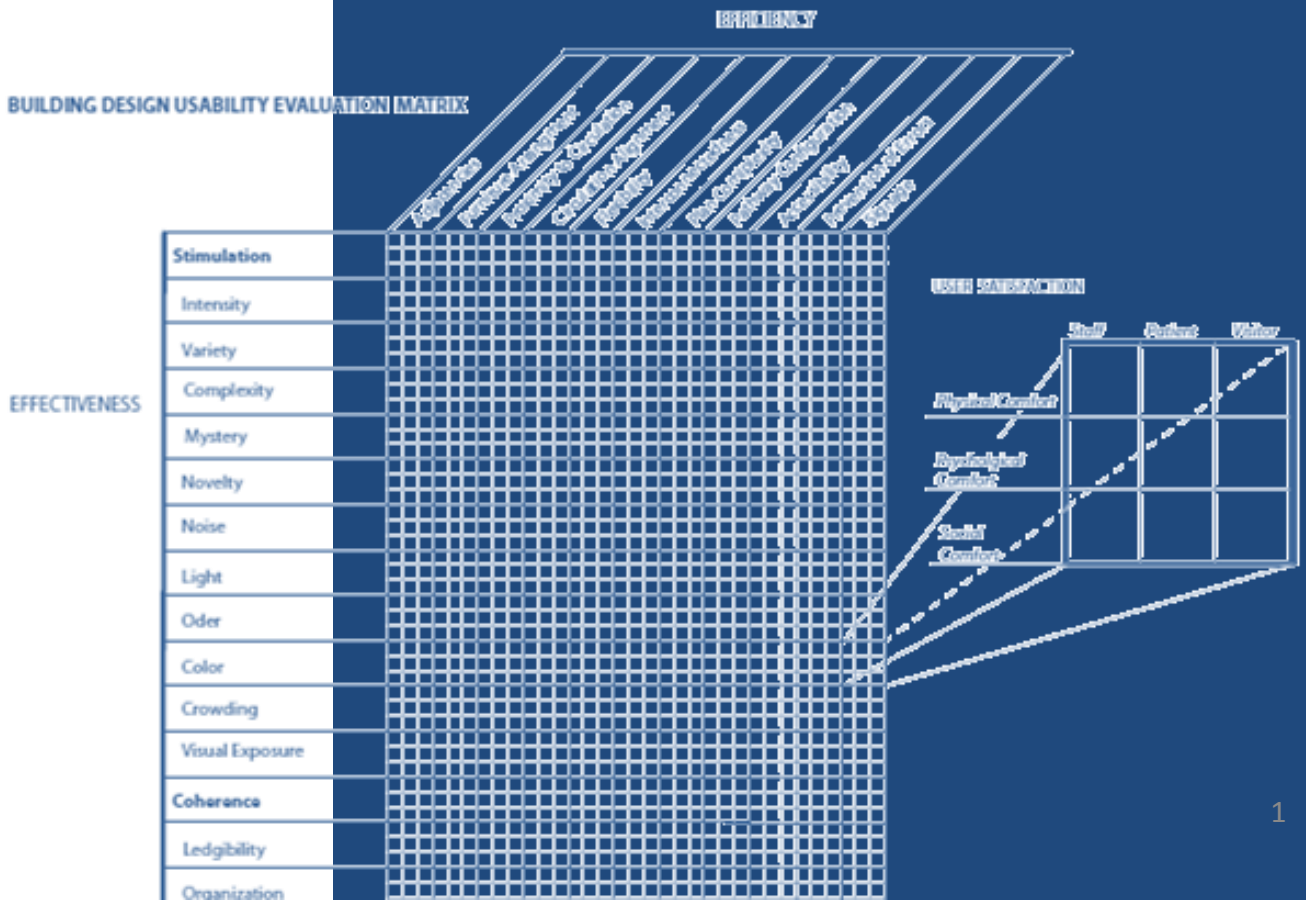




Building Usability Evaluation Tool-Kit: The Primary Care Clinic

BUILDING DESIGN USABILITY EVALUATION MATRIX





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Building Usability Evaluation Tool-Kit: The Primary Care Clinic

The term “usability” is widely used in fields such as product design, information technology, and web design. Building usability, unlike other technologies that are consciously used on a smaller scale, is about an entire experience around an individual with varying conscious and unconscious components based on the individual’s perception. Building occupants who “use” architecture on a daily basis rarely notice what they are using unless the discomforts of the environment exceedingly overwhelm the individual’s experience.

Architects have the responsibility of creating not just aesthetically pleasing but also “usable” spaces. Healthcare architecture demands precise research and creative intuition to consider the design usability of “healing spaces.” The designer’s intuition, the researcher’s analysis, and the user’s feedback all need to incorporate a growing body of literature on healing spaces to create effective, efficient, and user-satisfying spaces.

The process of successfully incorporating theoretical concepts and ideas addressed in the literature into the specific design requirements of a project requires layers of interpretation and analysis in order to synthesize appropriate design solutions.

The Building Usability Evaluation Tool-Kit: The primary care clinic provides usability analysis tools to aid the designer, the researcher, and the building users to assess the usability of their built environment. This tool-kit specifically addresses the usability of primary care clinics; however, these same tools can also be applied or slightly modified to apply to other building typologies.

Introduction to the Usability Matrix

The Usability Matrix is an analytical tool designed to frame psychosocially supportive design terms within the three standard usability dimensions: 1) effectiveness, 2) efficiency, and 3) user satisfaction (ISO, 1998). Psychosocially supportive design terms are defined in the literature as forces that either negatively or positively impact the perception of stress caused by the environment and thus influence the healing taking place within the environment (Dilani, 2012). These terms were categorized under the usability dimensions of effectiveness (the success of design in addressing its functional requirements through details and specific design feature) or efficiency (the number of resources such as travel distances, square footage, number of personnel needed to perform the programmatic function).

In the matrix, the dimensions of effectiveness and efficiency multiply to create user satisfaction. The user satisfaction unit is subdivided into three additional subunits of physical comfort, social comfort, and psychological comfort. These units can further be divided by user type. The matrix shown for a primary care facility is divided into three user types: staff, patient, and visitor.

The Usability Matrix demands both critical thinking and creativity in order to be successfully used by both designers and researchers. Prior to using The Usability Matrix, one must understand the terms used in the matrix. A glossary is provided that cites and defines the psychosocially supportive design terms used in their original context from the literature. A strong foundation and grasp of the literature are key to the successful design implementation of usability.

