visual perception of people living with Alzheimer's is such that they have little or no ability to focus on details like doors when certain colors cover the surfaces.

People living with Alzheimer's who enter a conventional corridor are frustrated by their perception of an exit at the end of the space.
People living with Alzheimer's perceptions of paths with dead-ends stimulates fears and/or frustrations

· People living with Alzheimer's have the percep-

Alzheimer's Environment-Behavior (E-B) Factors Model								
E-B Concepts	Definition/Examples	Dimensions						
1. Exit Control	Boundary conditions of each Special Care Unit; the surrounding walls, fences, doors and how they are locked or otherwise limit and allow people to come and go.	<i>Immediacy of Control</i> : the degree to which the exit doors are magnetically or other wise locked, versus open but alarmed.	Unobtrusiveness: the degree to which the exit doors are camouflaged by paint or other devices, the amount of hardware, and their location along side walls as opposed to the end of hallways					
2. Walking Paths	Circulation space residents use for wandering and moving around.	Continuousness with Destinations: The absence of dead-end and cul-de-sac corridors, and the presence of active destinations that might encourage residents there to turn around.	<i>Wayfinding</i> : The presence of orienting objects along the pathway, as well as wall objects that attract residents' attention and provide them a sense of being in a place.					
3. Individual Space	Spacesprimarily bedrooms- -assigned to and mostly used by a limited number of residents.	<i>Privacy</i> : The number of private bedrooms in the Special Care Unit.	<i>Personalization</i> : The degree to which residents are allowed to and actually do place personal objects in their rooms.					
4. Common Space	Sizes, relationships, and qualities of spaces used by all residents in the special care unit.	Quantity: The appropriate number of common rooms for the number of residents—to avoid crowding in too few rooms and too avoid "under-manning" in too many rooms.	<i>Variability</i> : The degree to which interior décor, furniture, and natural light provide common rooms with unique characteristics and "mood" appropriate to their use.					
5. Outdoor freedom	Residents' access to common areas out of doors and the way these places support residents' needs.	Availability: The degree to which there is an adjacent outdoor space, and the degree of free access residents have to that spacedoors unlocked and appropriate supervision.	Supportiveness: The degree to which the open space is a "therapeutic garden" with appropriate places to walk, sit, smell the plants, engage in safe and interesting activities, and be apart from others					
6. Residential Character	The lack of institutional surroundings—including furniture and décor, wall covering and flooring, and layout with prominent nursing station.	<i>Size</i> : The degree to which the size of the Special Care Unit reflects a large family space.	<i>Familiarity</i> : The degree to which the Special Care Unit uses residential furnishings, design features, and personal objects.					
7. Autonomy Support	The ways in which the facility encourages and supports residents to use their remaining faculties to carry out basic tasks and activities independently and with dignity, including enabling staff to avoid being overprotective.	: The degree to which the unit's physical environment protects residents from injury from objects and inappropriate furniture, helps to prevent falls and injury from inevitable falls, and prevents elopements.	Prosthetic: Physical supports in the environment for residents to do things for themselveshandrails, toilet seats high enough for self toileting, bathtub and shower support rails					
8. Sensory comprehension	Quality of the sensory environment-acoustic, visual, thermal, odor and kinesthetic environment in all spaces, and the degree to which these conditions may confuse residents.	Sensory Management: The degree to which staff can control auditory and visual "noise" in the unit and the degree to which such sensory complexity has been controlled by design.	<i>Meaningfulness to residents</i> : The degree to which the ambient sensory environment is familiar to residentssmells, sights, sounds, and touch/textures.					

tual ability required to recognize an object that is intended to "orient"

• People living with Alzheimer's are able to have a "sense of place" based on perception of objects that are "familiar."

• When people living with Alzheimer's are shown personal objects (other than photographs) recognition is registered in the frontal cortex, when they are shown objects that are not theirs there is no such registration. Level of impairment with respect to recognition of objects will influence subjects' suitability for this particular study.

• Is the décor of common rooms (wall covering, curtains, colors, light fixtures) able to register in the recognition areas of the brains of people living with Alzheimer's as indicators of use .i.e this is a place to eat, this is a place to have a good time with others, or this is a place to just sit and relax.

• Does the style of furniture in such rooms elicit similar responses or is the preference of people living with Alzheimer's so idiosyncratic that there is no common association with furniture style and room use.

• Does the introduction (or elimination) of natural light elicit similar responses or is it the ambient light level regardless of source.

• What might be useful to explore is what areas of the brain are activated while a person living with Alzheimer's is caring for a plant, followed by experienced analysis of why these patterns of brain response could lead to "therapeutic" results.

• Regarding privacy, a cognitive neuroscience study might evaluate whether people living with Alzheimer's feel that being apart from others for a period of time is positive.

• If privacy seems to register positive emotions, why would this be true?

• Does the brain and nervous system of a person living with Alzheimer's respond to sensory environmental variables differently than "normal" subjects?

• Are some odors better at eliciting good memories and hence positive comprehension by people living with Alzheimer's?

• Do certain textures elicit memories in people living with Alzheimer's whose non-conscious sense of touch may have associated memories that their conscious response to texture preference questions would not reveal? Environment as treatment has a long history. Florence Nightingale was one of the first in the modern age to advocate that sunlight and air were healing. Many environment-behavior specialists since have been working on the contributions environment can make to health. This field appears to be on the cusp of a new era where methods and findings of neuroscience will be useful in helping us understand environmental phenomena and their treatment effects more thoroughly.

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