The Evidence for Evidence-Based Design

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What is Design Research?

*Design research is the exploration of the relationship between physical and virtual/representational environments and psychological, behavioral, physiological, and mechanical responses.*
Types of Environments

Environments

Physical Environment
- Nature
- Buildings
- Color
- Scale
- Complexity
- Climate
- Sound

Virtual/Representational
- Art
- Computer simulation

Responses
Types of Outcomes

Responses

- Psychological
  - Perception
  - Emotion
  - Preference
  - Satisfaction

- Behavioral
  - Hand-washing
  - Visiting
  - Walking
  - Way-finding
  - Socializing
  - Operational
  - Staffing

- Physiological
  - Cardiac
  - Chemical
  - Hormonal
  - Infection
  - Respiratory
  - Galvanic

- Mechanical
  - Cost
  - Construction
  - Bacterial levels
  - Air quality
  - Demographics
Direct & Indirect Environmental Impacts

- Direct impact of environment on outcomes is primary design research.

- Indirect impacts are correlate design research.
What is Evidence-based Design?

*Evidence-Based Design is the process of basing decisions about the built environment on credible research to achieve the best possible outcomes.*
Evidence-based Practitioner

EBD integrates design research into actual projects.

Hamilton’s Practitioner Levels:

1. Keep up with the literature and apply the evidence.
2. Predict and measure the outcomes
3. Share findings
4. Peer-reviewed publications
Differing Definitions of Research

- Kim (2001) found discrepancies between academic definition and perspectives of practitioners.
Differing Definitions of Research

• For academics, observation, questionnaires, interviews, and programming involve research, if the methods are rigorous, objective and entail a hypothesis.

• Hypotheses provide structure for studying whether design intentions were met.

• Programming may involve observation, questionnaires, and interviews, but may not be rigorous.
Who Should Conduct Research?

• Lack of understanding regarding the meaning of research limits the promotion of research.
• Most research is conducted by academics or by specialized consultants.
• Because of this, the gap between practitioner and scientist is problematic.
Impediments to Research

• Limited funding and design clients for research activities.
  o Organizations such as TAMU, Georgia Tech, the NSF, and the RWJ Foundation promote research through grants.
  o Funding for research is generally limited to academics but may be available for practitioners.
Impediments to Research

- Designers should include a research phase in the fee proposal.
- A firm’s ability to offer such services sets them apart.
- Reports vary regarding this approach.
Impediments to Research

• Research training is uncommon
  o CEU after graduation.
  o Courses in questionnaire and interview methodology at most educational institutions, directly or remotely.
  o Executive masters programs.
  o Collaborate with research faculty and graduate students at universities.
Impediments to Research

• Experimenter bias may be introduced in the methods and interpretation.
  o Most in-house studies are conducted by staff, who have been involved with the project.
  o E.g., in limiting topics the outcomes can be skewed.
Impediments to Research

• Differing perspectives:
  o Researchers attempt to understand the problem, the goal of industry is incremental improvement.
  o Researchers scale down problems, while practitioners expand them;
  o Research emphasizes individual accomplishment, where industry focuses on team (Rouse, 1985).
Impediments to Research

• Lack of publishing venues
  o Firm journals normally include *Architectural Record, Landscape Architecture, and Modern Healthcare*.
  o Researchers publish in *Environment & Behavior, Environmental Psychology, or Health Environments Research and Design*. 
Impediments to Research

• Reluctance to be scrutinized
  o Concern about “bad publicity.”
  o If firms review the results, they might request omission of negative outcomes.
  o Conversely, when collaboration is not permitted, the designer and owner feel alienated.
Impediments to Research

- Two ways to address this problem:
  1. keep results confidential
  2. publish the results without identifying the institution.
- Shortcoming of in-house results is that others cannot benefit.
- Keeping the site anonymous helps, but anonymity is difficult if drawings are incorporated.
Impediments to Research