BUILDING DESIGN USABILITY MATRIX

EFFICIENCY
The Primary Care Clinic

EFFECTIVENESS

- Adjacencies
- Furniture Arrangement
- Proximity to Circulation
- Circulation Alignment
- Flexibility
- Interconnectedness
- Plan Complexity
- Pathway Configuration
- Accessibility
- Prevention of Errors
- Signage

Stimulation

- Intensity
- Variety
- Complexity
- Mystery
- Novelty
- Noise
- Light
- Order
- Color
- Crowding
- Visual Exposure

Coherence

- Ledgibility
- Organization
- Thematic Structure
- Predictability
- Landmark
- Distinctiveness
- Exterior Vistas

Control

- Crowding
- Boundaries
- Climatic & Light Controls
- Spatial Hierarchy
- Territoriality
- Symbolism
- Responsiveness
- Privacy
- Navigation
- Functional Distances
- Focal Point
- Depth

Restoration

- Minimal Distraction
- Stimulus Shelter
- Attraction
- Solitude

USER SATISFACTION

	Staff	Patient	Visitor
Physical Comfort			
Psychological Comfort			
Social Comfort			

Notes

EFFECTIVENESS: Stimulation

Stimulation	<p>“Stimulation allows for freedom, movement, and a variety of experiences” (National Center for Education in Maternal and Child Health and Georgetown University). Insufficient environmental stimulation will enable an individual to seek stimulating activities and where there is excessive stimulation; the individual will restrict activity or engage in “monotonous routine patterns of activity in order to attenuate arousal “(Optimal Stimulation Theory) (Leuba, 1955).</p>
Intensity	<p>Intense environments are environments in which effects of stress negatively influence performance and tasks do not allow for "time out" (Teague & Park, 1996).</p>
Variety	<p>Variety is a number or range of things of the same general class that are different or distinct in character or quality (Merriam-Webster Inc., 2012).</p>
Complexity	<p>“Complexity is the "involvement" component at this surface level of analysis. Perhaps more appropriately referred to as "diversity" or "richness," this component was at one time thought to be the sole or at least the primary determinant of aesthetic reactions in general. Loosely speaking it reflects how much is "going on" in a particular scene, how much there is to look at. If there is very little going on -- as, for example, a scene consisting of an undifferentiated open field with horizon in the background -- then preference is likely to be low” (Kaplan, 1988).</p>
Mystery	<p>“Mystery. One of the most striking aspects of people's reaction to landscapes that suggests a three-dimensional interpretation is their preference for scenes where it appears as if one could see more if one were to "walk into" the scene a ways. Strong as this "involvement" component of the spatial interpretation has been, it has been frustratingly difficult to find a name for. We have decided on mystery, a term long ago used in the context of landscape architecture to refer to an essentially similar idea (Hubbard & Kimball, 1917). (Kaplan, 1988)”</p>
Novelty	<p>Novelty is a new or unfamiliar experience/environment.”. (Nikaido & Nakashima, 2009) Response to stress is higher in an unfamiliar environment than in a familiar environment. “Environmental novelty of an unfamiliar environment enhances these TMT-induced responses.” (Nikaido & Nakashima, 2009)</p>

EFFECTIVENS: Stimulation

Noise	“Noise is a loud unpleasant sound that can cause stress by elevated blood pressure and hearing loss.” Subjective effects of noise include interference with task performance and speech communication (Westman & Walters, 1981).
Light	Daylight has positive effects on humans’ psychological wellbeing. “A lack of daylight can lead to both physiological and psychological difficulties” (Dilani 2012). Luminosity (Stamps, 2007).
Odor	Oder is an environmental stimulus which "induces various emotional behavior; fear, anxiety, aversion, pleasure, pleasantness, relaxation and so on, and also induces the stress response of the hypothalamic–pituitary–adrenal (HPA) axis, resulting in increased circulating adrenocorticotrophic hormone (ACTH) and glucocorticoid (cortisol in human and corticosterone in rodents). Plant-derived odors, such as alpha-pinene, lavender and, lemon, grapefruit and green odor influence mammals. These plant-derived odors have the potential to be applied for therapy)” (Nikaido & Nakashima, 2009).
Color	“Colors can possibly affect the brain’s activity and create a sense of wellbeing and originality within architecture. Colors can also have symbolic value and in that way contribute to the building’s identity and/or cultural meaning (Dilani, 2012).”
Crowding	Crowding id “experienced when situational density forces the blocking of goals, the interruption of behaviors, or cognitive overload to occur”(Schmidt & Keating, 1979).
Visual Exposure	Visual exposure is "a measure of the visible portion of whatever is the focus of the investigation, whether the entire landscape or a set of features" (Llobera, 2003)

EFFECTIVENESS: Coherence

<p>Coherence</p>	<p>“Coherence is the "making sense" component at this surface level of analysis. It includes those factors which make the picture plane easier to organize, to comprehend, to structure. Coherence is strengthened by anything which makes it easier to organize the patterns of light and dark into a manageable number of major objects and/or areas. These include repeated elements and smooth textures that identify a "region" or area of the picture plane. Readily identifiable components aid in giving a sense of coherence. It is also important that a change in texture or bright-ness in the visual array is associated with something important going on in the scene. In other words, something that draws one's attention within the scene should turn out to be an important object or a boundary between regions or some other significant property. If what draws one's attention and what is worth looking at turn out to be different, then the scene lacks coherence” (Kaplan, 1988).</p>
<p>Legibility</p>	<p>“Legibility refers to the possibility of making sense within a three-dimensional space. Like mystery, legibility entails a promise, a prediction, but in this case not of the opportunity to learn but to function. It is concerned with interpreting the space, with finding one's way, and not trivially, with finding one's way back. Hence it deals with the structuring of space, with its differentiation, with its readability. It is like coherence but instead of dealing with the organization of the "picture plane" it deals with the organization of the ground plane, of the space that extends out from the foreground to the horizon. A highly legible scene is one that is easy to oversee and to form a cognitive map of. Hence legibility is greater when there is considerable apparent depth and a well-defined space. .. Another aspect of legibility involves the ease with which-one can perceive the space as divided up into subareas or regions. There is a strong parallel here to what makes a scene coherent, but coherence differs in referring to the organization of the visual array rather than to the three-dimensional space” (Kaplan, 1988).</p>
<p>Organization</p>	<p>Organization is “to arrange by systematic planning and united effort“(Merriam Webster Inc., 2012)</p>

EFFECTIVENESS: Coherence

<p>Thematic Structure</p>	<p>Thematic structure is a unifying concept or idea in which a design is assembled or organized.</p>
<p>Predictability</p>	<p>"Unpredictable or low control situations promote greater physiologic reactivity to acutely stressful events. Environments that are predictable or that afford opportunities to exert personal control may lead to self-regulatory activities characterized by such features as a future temporal orientation, long-term planning, and goal setting" (Aspinwall & Taylor, 1997). -associated with learnability and memorability</p>
<p>Landmark</p>	<p>"Landmarks are defined in physical space as having key characteristics that make them recognizable and memorable in the environment. Landmarks help to organize space because they are reference points in the environment. Characteristics of a landmark include: prominence of spatial location; accessibility; content meaning use or cultural significance, and prototypicality"(Sorrows & Hirtle 1999). "Distant landmarks (external landmarks) may be used to identify and location where as local landmarks (internal landmarks) may be used to assist navigation or wayfinding" (Lynch, 1960).</p>
<p>Distinctiveness</p>	<p>Environmental distinctions are cues in the physical environment of "personal or social self-categorizations that define one at work" or may describe "how one ranks" compared with others in a group (Brickson, 2000; Elsbach, 2003).</p>
<p>Exterior Vistas</p>	<p>"Designers can significantly improve the quality of the user's experience by choosing a predetermined parametric set of viewing parameters (vistas)" (Hanson , Wernert, & Hughes, 1997). "Vistas of 50 feet or more allow us to change our focal length, important to both eye health and comfort" (Nair & Feilding, 2005).</p>

EFFECTIVENESS: Control

Control	<p>"Personal control is not a simple psychological variable. Rather, it is a complex composite of different concepts: Averill (1973) has distinguished three primary categories of control: behavioral, cognitive, and decisional" (Schmidt & Keating, 1979).</p>
Crowding	<p>"Crowding is closely linked to social support and is often defined as the number of persons in a certain area or how much space every individual has received in a certain area (ibid.). Altman (1975) describes crowding as a condition where a person's private sphere is trespassed. If there is too much undesirable contact, an individual may experience a sense of crowding. On the other hand, if an individual experiences too little contact, there is a risk that he or she may feel lonely and isolated (ibid.). This balance between social interaction and desired loneliness can, according to Maxwell (2006), be regulated and achieved if one can control his or her own levels of social interaction" (Dilani, 2012).</p>
Boundaries	<p>Boundaries exist when a "setting has a high degree of spatial differentiation from other settings and therefore from other activities". Characteristics include: partially surrounding walls or partitions; bookcases, storage cabinets, or shelves used as partial dividers and able to be moved and changed as staff and children wish in order to accommodate varied group sizes; changes in levels, either the floor or the ceiling; changes in floor coverings or textures; hangings and placement of overhead lighting to define spaces; and implied boundaries suggested by the placement of columns, posts, or other strong visual elements, or the visual completion of space by the implied visual connection between wall stub ends [i.e. the Gestalt principle of pragnanz or, more specifically, the law of perceived closure of almost closed figures (Koffka, 1935; Moore, 1986)</p>
Climatic & Light Controls	<p>A setting allows for control of temperature and light levels in a space.</p>

EFFECTIVENESS: Control

<p>Spatial Hierarchy</p>	<p>“People divide the environment into subunits or categories, and that, once established, this chunking affects spatial judgment” (Allen 1981). A chunk is defined by its 'reference point'. “Properties that may make an environmental feature a reference point include perceptual or symbolic salience, frequent interaction with the feature, location near a decision point, or significance in a person's life. These 'personally most important features on a subject's cognitive map are expected to 'anchor' the secondary features, which in turn serve as anchors for features of lower significance, thus creating a hierarchy of anchor points” (Holding , 1992). “Evidence also suggests that clusters have consequences for performance in various tasks that require access to spatial information” (Hirtle & Jonides, 1985).</p>
<p>Territoriality</p>	<p>Territoriality is "one of several mechanisms used to close or open the self to social contact" Three types of territories are "defined by duration of occupancy and psychological centrality. Public territories, such as bus seats or city sidewalks, are least central and enduring; and primary territories, such as bedrooms and homes, are most central and enduring. In between are secondary territories, such as bars and certain neighborhoods, which are also often characterized by shared ownership among members of a group" (Altman, 1975; Brown & Altman, 1983).</p>
<p>Symbolism</p>	<p>There is a “human need to extend symbols such as social dominance, territory, and sexuality away from their bodies into the built environment. The emotional associations with such symbols may underlie aesthetic feelings” (Greenbie, 1982).</p>
<p>Responsive-ness</p>	<p>Responsiveness is “one's sensitivity or reply to the natural environment. Responsiveness is based on a individuals perception of perceived efforts and abilities, perceptions of control and perceived environmental values (Kelly,1996)</p>

EFFECTIVENESS: Control

<p>Privacy</p>	<p>“Privacy is a multifaceted thing. Lawyers stereotypically equate privacy with autonomy (being let alone). Psychologists stereotypically equate privacy with solitude (being apart from others). Technologists, economists, architects, and others stereotypically equate privacy with confidentiality (keeping secrets)”(Boyle & Geenberg, 2005).</p>
<p>Navigation</p>	<p>Navigation is “forming an understanding or representation of the environment and to plan routes to areas that are not in view” (Sorrows & Hirtle, 1999).</p>
<p>Functional Distances</p>	<p>"In environmental psychology, functional distance is the distance between two living quarters. In studies of the impact of physical environment on interpersonal behavior, functional distance represents the possibility for interaction between persons in any two residences” (Corsini, 2002).</p>
<p>Focal Point</p>	<p>Focal point is “a center of activity, interest, or attention” (Merriam Webster Inc., 2012)</p>
<p>Depth</p>	<p>“Depth of view has been related to judged enclosure” (Stamps, 2007). Safety and enclosure are functions if the ability to see possible danger. “Light has also been a strong predictor of judged enclosure and judged safety” (Stamps, 2007).</p>

EFFECTIVENS: Restoration

<p>Restoration</p>	<p>“Environment which helps people recover from mental fatigue. Restorative environments have a special connection to nature as natural environments play an essential role in human functioning” (Kaplan, 1992).</p>
<p>Minimal Distraction</p>	<p>“When faced with a difficult task, an environment with minimal distraction (closed eyes or blank screen) enables better performance in a variety of cognitive tasks than an environment with visual or auditory distractions” (Ex. Closing the eyes help people remember) (Vredeveltdt, Hitch, & Baddeley, 2011)</p>
<p>Stimulus Shelter</p>	<p>“Stimulus shelter is a mechanism that shields us from the barrage of information coming our way every minute. An individual is constantly bombarded by television, mobile phone calls, text messages, emails, social networking messages and the resultant multi-tasking puts a lot of pressure on the brain. In such a situation, concentration and focus is lost and the person has to devise a method to filter out the unimportant stimuli and retain the important ones, by building a stimulus shelter” (Arvind, 2009).</p>
<p>Attraction</p>	<p>"An attractive and supportive work environment can be described as an environment that attracts individuals into the health professions, encourages them to remain in the health workforce and enables them to perform effectively" (Wiskow & Pietro, 2010).</p>
<p>Solitude</p>	<p>Solitude is a “factor which enhances restoration when safety is controlled while company enhances restoration through its effect on safety” (Staats & Hartig, 2004).</p>

EFFICIENCY

Adjacencies	“An adjacency is a user groups' functional relationship requirements to all other user groups or among functional areas” (Pena & Parshall, 2001).
Furniture Arrangement	“An effective furniture layout must address both functional and visual criteria. The functional criteria evaluate how well the layout supports the human activities that take place in the space, such as conversation, rest, or movement. The visual criteria concern the perception of the layout as a visual composition. The primary visual rules of thumb used by interior designers are visual balance, alignment, and a dominant point of emphasis” (Merrell, Schkufza, Li, Agrawala, &Koltum, 2011).
Proximity to Circulation	Proximity to circulation is the nearness or vicinity to area of main traffic.
Circulation Alignment	Circulation is designed so that functional tasks are planned and arranged in an optimally efficient layout.
Flexibility	“Flexibility means the building can accommodate for grow or expansion (expandability), can allow for changes in function through the conversion of spaces (convertibility), and provides the most for the money through multi-functional spaces (versatility)” (Pena & Parshall, 2001).
Interconnecte dness	Interconnectedness is “having internal connections between the parts and elements” (MerriamWebster Inc., 2012).