• The only way to circumvent the problem of “research outcome paranoia” is to change our culture as designers.
• If self-evaluation were commonplace, the results would be less likely to stigmatize the building product.
Impediments to Research

• Even if a practitioner embraces applied research, distilling the literature is challenging.
  o For those who are not acquainted with research, the following 7 criteria are useful when reviewing studies:
SUPPORT – Substantive Methodology

• Does the project describe a credible methodology?
• Qualitative studies will be respected if they use a reputable methodology.
• E.g., naturalistic inquiry; involves structured analysis of naturally acquired data.
SUPPORT – Uncovers New Knowledge

• Does the study provide new knowledge?
• Is it rehashing old ideas, or drawing new conclusions?
• A literature review does not provide new knowledge unless it draws original conclusions through a synthesis of articles.
SUPPORT – Peer-reviewed or Refereed

• Has article been published in a peer-reviewed journal?
• Peer-reviewed manuscripts are evaluated by experts.
• Refereed articles reviewed by individuals not on editorial board.
• Author’s guidelines indicate review process.
SUPPORT – Problem or Hypothesis

• Does the research in the article specify a problem or hypothesis?
• Intentions of researcher are articulated at the outset of the manuscript.
A problem well put is half-solved.

- Dewey, 1973
Hypotheses

- Once a designer is clear about the intentions of the client, the project flows.
- If unclear, the designer will be inefficient.
- In research, an hypothesis, or problem statement, is equally critical.
Sources of Hypotheses

• An hypothesis may evolve from:
  – comparison of the building program to building outcomes,
  – response to pressing research topics, or
  – study of previously untested innovations.
Role of Building Program

- Mission statement
- Objectives
- Descriptive functional narratives
- Adjacency diagrams
- Space lists
- Code analysis
- Preliminary cost analysis
- Support materials (site visits, meeting minutes, relevant literature, etc.)
Role in Building Program

- A program by EBD designers may also contain research articles and data from building users, some of which may be used for pre- and post-occupancy evaluation.
Role in Building Program

• Mission statement critical to hypothesis
• Serves as a preamble by providing context
• Researchers limited to a few tenets
• Objectives, such as family-centered care, serve as the hypothesis
• Functional narratives, adjacency diagrams, and space lists include information required for surveys.
Pressing Research Topics

- Decentralized nursing stations
- Universal rooms
- Private NICU rooms
- LDR vs. LDRP
- Decentralized vs. centralized support spaces
- Same-handed or mirrored rooms
Relationship to Innovations

• Occasionally a designer introduces a novel design feature
  – first free-standing facility for persons with AIDS
  – first free-standing single-room maternity care women’s center
  – use of a rolling equipment cart in an NICU

Source: The Design Partnership
Source: virginiamason.org
Relationship to Innovations

- Difficulty in finding a facility with pre- and post-conditions
- To study SHRs, we would want a facility whose staff was using mirrored and SHRs or had previously been in a traditional unit and relocated to a SHR
- Problem with innovations is rareness of study sites

Source: Hermanmiller.com
Relationship to Innovations

• Novelty generates interest from individuals who tour the facility and incorporate the innovation outright
• Responsibility to do an evaluation to confirm effectiveness
• Information should be shared with organizations considering replication
Components of Hypotheses

- subjects
- intervention or independent variable
- dependent variable
- response
Components of Hypotheses

• Physical environment is typically the independent variable
• Dependent variables depend on independent variables
• Dependent variables are the factors used to measure impact of the physical environment
Components of Hypotheses: Subjects

- Patients
- Families
- Visitors
- Nurses
- Physicians
- Technicians
- Clerical staff
- Administrative staff
- Volunteers
- Housekeeping staff
- Maintenance personnel
- Food service staff
- Others
Components of Hypotheses

- age
- gender
- job title
- duration of employment
- ethnicity
Components of Hypotheses

- With regard to the independent variable, or the physical environment, the study could address a facility, room or piece of furniture.
Hypothesis vs. Guidelines

• All design guidelines may not originate from hypotheses, but all contribute to outcomes
• Every hypothesis is a design guideline, because the environment “affords” the occurrence of activities
• For example, a typical design guideline for the development of a new clinic is:
Hypothesis vs. Guidelines

The clinic should support family-centered care.
Hypothesis vs. Guidelines

• This guideline includes all four of the components:
  – independent variable (the clinic),
  – outcome (family centered care),
  – dependent variable (support of family-centered care), and
  – subjects (families).