EFFICIENCY

<p>Plan Complexity</p>	<p>Floor plan complexity is the “number of links and nodes a plan contains. Landmarks at nodes and vistas along links should be added to reduce plan complexity” (McCormick, 1996). “Plan configuration was found to exert a significant influence regardless of signage, because the wayfinding performance of participants with access to signage in the most complex settings remained equivalent to, or significantly poorer than, those in the simplest settings with no signage” (O'Neill, 1991).</p>
<p>Pathway Configuration</p>	<p>Pathway configuration or landmark placement is when distinctive landmarks are placed particularly at decision points to influence cognitive strategies for wayfinding (Lindberg 1984, Jones 1972, Heft 1979) Stress may interact with some physical variables to influence environmental cognition. Stress can both improve and decrease memory (Evans, 1984). Pathway elements may include: hallway width, protruding object in hallway, hallway steps, hallway ground type, hallway rise, clear floor, signage terminal nodes, corner nodes, decision nodes, escalator width, elevator size, elevator button, elevator door, stairway hand rail, stairway tread width (Karimi & Ghafourian, 2010).</p>
<p>Accessibility</p>	<p>Accessibility is the ease at which a first time visitor can find and enter the building/ designed area (Pena & Parshall, 2001).</p>
<p>Prevention of Errors</p>	<p>“A continuous improvement method that studies why and how errors occur and looks for ways to keep them from happening again” (Tooling University, 2012).</p>
<p>Signage</p>	<p>“Signage is commonly employed to enhance wayfinding efficiency, especially in buildings with complex floor plan configurations. Graphic signage produced the greatest rate of travel in all settings, but textual signage was the most effective in reducing wayfinding errors, such as wrong turns and backtracking” (O'Neill, 1991).</p>

Usability Matrix as a Design Tool for the Architect

A simple way a designer can use the matrix in his/her design development is to ask two questions: “To what degree is the effectiveness of the (effectiveness term in the y axis) in relation to (an efficiency term in the x axis) providing (physical/social/psychological) comfort to the (user type)?” and “How can the design feature be improved?” Depending on the design typology and context, some units in the matrix will be more applicable than others.

For example, when analyzing the usability of a waiting area, one may ask: “To what degree are the boundaries set by the waiting chair clusters (furniture arrangement) providing psychological or social comfort to the visitors and patients.” Through asking questions such as the example provided, the designer can use this tool as a think tank to organize and develop design concepts and strategies.

At the design development phase, it helps to note the functions of a particular area and its featuring design characteristics in the “Notes” section of the Usability Matrix. Specific design features connected to the psychosocially supportive design terms can also be written on the x and y axes. Because the design is a development in progress, this process may be more loosely structured the way in which a researcher might analyze an already existing building.

The Usability Matrix becomes an organization tool to allow the designer to clarify, refine, and further develop more effective, efficient, and user-satisfying designs. It helps the designer to continue to write about the design while using the Usability Matrix and color in units that are most applicable to the design. Analysis from the tool can then be directly applied to sketches and models in design development.

Building Usability Evaluation Tools for the Researcher: *Usability Observation Tool*

The Usability Matrix holds strong potential as an aid for researchers of the built environment. The researcher can use The Usability Matrix to analyze the usability of an existing building. By gathering some initial data in a behavioral observation and integrating this data within the Usability Matrix, the researcher can further analyze and assess the potential and merits of the built environment.

The initial data collection during the behavioral observation needs to grasp the systems and environment/behavior dynamics of the clinic environment. The provided Usability Observation Tool notes the objects within the environment, the tasks that occur with use of the objects, and the types of interactions that need to occur between people to perform these tasks. Additionally, the tool notes the spatial attributes of the behavioral patterns that coincide with the attributes. The Usability Observation Tool template and an example behavioral observation of a primary care waiting area are provided on the next page.

During the observation, The Usability Matrix can be used as a reference next to The Usability Observation Tool. This allows the researcher to be in the space and be able to connect back to the literature at the same time to ensure all necessary information is observed and collected for further analysis.

Check-in/ Waiting Area of a Primary Care Clinic

Objects	Tasks	Interaction	Spatial Attributes & Noted Behaviors
Children's corner	Wait	CMA calls out patients name	<ul style="list-style-type: none"> • Patients desire to be spread out. • Patients will also use the chair next to theirs. • Adults sit in seating that has strong visibility to the children's area. • HIPPA walls need to be able to provide privacy and still provide visibility to the MOA at the front desk.
Seating	Play		<ul style="list-style-type: none"> • Child size seating available
Double Seating	Read		<ul style="list-style-type: none"> • Area for magazine s or purse
Computer desk			
Other seating clusters			<ul style="list-style-type: none"> • Patients will first disperse in each individual cluster then fill in the spaces.

Objects	Tasks	Interaction	Spatial Attributes & Noted Behaviors

Building Usability Evaluation Tools for the Researcher: *Coding Analysis Table*

After the behavioral observation, it is helpful if the researcher codes the “spatial attributes and noted behaviors” section under the usability dimensions: effectiveness, efficiency, and user satisfaction. The categorization allows the spatial needs of each observed task to be viewed from three different usability angles.

An example of a Coding Analysis Table that considers the check-in/waiting area of a primary care clinic and a Coding Analysis Table template are provided in the following pages. When classifying the collected data, the researcher may find that more information can be described about the space than what was directly observed and written down. The Coding Analysis Tools can help the researcher start to fill in usability blanks that were left without comments during the observation. Also please note that the analysis is still in its initial stages and a particular observation may seem like it could fit in more than one category. This is because the information needs more dissection.

Effectiveness

Efficiency

User
Satisfaction

Tasks	Ergonomic and Design Details	Travel Distances , Access, and spatial needs	Mental, Physical & Social Comfort
General waiting	Counter top tall enough	Central edge or corner location	Provide privacy, personal space, and security HIPAA Wall dividing space and providing privacy.
Elderly Patients waiting		Easy access exam rooms	Larger seating for comfort and space
Children waiting	Children's corner does not have toys that can potentially spread infections	Enough space for children to move around, when desired	Children's corner has strong visibility to parent seating and MA
Parents waiting		Seated close to children's corner	
New Patients waiting	No Space for paperwork along with computer		
MOA attending Patient/Visitor	Space for paperwork	Location of fax machine in distance unlike insurance card scanner	Floor height, or chair height For visibility to patients HIPAA wall should not reduce MA visibility
CMA attending	Electronic check in?	More than one utilized entry from exam room area to waiting space	Welcome



Tasks	Ergonomic and Design Details	Travel Distances , Access, and spatial needs	Mental, Physical & Social Comfort

Building Usability Evaluation Tools for the Researcher: *Usability Matrix*

After the collected data have gone through an initial coding and analysis, the information is ready to be further analyzed in the Usability Matrix. Each level of analysis yields more and more criteria in design analysis. The Coding Analysis Table provides baseline criteria to develop as customized by the usability dimensions within the specific design parameters of the area being observed. By writing in these design features next to the psychosocially supportive design terms in the x and y axes, the Usability Matrix can then restructure itself to adapt to the specific design qualities, providing an all-encompassing usability checklist for the researcher. Please see an example Usability Matrix that analyzes the primary care clinic waiting area (next page).

Similar to how a designer uses the Usability Matrix, the researcher can incorporate the gathered data into the matrix by asking similar questions about the design, such as, “To what degree is the effectiveness of the (effectiveness term in the y axis) in relation to (an efficiency term in the x axis) providing (physical/social/psychological) comfort of the (user type)?” Or “How may this design feature impact the users?”

As these questions are thought out and written, this complex analysis can be visualized in the Usability Matrix by coloring in areas where the design issues are applicable, leaving blank units where a design feature is not relevant to that particular design (*please see example on next page*). Questions addressing the success or failure to the applicable areas can be evaluated later by constructing a User’s Survey.

Check in
Waiting
Area

		BUILDING DESIGN USABILITY MATRIX										
		Adjacency	Furniture Arrangement	Proximity to Circulation	Circulation Alignment	Flexibility	Interconnectiveness	Plan Complexity	Pathway Configuration	Accessibility	Prevention of Errors	Gigage
Clean	Stimulation											
	Intensity											
	Variety											
	Complexity											
	Mystery											
	Novelty											
	Noise											
	Light											
	Order											
	Color											
	Crowding											
	children's corner	Visual Exposure										
Coherence												
Ledgibility												
Organization												
Thematic Structure												
Predictability												
Landmark												
Distinctiveness												
Exterior Vistas												
Control												
Crowding												
walls		Boundaries										
	Climatic & Light Controls											
	Spatial Hierarchy											
seating clusters	Territoriality											
	Symbolism											
	Responsiveness											
	Privacy											
	Navigation											
	Functional Distances											
	Focal Point											
	Depth											
	Restoration											
	Minimal Distraction											
Stimulus Shelter												
Attraction												
Solitude												

USER SATISFACTION

	Staff	Patient	Visitor
Physical Comfort			
Psychological Comfort			
Social Comfort			

Notes

Waiting Area and Check in
Clusters of seating divide the room.

Two thick walls provide visual and acoustical privacy.

Privacy should not limit Medical Office Assistant visibility to patients.

Patients try to spread out as much as possible taking the cluster concept to their advantage.

Wider seating for patients is available for people who may need more room.

Place for personal items.
Children's seating area needs adequate visual access to parents' seating.

Printer scanner needs to be in close approximation to Medical Office Assistant.

When patients have to fill out long forms there is adequate space allocated for them to sit down comfortable and fill it out.

Adequate space is provided around the check in area for privacy and easy patient flow.

User's Survey: The Primary Care Clinic

The researcher can further develop his/her study by collecting information about the design from the users themselves. In order to do this, the information collected needs to be framed in jargon that can be understandable to the end user.

The following survey was developed using the previous introduced behavior observation tools and Usability Matrix for a primary care clinic. The survey is designed for the end users who spend most of their day “using the building”—the *staff*.

End users have greatest understanding of the success of a design's usability. The survey provides a comprehensive assessment of the usability of a primary care clinic. The survey is partially based on the ASPECT (A Staff and Patient environment Calibration Tool) tool. This tool was developed by the Department of Health in the United Kingdom to assess healthcare settings. The survey in the Usability Tool-Kit, however, is designed to specifically address primary care clinics.

“You can never solve a problem on the level on which it was created” (Albert Einstein). The Usability Tool-Kit is designed to get the investigator to think about the design that he/she is analyzing on different levels. New and exciting paths in design research can be paved by forcing oneself to apply all the issues being discussing in environmental psychology to a specific design problem.

Building Usability Evaluation for A Primary Care Clinic

Dear Clinic Staff,

Please consider taking 20-30 minutes to participate in this voluntary survey to assess the usability of your work environment. Your feedback is a critical step to create a working dialogue between healthcare planners and the people who uses and operate the facility day-to-day. Your input can help plan, renovate, or construct improved primary care delivery systems.

Thank you once again for your time and consideration!

Check-in And Waiting

Strongly Disagree Somewhat Disagree Neither Agree nor Disagree Somewhat Agree Strongly Agree

Stimulation

1	The waiting area provides a variety of seating for the patients.	1	2	3	4	5
2	The waiting area provides a variety of positive distractions (magazines, TV., music, toys).	1	2	3	4	5
3	Patients feel they can spread out in different areas when they come in the waiting area.	1	2	3	4	5
4	Medical Office Assistant has strong visibility to all corners of the waiting area.	1	2	3	4	5
5	Medical Office Assistant has visibility to all seating in waiting area (especially children's area).	1	2	3	4	5
6	Adequate seating is provided for parents in close proximity to children's area.	1	2	3	4	5
7	Appropriate art and decorations are used on walls.	1	2	3	4	5
8	The waiting area design minimizes unwanted noise.	1	2	3	4	5
9	Adequate lighting is provided for psychological comfort and task performance.	1	2	3	4	5
10	The waiting area is hardly ever cramped and crowded.	1	2	3	4	5
11	The color palette, textures, and views in the waiting area are pleasing.	1	2	3	4	5
12	The waiting area has no odor when you enter.	1	2	3	4	5

Check-in And Waiting		Strongly Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Strongly Agree
Coherence						
13	Circulation space and waiting space are easily distinguished in waiting area design.	1	2	3	4	5
14	The check in area is easily visible and recognized upon entrance.	1	2	3	4	5
15	Pathway to check-in area upon entrance is clear.	1	2	3	4	5
16	Appropriate signage is used if needed.	1	2	3	4	5
17	A computer area and internet access is available to patients and visitor who seek additional information in close proximity to sign in area.	1	2	3	4	5
18	Medical Office Assistant at front desk has a printer/scanner placed in a convenient easy to access location.	1	2	3	4	5
Control						
19	Patients are provided comfortable seating and ample desk space to write if required to fill out new patient forms.	1	2	3	4	5
20	Waiting area provides enough personal space between seated individuals.	1	2	3	4	5
21	Patients signing in are provided with adequate privacy if patients are behind one another in a line.	1	2	3	4	5
22	Adequate distance is provided between check in counter and circulation space.	1	2	3	4	5
23	HIPAA walls or boundaries between the waiting and check-in space (if there) help provide privacy to patients.	1	2	3	4	5
24	The waiting area provides a caring and reassuring atmosphere.	1	2	3	4	5

Check-in And Waiting

Strongly Disagree Somewhat Disagree Neither Agree nor Disagree Somewhat Agree Strongly Agree

Control

25	Clustering seats in the waiting area helps Medical Office Assistant monitor patients.	1	2	3	4	5
26	Clustering seats in the waiting area helps patients make the large space more easy to understand upon entrance.	1	2	3	4	5
27	Patients and visitors have a place to keep personal items close to them.	1	2	3	4	5

Restoration

28	The patients have a pleasant view of nature from windows, interior foliage, and in artwork from their seating.	1	2	3	4	5
29	Patients have access to usable landscaped areas.	1	2	3	4	5
30	Patients feel safe in the waiting area.	1	2	3	4	5

Is there anything else you would add or change in the check-in and waiting area if you could?

Exam Room		Strongly	Somewhat	Neither	Somewhat	Strongly
		Disagree	Disagree	Agree nor Disagree	Agree	Agree
Stimulation						
1	The ceiling design is pleasant interesting.	1	2	3	4	5
2	The examination room looks clean.	1	2	3	4	5
3	Adequate lighting is provided for psychological comfort and task performance.	1	2	3	4	5
4	Appropriate art and decorations are used on walls.	1	2	3	4	5
5	A chair designated to note vitals is placed within close proximity to computer desk with computer screen, glove compartment, and trash bin/biohazardous trash bin.	1	2	3	4	5
6	It may be overwhelming for the patient to see all the equipment/ gadgets in the examination room.	1	2	3	4	5
7	*The examination room design minimizes unwanted noise.	1	2	3	4	5
8	Patients are able to see information being discussed by their provider on a screen.	1	2	3	4	5
Coherence						
9	Examination rooms are standardized modules.	1	2	3	4	5
10	EKG machines are easily accessible when needed.	1	2	3	4	5
11	Medical supplies and gadgets are stored in labeled cabinets.	1	2	3	4	5
Control						
12	*Patients and visitors have an area to hang/place personal items.	1	2	3	4	5
13	Examination room opens inward hiding the patient exam chair to maximize privacy.	1	2	3	4	5
14	Exam room is not situated directly across major areas of traffic flow.	1	2	3	4	5
15	The exam room is large enough to accommodate all tasks.	1	2	3	4	5

* Indicates a statement is used from A Staff and Patient Calibration Tool (ASPECT), a questionnaire developed by the Department of Health in the United Kingdom.