• A clearer articulation that would provide both an understanding the design objectives and a structure for conducting a study would be:
Hypothesis vs. Guidelines

The clinic should provide spaces (e.g., waiting areas and exam rooms) that are designed to increase family satisfaction regarding family-centered care.

Source: saludjuntos.org
Hypothesis vs. Guidelines

• The primary difference between this statement and the previous one is that it enumerates specific spaces that can be measured, rather than addressing the entire facility, and it specifies the type of behavior that needs to be measured.

• Another example…
In the interest of reducing patient stress, the facility will have access to nature.

Source: djc.org
Hypothesis vs. Guidelines

• This would be better stated as…
Hypothesis vs. Guidelines

Gardens and views of nature will be provided in waiting areas and along corridors to reduce the stress of patients.

Hypothesis vs. Guidelines

• And another example…
Hypothesis vs. Guidelines

The new facility will employ techniques to increase light levels and sustainability.

Source: inhabitat.com
Hypothesis vs. Guidelines

• Would be better stated as…
Hypothesis vs. Guidelines

Sustainability will be enhanced through the reduction of the width of the floor plate and introduction of skylights in core areas, resulting in increased light levels and a reduction in lighting energy costs.
Hypothesis vs. Guidelines

- Primary difference in all 3 is clarity regarding the physical environment and what needs to be measured.
- Mission statements and guidelines should consider phrasing to permit a direct transition to evaluation research hypotheses.
Name 3 sources of potential hypotheses.

What is a primary difficulty in conducting an evaluation based on an innovation?

What are the components of a hypothesis?
QUIZ

Name 3 sources of potential hypotheses.
*Innovation, pressing issue, program*

What is a primary difficulty in conducting an evaluation based on an innovation?
*Rareness*

What are the components of a hypothesis?
*Subject, response, dependent and independent variables*
Quiz

Define independent and dependent variables.

List 3 independent variables associated with healthcare settings.
Define independent and dependent variables. *Independent variables provoke change in dependent variables. Dependent variables potentially respond to the independent variable.*

List 3 independent variables associated with healthcare settings.
*Site, building, furniture.*
SUPPORT – Objective Researchers

• Has the study been conducted by objective researchers?
• Is there a possibility that the design of the study or a description of the outcomes is influenced by the individual who has generated the study?

Substantive Method
Uncover knowledge
Peer-reviewed
Problem/hypothesis
Objective research
Repeatable methods
Triangulated
SUPPORT – Repeatable Methodology

- Is the methodology clearly articulated?
- Is it descriptive enough so that it could be repeated?
- Part of what can be learned is how to conduct subsequent experiments.
- It is important to make research techniques accessible to others.
Selecting a Methodology

cognitive style

availability of precedent studies

advice of a statistician

availability of resources, and

impact of the IRB process.
Selecting a Methodology

• **Cognitive Style** is the link between intelligence and personality.

• Qualitative researchers may feel more intuitive and interested in the big picture.