Exam Room		Strongly Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Strongly Agree
Control						
16	Patients and staff can easily control exam room temperature.	1	2	3	4	5
17	Patients and staff can easily exclude daylight in the exam room.	1	2	3	4	5
18	Patients and staff can easily control artificial lighting.	1	2	3	4	5
19	Family members accompanying patients in the exam room are able to be seated.	1	2	3	4	5
20	The exam rooms gets crowded when family members are in the exam room with the patient.	1	2	3	4	5
21	The focal point of the area is the art not the medical supplies and gadgets in the room.	1	2	3	4	5
22	Procedure room provides a caring and reassuring atmosphere.	1	2	3	4	5
23	Staff has easy visibility and access to a hand washing sink.	1	2	3	4	5
Restoration						
24	The provider, Registered Nurse or Certified Medical Assistant is able to concentrate on performing tasks when more than one visitor is accompanying the patient.	1	2	3	4	5
25	The examination room has pleasant views of nature and/or scenic painting/photography.	1	2	3	4	5

Is there anything else you would add or change in exam room if you could?

Procedure Room		Strongly Disagree	Somewhat Disagree	Neither	Somewhat Agree	Strongly Agree
				Agree nor Disagree		
Stimulation						
1	*The ceiling design is pleasant and interesting.	1	2	3	4	5
3	The procedure room looks clean.	1	2	3	4	5
4	Adequate lighting is provided for psychological comfort and task performance.	1	2	3	4	5
5	Appropriate art and decorations are used on walls.	1	2	3	4	5
6	It may be overwhelming for the patient to see all the equipment/ gadgets in the procedure room.	1	2	3	4	5
7	*The procedure room design minimizes unwanted noise.	1	2	3	4	5
Coherence						
8	Medical supplies and gadgets are stored in labeled cabinets.	1	2	3	4	5
9	Storage shelf spacing allows maximum storage.	1	2	3	4	5
10	The procedure room is centrally located to provide efficient navigation to all staff.	1	2	3	4	5
11	The procedure room is located in close proximity to lab area.	1	2	3	4	5
Control						
12	Adequate lighting control is provided to be able to perform minor surgeries in the room.	1	2	3	4	5
13	*Patients and visitors have an area to hang/place personal items.	1	2	3	4	5
14	Procedure room opens inward hiding the patient's exam chair to maximize privacy.	1	2	3	4	5

* Indicates a statement is used from A Staff and Patient Environment Calibration Tool (ASPECT), a questionnaire developed by the Department of Health in the United Kingdom.

Procedure Room		Strongly Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Strongly Agree
Control						
15	Procedure room is not situated directly across major areas of traffic flow.	1	2	3	4	5
16	The procedure room is large enough to accommodate all tasks.	1	2	3	4	5
17	Patients and staff can easily control exam room temperature.	1	2	3	4	5
18	There is enough space around the examination chair to have a Certified Medical Assistant and provider work together using the procedure tray/cart with necessary supplies, and with bio hazardous waste disposal and trash can within reach of the provider.	1	2	3	4	5
19	*Procedure room provides a caring and reassuring atmosphere.	1	2	3	4	5
20	The focal point of the area is the art not the medical supplies and gadgets in the room.	1	2	3	4	5
21	Staff has easy visibility and access to hand washing sink.	1	2	3	4	5
Restoration						
22	The examination room has a pleasant view of nature on a walls visible from the exam chair.	1	2	3	4	5

* Indicates a statement is used from A Staff and Patient Environment Calibration Tool (ASPECT), a questionnaire developed by the Department of Health in the United Kingdom.

Is there anything else you would add or change in procedure room if you could?

Lab Area		Strongly	Somewhat	Neither	Somewhat	Strongly
		Disagree	Disagree	Agree nor Disagree	Agree	Agree
Stimulation						
1	The lab area looks clean.	1	2	3	4	5
2	Adequate lighting is provided for psychological comfort and task performance.	1	2	3	4	5
3	Appropriate art and decorations are used on walls.	1	2	3	4	5
4	*The lab area design minimizes unwanted noise.	1	2	3	4	5
5	The surrounding objects (sharps box, blood tubes, and bio-hazardous waste bin) are positioned so they do not overwhelm the patients.	1	2	3	4	5
6	Adequate lighting and lighting control is provided to be able to perform minor surgeries in the room.	1	2	3	4	5
Coherence						
7	Medical Office Assistant has a designated convenient location to place lab slips for the lab tech.	1	2	3	4	5
8	Staff circulation and patient/visitor circulation is legible in layout and/or floor pattern.	1	2	3	4	5
9	A computer station and fax machine is located in close proximity to area where lab slips are dropped off.	1	2	3	4	5
10	There is enough counter space to organize all the lab slips.	1	2	3	4	5
11	The lab area is easily identifiable by patients and staff.	1	2	3	4	5
12	The lab area looks neat and organized.	1	2	3	4	5
13	A usable waiting area for patients is available in close proximity to lab.	1	2	3	4	5

* Indicates a statement is used from A Staff and Patient Environment Calibration Tool (ASPECT), a questionnaire developed by the Department of Health in the United Kingdom.

Lab Area		Strongly	Somewhat	Neither	Somewhat	Strongly
		Disagree	Disagree	Agree nor Disagree	Agree	Agree
Control						
14	The lab area is located in close proximity to bathrooms.	1	2	3	4	5
15	*Toilets/bathrooms are located logically, conveniently and discretely	1	2	3	4	5
16	*Bathrooms have seats, handrails,, non-slip flooring, a shelf, for toiletries and somewhere to hang cloths within easy reach.	1	2	3	4	5
17	The lab area is centrally located in the clinic providing easy access to both patients and staff.	1	2	3	4	5
18	The lab tech is able to navigate around the lab area efficiently.	1	2	3	4	5
19	Lab area provides a caring and reassuring atmosphere.	1	2	3	4	5
20	The patients chair in the lab room does not overwhelm or confine the patient.	1	2	3	4	5
21	The focal point of the area is the art not the medical supplies and gadgets in the room.	1	2	3	4	5
22	Patients and visitors have an area to hang/place personal items.	1	2	3	4	5
Restoration						
23	A pleasant view of nature/art is positioned so that is clearly visible to the patient is the lab rooms chair.	1	2	3	4	5
24	A usable waiting area for patients is available in close proximity to lab.	1	2	3	4	5

* Indicates a statement is used from A Patients and Staff Environment Calibration Tool (ASPECT), a questionnaire developed by the Department of Health in the United Kingdom.

Is there anything else you would add or change in the lab area if you could?

Check-out Area		Strongly Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Strongly Agree
Stimulation						
1	Check-out area is visible from exam rooms.	1	2	3	4	5
2	The color palette and textures used for the check out area are pleasing.	1	2	3	4	5
3	Check-out area is in an area of major traffic flow.	1	2	3	4	5
4	Adequate lighting is provided for psychological comfort and task performance.	1	2	3	4	5
5	Appropriate art and decorations are used.	1	2	3	4	5
6	Countertop have varying heights for visibility and patient choice.	1	2	3	4	5
Coherence						
7	The check-out areas are easily recognizable.	1	2	3	4	5
8	If there are multiple check out locations, each location has certain distinct characteristics.	1	2	3	4	5
9	The hallway is easily distinguished from the check-out area.	1	2	3	4	5

Check-Out Area		Strongly Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Strongly Agree
Control						
10	The check-out area provides privacy to patients.	1	2	3	4	5
11	The check-out station often gets crowded.	1	2	3	4	5
12	It is easy to navigate out of the building after check-out.	1	2	3	4	5
Restoration						
13	* Patients and staff can easily see plants vegetation and nature from the check out area.	1	2	3	4	5

* Indicates a statement is used from A Staff and Patient Environment Calibration Tool (ASPECT), a questionnaire developed by the Department of Health in the United Kingdom.

Is there anything else you would add or change in the check out area if you could?

Workstations and Offices		Strongly	Somewhat	Neither	Somewhat	Strongly
		Disagree	Disagree	Agree nor Disagree	Agree	Agree
Stimulation						
1	Area around offices can get noisy.	1	2	3	4	5
2	Workstation area is noisy.	1	2	3	4	5
3	Appropriate art and decorations are used on walls.	1	2	3	4	5
4	Work stations and offices look neat and clean.	1	2	3	4	5
5	Staff are easily visible from their work stations.	1	2	3	4	5
Coherence						
6	Work stations and offices are adequately sized.	1	2	3	4	5
7	Work stations have enough storage areas for effective organization.	1	2	3	4	5
8	All staff area are interconnected as much as possible for effective face to face communication.	1	2	3	4	5
Control						
9	Work stations and offices have designated locations for drop off items on desk.	1	2	3	4	5
10	Providers are able to personalize their office space.	1	2	3	4	5
11	Providers can use office space to discuss private information with a patient.	1	2	3	4	5
12	Office and work stations are in close proximity to exam rooms.	1	2	3	4	5
Restoration						
13	Providers can use their office space to contemplate or be alone.	1	2	3	4	5
14	Staff have a private break area in close proximity to their work stations.	1	2	3	4	5
15	Office and work stations have pleasant views to the outside.	1	2	3	4	5

Is there anything else you would add or change about the workstation or office design if you could?

Storage	Strongly Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Strongly Agree
Stimulation					
16 Storage areas are located away from main patient traffic areas.	1	2	3	4	5
17 Storage areas look neat and clean	1	2	3	4	5
Coherence					
18 Storage areas are labled and categorized.	1	2	3	4	5
19 Shelving in the storage areas are appropriatly space to maximize capacity (no more than 8").	1	2	3	4	5
Control					
20 The storage area are easily accessible to Certified Medical Assistants and RNs.	1	2	3	4	5
21 All supplies in storage areas are within reach of staff.	1	2	3	4	5

Is there anything else you would add or change about the storage areas if you could?

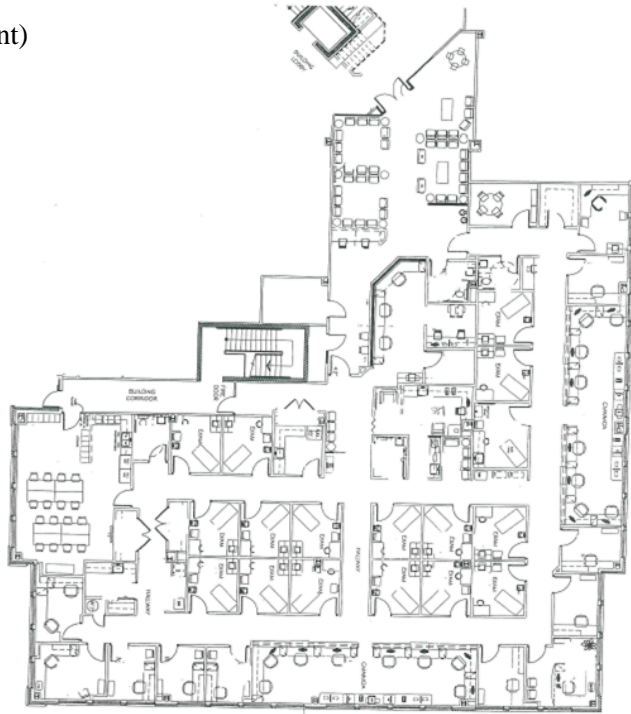
Overall Building Layout		Strongly Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Strongly Agree
Stimulation						
1	The design effectively distributes available daylight into appropriate locations.	1	2	3	4	5
2	*The building is interesting to look at.	1	2	3	4	5
3	*The building has a caring and reassuring appearance.	1	2	3	4	5
4	*Entrances to the building are obvious.	1	2	3	4	5
5	*It is easy to understand how the building is laid out from the exterior.	1	2	3	4	5
Coherence						
6	Exterior entrance and landscape are inviting and easy to locate from parking area and or bus stop.	1	2	3	4	5
7	*There is a logical hierarchy of spaces.	1	2	3	4	5
8	*Different part of the building have different characteristics.	1	2	3	4	5
9	*When you leave the building the way out is obvious.	1	2	3	4	5
10	Appropriate landmarks and signage are placed.	1	2	3	4	5
Control						
11	Layout minimizes turns along patient routes for easy navigation.	1	2	3	4	5
12	Rooms, office spaces and other programmatic elements are sized to be flexible spaces if required.	1	2	3	4	5
13	Building is designed to be able to expand in the future if needed.	1	2	3	4	5
Restoration						
14	Patients and staff have a landscaped area to relax and enjoy nature.	1	2	3	4	5

* Indicates a statement is used from A Staff and Patient Environment Calibration Tool (ASPECT), a questionnaire developed by the Department of Health in the United Kingdom.

I am a _____

Please indicate where you work most often in the plan provided below.

- CMA (Certified Medical Assistant)
- MOA (Medical Office Assistant)
- MA (Medical Assistant)
- Physician
- Physician's Assistant
- Nurse Practitioner
- Registered Nurse



If there are any other comments you would like to add, feel free to write in the space below.

Directions for Future Research

There is still much more that needs to be investigated to address the topic of building usability. It is important to always try new paths. Each new design inquiry has the potential of offering something new to the table. The User's Survey in this tool-kit takes the staff's perspective. A patient's survey can also be developed with some further analysis. Usability analysis of other building typologies can also be developed by using this toolkit as a guideline.

Furthermore, there is room for more development in the theoretical framework design. This study introduces a broad range of topics. Each psychosocially supportive design term can be further investigated in more depth. Creating standard graphic and representational techniques for these terms will further assist designers and researchers in their analyses.

It is important to be constantly thinking of new and innovate ways to apply the concepts addressed in this thesis to a design; as Albert Einstein once said, "Imagination is more important than knowledge."

REFERENCES

- Allen, G. L. (1981). A developmental perspective on the effects of "subdividing" macrospatial experience. *Journal of Experimental Psychology: Human Learning and Memory*, 7(2), 120.
- Altman, I. (1975). *Environment and Social Behavior: Privacy, Personal Space, Territory, and Crowding*. Monterey, Ca.: Brooks/Cole.
- Arvind, M. (2009). What is a Stimulus Shelter? Retrieved 7-8, 2010, from http://articles.timesofindia.indiatimes.com/2009-05-10/open-space/28164195_1_messages-networking-mobile-phone
- Aspinwall, L. G., & Taylor, S. E. (1997). A stitch in time: self-regulation and proactive coping. *Psychological Bulletin*, 121(3), 417.
- Averill, J. R. (1973). Personal control over aversive stimuli and its relationship to stress. *Psychological Bulletin*, 80(4), 286.
- Boyle, M., & Greenberg, S. (2005). The language of privacy: learning from video media space analysis and design. *ACM Trans. Comput.-Hum. Interact.*, 12(2), 328-370. doi: 10.1145/1067860.1067868
- Brickson, S. (2000). The impact of identity orientation on individual and organizational outcomes in demographically diverse settings." *Academy of Management Review*(25), 82-101.
- Brown, B., & Altman, I. (1983). Territoriality, defensible space and residential burglary: An environmental analysis. *Journal of Environmental Psychology*, 3(3), 203-220. doi: 10.1016/s0272-4944(83)80001-2
- Corsini, R. (2002). *The Dictionary of Psychology* New York, NY: Brunner-Routledge.
- Dilani, A. (2012). Psychosocially supportive design, from <http://www.worldhealthdesign.com/Psychosocially-Supportive-Design.aspx>
- Elsbach, K. D. (2003). Relating physical environment to self-categorizations: identity threat and affirmation in a non-territorial office space. *Administrative Science Quarterly*, 48(4), 622-654.