• Quantitative researchers are comfortable with a controlled/detailed analysis.
Selecting a Methodology

- Finding one’s comfort zone is appropriate
- However, if an individual is interested in growing as a researcher, then exposure to multiple types of methodologies is mandatory

Source: elizabethhatkinson.com
Building on Previous Studies

• New researchers are discouraged from reinventing the wheel when developing methods
• Using the approach of a previous researcher is not plagiarism
• Using a similar questionnaire (with permission) helps to establish validity and reliability, and affords the opportunity to make comparisons between studies
Building on Previous Studies

• Similar to inspiration during the design process, no designer begins with a blank slate
• Design process is fraught with precedent and the integration of the fabric of prior experiences within the environment
Multi-methods

• Many believe multi-methods are necessary to understand the socio-environmental issues.

• Multi-methods look at a question from a variety of perspectives, or use one method to provide information for the next.
Consulting with a Statistician

• In the early stages of developing a methodology, consultation with a statistician is helpful
• He/she can recommend ways to gather data and summarize implications of different approaches relative to analysis complexity

Source: blogzizee.com
Assessing Resources

• Different methods have different personnel and equipment costs
  – Mail surveys entail postage and copying, but are inexpensive.
  – Online surveys require purchase of software.
  – Observation methods are personnel intensive.
  – Physiological measures require medical equipment and trained staff.
Impact of Methods on IRB

• Some methods may require extended lead time to be ushered through the IRB process.
• If information is needed quickly, the researcher may opt to use alternative, nonintrusive measures.
• Multiple methods not advisable if funding is limited
Post Mortems & Honeymoons

• One approach is to conduct the study immediately after occupancy
• Dickey calls this a *post mortem* and notes that personnel adapt quickly in inappropriate situations
• If you wait too long, they will not recall what part of the environment impeded their activities
Post Mortems & Honeymoons

- Advantages: the building is prominent in the minds of the users, and if you are conducting PreOE and POE, the respondents are likely the same
- Disadvantages: staff adjustment to designs that are supporting new care delivery protocols and the inevitable “breaking in” of building systems and equipment
Post Mortems & Honeymoons

- EDAC recommends POEs 6 months after occupancy
- Allows for breaking in of systems and protocols, and effective

Source: amazon.com
Post Mortems & Honeymoons

Three reasons to wait 12 months

1. impact of seasonal changes recall

2. cognitive dissonance— the discomfort people feel when their actions and life philosophies are not consistent

3. access to a significant cluster of data. Assuming behavior had achieved consistency in 6 months, one would likely need to gather data at least 6 months into the future to have 6 months (for a total of 12 months) worth of stable data.
Post Mortems & Honeymoons

• In an ideal world, obtain feedback as part of the commissioning process
• then again after 6 months (to be available as quickly for future projects), and
• again after 12 months (to obtain the appropriate quantity to support statistical analysis)
• If data were gathered every 2 years thereafter, it would both support remodel efforts and provide information for future replacement facilities
Pre-testing and Pilot Studies

• No matter how accurate the research tools appear to be, there are always unforeseen problems

• Because of this, it is important to do pretesting and pilot studies before each research project
Pre-testing and Pilot Studies

• A pilot study can be thought of as a dry run
• Though normally done at the end of the process of developing the tool, pilot studies can be run while the tool is being developed to test portions of the tool
• A pilot study is distributed to a small population to determine its effectiveness; a helpful lesson is how long the process will take
**SUPPORT** – Triangulated Outcomes

- Use multiple methods to obtain information on a single question
- Combined qualitative and quantitative approaches are ideal.
- Compare the outcomes of different studies on the same topic.
Future Research

• At the macro level the two areas most in need of research were trends in healthcare needs and healthcare systems and financing (Kim, 2008).

• On the micro scale, functional requirements, health outcomes issues, technology issues, and user/patient issues were mentioned most frequently in Kim’s study.
Future Research

• Rubin, Owens & Golden (1998) examined 78,761 articles in search of those that were based on sound methodology and suggested a correlation between patient outcomes and the physical environment.

• Only 84 studies successfully met their criteria.
Future Research

• Shepley & Quan (2003) conducted an analysis for the period between 1998 and 2002. Examining 2,000 titles, an additional 35 were selected.