- Evans, G. W., Skorpanich, M. A., Gärling, T., Bryant, K. J., & Bresolin, B. (1984). The effects of pathway configuration, landmarks and stress on environmental cognition. *Journal of Environmental Psychology*, 4(4), 323-335.
- Greenbie, B. B. (1982). Atavistic social symbolism in aesthetic response to the built environment. *EDRA: Environmental Design Research Association*, 13, 166-171.
- Hanson, A. J., Wernert, E. A., & Hughes, S. B. (1997). *Constrained navigation environments*. Paper presented at the Scientific Visualization Conference, Dagstuhl Seminar. Germany.
- Heft, H. (1997). The relevance of Gibson's ecological approach to perception for environment-behavior studies. *Advances in environment, behavior, and design*, 4, 71-108.
- Hirtle, S., & Jonides, J. (1985). Evidence of hierarchies in cognitive maps. *Memory & Cognition*, 13(3), 208-217. doi: 10.3758/bf03197683
- Holding, C. S. (1992). Clusters and reference points in cognitive representations of the environment. *Journal of Environmental Psychology*, 12(1), 45-55.
- Hubbard, H. V., & Kimball, T. (1917). *An Introduction to the Study of Landscape Architecture*: New York: Macmillan.
- ISO. (1998). ISO 9241-11: Ergonomic requirements for office work with visual display terminals (VDTs): Part 11: Guidance on usability. *International Organization for Standardization*. Retrieved from www.it.uu.se/edu/course/homepage/acsd/vt09/ISO9241part11.pdf
- Jones, M. M. (1972). Urban path-choosing behavior: A study in environmental clues. *Environmental Design: Research and Practice*, 3.
- Kaplan. (1988). Perception and landscape: Conceptions and misconceptions *Environmental aesthetics: Theory, research, and applications* (pp. 45-55). New York, NY, US: Cambridge University Press.
- Kaplan. (1992). *The Restorative Environment: Nature and Human Experience* The Role of Horti in Horticulture on Human Well-Being and Social Development (pp. 134-142). Portland, OR: Timber Press. Retrieved from www.courses.washington.edu/esrm200/Kaplan_Restorative_1992.pdf.

- Karimi, H. A., & Ghafourian, M. (2010). Indoor routing for individuals with special needs and preferences. [Article]. *Transactions in GIS*, 14(3), 299-329. doi: 10.1111/j.1467-9671.2010.01198.x
- Kelly, C. M. (1996). *Understanding our sensitivity to the natural environment: An initial theory of the nature of environmental responsiveness*. (Ph.D. 9707627), University of Maryland College Park, Maryland. Retrieved from <http://lib-ezproxy.tamu.edu:2048/login?url=http://search.proquest.com/docview/304314936?accountid=7082> ProQuest Dissertations & Theses (PQDT) database.
- Koffka, K. (1935). Principles of Gestalt psychology.
- Leuba, C. (1955). Toward some integration of learning theories: the concept of optimal stimulation. *Psychological Reports*, 1, 27-33.
- Llobera, M. (2003). Extending GIS-based visual analysis: the concept of visualsapes. *International Journal of Geographical Information Science*, 17(1), 25.
- Lynch, K. (1960). *The Image of the City USA*: MIT Press.
- Maxwell, L. E. (2006). Crowding, class size and school size. *Frumkin, H., Geller, R.J.*
- McCormick, M. S. (1996). *How to get there from here: wayfinding in complex environments*. (Ph.D), Texas A&M University College Station, TX.
- Merrell, P., Schkufza, E., Li, Z., Agrawala, A. M., & Koltun, A. V. (2011). Interactive furniture layout using interior design guidelines. *ACM Trans. Graph*, 30(4), 1-10.
- Merriam Webster Inc. (Ed.) (2012) Merriam Webster Dictionary.
- Moore, G. T. (1986). Effects of the spatial definition of behavior settings on children's behavior: A quasi-experimental field study. *Journal of Environmental Psychology*, 6(3), 205-231. doi: 10.1016/s0272-4944(86)80023-8
- Nair, P., & Fielding, R. (2005). *The language of design: design patterns for the 21st century USA*: DesignShare.

- Nikaido, Y., & Nakashima, T. (2009). Effects of environmental novelty on fear-related behavior and stress responses of rats to emotionally relevant odors. *Behavioural Brain Research*, 199(2), 241-246. doi: 10.1016/j.bbr.2008.11.043
- O'Neill, M. J. (1991). Effects of signage and floor plan configuration on wayfinding accuracy. *Environment and Behavior*, 23(5), 553-574. doi: 10.1177/0013916591235002
- Pena, W. M., & Parshall, S. A. (2001). *Fourth Edition: Problem Seeking An Architectural Programming Primer*. New York John Wiley & Sons.
- Schmidt, D. E., & Keating, J. P. (1979). Human crowding and personal control: An integration of the research. *Psychological Bulletin*, 86(4), 680-700. doi: 10.1037/0033-2909.86.4.680
- Sorrows, M., & Hirtle, S. (1999). The Nature of Landmarks for Real and Electronic Spaces Spatial Information Theory In C. Freksa & D. Mark (Eds.), *Cognitive and Computational Foundations of Geographic Information Science* (Vol. 1661, pp. 748-748): Springer Berlin / Heidelberg.
- Staats, H., & Hartig, T. (2004). Alone or with a friend: a social context for psychological restoration and environmental preferences. *Journal of Environmental Psychology*, 24(2), 199-211. doi: 10.1016/j.jenvp.2003.12.005
- Stamps, A. E. (2007). Mystery of environmental mystery. *Environment and Behavior*, 39(2), 165-197. doi: 10.1177/0013916506288053
- Teague, R., & Park, O.-C. (1996). Environmental intensity, stress, and training. Retrieved from www.dtic.mil/cgi-bin/GetTRDoc?AD%3DADA310297
- Tooling University. (2012). What is the definition of error prevention? , 6/28/2012, from <http://www.toolingu.com/definition-900160-11823-error-prevention.html>
- Vredeveltd, A., Hitch, G., & Baddeley, A. (2011). Eye closure helps memory by reducing cognitive load and enhancing visualisation. *Memory & Cognition*, 39(7), 1253-1263.
- Westman, W. (1981). Noise and stress: a comprehensive approach. *Environmental Health Perspectives*, 41, 291-309.
- Wiskow, & Pietro. (2010). How to create an attractive and supportive working environment for health professionals. Retrieved from www.euro.who.int/_data/assets/pdf_file/0018/.../e94293.pdf