• The increase over the Johns Hopkins study was likely due to the availability of better search systems in 2002 combined with an increased interest in the field.
Future Research

- Ulrich and Zimring (2004) incorporated a broader range of disciplines. *Evidence-Based Hospital Design Improves Healthcare Outcomes for Patients, Families, and Staff* identified more than 400 studies.

- Addresses the impact of design on patient falls, hospital-acquired infections, medical errors, and noise levels.
Return on Investment (ROI)

• “Do building owners/occupants see their environment as necessary overhead or as a value-adding resource?” (McDougal, et al., 2002)

Source: Blog.larrybodine.com
Return on Investment

• Future systematic Practitioner-Focused Facility Evaluations (PFEs) for facilities management rest on the answer.
  – Commitment of management required for measurement initiatives.
  – Driven by a problem, rather than continuous improvement.
EBD/ROI Premise

• By implementing design features supported by evidence, healthcare facilities will reduce operating costs.
EBD and ROI

- EBD features may add capital costs

HOWEVER...

- Environmental/social sustainability affects investment property (Boyd, 2006)
Benefits of ROI (Hall, 2008)

Patient Satisfaction & Hospital Profitability

Profitability (1=least, 4=most)

- Group 1: 81
- Group 2: 82
- Group 3: 83
- Group 4: 84

Source: Hall, 2008
EBD and ROI

- Use data early to avoid changes
- Evidence evaluated via risk magnitude associated with quality of methodology

Source: Rybkowski & Ballard, 2009
POEs and ROI

- PFE is ideal for determining ROI
- Maximum value management requires ongoing commitment to evaluation (Green & Moss, 1998)
POEs/PreOEs and ROI

- POE can identify problems in an existing building before they grow to be more expensive
- PreOE can help clients avoid repeating costly mistakes
Reasons for creating a business case (Anderson, 2004):

1. Support decision process
2. Justify change
3. Provide record of decision process
4. Evaluate decisions, and
5. Provide framework for approving projects.
Business Case and ROI

- Life cycle costs key to ROI, not fixed (S3 Dev Corp, 2010)

Source: S3dev.com
Business Case and ROI

• Staff dissatisfaction can be measured as absenteeism, advertising, and retraining (van der Voordt, 2004).
• Data available on patient and staff satisfaction re: IT ordering, transcription, administration, and calculation errors (Newell & Christensen, 2003).
• Research validates well-being and productivity in sustainable buildings (Singh, et al., 2009).
Financial Benefits of ROI

- Based on cost-benefit ratio of industry…

Cost of Corrections
Prog/SD & DD

- $1
- $10

Cost of Corrections
Prog/SD & CA

- $1
- $100

Gibb, 1988
Financial Benefits of ROI

MacLeamy Curve

Ability to impact cost & function

Cost of design changes

Design Phase

Design Effort/Effect

Integrated Process

Traditional Process

Source: Ohainc.com
Financial Benefits of ROI

Payback Period

Source: Center for Health Design, 2009
ROI Process (per Sadler et al., 2008)

1. Determine problem scope and opportunity for improvement
2. Estimate cost of improvement
3. Estimate revenue savings
4. Compare cost and savings to determine ROI
5. Incorporate approach by involving EBD architects
6. Communicate targets and share lessons
Questions

Push *1 on your telephone key pad to comment or ask your question.

OR

1. Click on ‘Q&A’ on the menu bar. This will open the Q&A panel.

2. Type your question in the upper section and then click ‘Ask.’ You’ll receive confirmation that your question was received and only you and the presenters will see your question.

Submitted questions will be answered verbally as time allows.
Thank you for joining us for today’s webinar.

Healthcare 201: Evidence for Evidence-Based Design

Tuesday, September 6, 2011

2:00 pm – 3:30 pm ET
1:00 pm – 2:30 pm CT
12:00 pm – 1:30 pm MT
11:00 am – 12:30 pm PT

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