the optimum level of arousal in architecture

a study of the effects of the complex built environment
Composed

by

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may, 1988
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PREFACE

Architecture is considered a social art form, which means the function of the form affects the occupant. This type of statement suggests two unique aspects about architecture. The first being the concept of social art, while the second question confronts the interpretation of functionality.

The theory of social art describes the idea that forms within architecture relate to society. This simple statement does not suggest that the public actually designs the architecture, but that the public is the "giver" of ideas or formulas for environmental manipulation. The architect is merely the interpreter of these ideas. The architect is not to become the interpreter only, but become the translator of these simple concepts. This means that the architect does produce architecture that is only a duplication of the ideas, but rather the forms need are developed from the idea that our built environment is a significant, contributing factor in the psychological well-being of the individual. This view of what architecture contributes to society leads to the re-interpretation of the term functionalism.

The concept of functionalism in architecture is actually a misconceived concept. For a piece of architecture to be truly functional, it would need to solve the pragmatic, as well as the philosophical and psychological issues. This type of differentiation would include a few, very scattered pieces of architecture through history. For example, the St. Peters Cathedral expresses the religious and philosophical, which support the psychological aspects of the observer. Unfortunately, the cathedral does not present a pleasant temperature setting for some individuals. This is the pragmatic problem of the piece. One can select others, such as Ronchamp, that seem to have a familiar socialistic contribution. Functionalism now becomes a goal for one to produce architecture by, the resolution of the aforementioned tangible and intangible problems. This concept of designing architecture or rather doing environmental design evolved into the thesis of this book.

The theories that are evaluated in this book, are completed by using an expanded range of philosophical bases. The primary study revolved around the understanding of human behavior. The study of human behavior exists within the study of psychology. The reason for the use of such a diverse background helps the reader to become aware of the reasons behind environmental design. The architect is created from the results of this study.
ABSTRACT

Before describing what is needed to produce arousal and want type of arousal is being described, we need to produce a theory on how people look at the environment. The strongest theory that most environmental psychologists use concerning the observer of the environment, believes that the occupant of a place is active in seeking out his or her own source of constant stimulation. This says that a person will not just passively pass through a place, but that they will be affected by the place. One can go further and make a judgement by saying that the occupant of a place needs environmental stimulation and that they need it in a constant non-patterned way. Meaning that once the occupant has seen a certain stimulus (built form), that they need a new or more complex form or arrangement. This concept leads itself to another theory known as the level of adaptation theory. This theory explains why a person within an environment is not stimulated or not aware of the place after a given period of time; the environment becomes mundane. The approach that one could take in alleviating this problem is one that this thesis has worked with, which is the use of complexity in the three-dimensional built form. It is in the interpretation of complexity that one may find the beginnings to some of the environmental stimulation problems. By the use of complexity in the environment one can observe positive arousal, which the architect should always strive for. Along with the use of complexity in the environment, one could use simplicity to create harmony and balance, which is part of the "balance theory of stimulation". There are some questions that appear when evaluating the ranges of complexity. At what point do we reach the optimal level of complexity and how is it achieved? Is it possible for architecture to become too complex or too simple? Is there a limit to the complexity and simplicity values? When does complexity and simplicity become negative within the environment? How far will the adaptation theory go? When some of these questions become answerable the next stage of theoretical study is to find when complexity and simplicity become preferable, or rather beautiful; with this, we find questions similar to those regarding complexity. When some understanding of both complexity and beauty values are found, one can then develop correlations between the two; such as, how closely related beauty is to complexity. From this, one can discover a distinction between interest and beauty.
This thesis looks at the correlation of two diverse backgrounds or areas of learning. Both are concerned with the same dimension, the human dimension. These two "professions" are known as the environmental psychologist and the architect. The thesis presented is not to examine each of the professions, but rather to use each to evaluate architecture and to learn the meaning of the built form. The environmental psychologist will be outlined first, even though the architect was the first to appear in history.

The field of environmental psychology is actually a new profession, becoming a more influential field only in the past 20 years. The paradigm of the field is based on the understanding of the effects of the environment on human behavior. This type of study has influenced such things as preferred lighting levels, signage, and color preferences. The scientific studies of the environmental psychologist have discovered behavioral effects of color intensity as well as the effects of viewing the natural environment from a building. The studies of the psychologist are observed as theories and not as practical art. For instance, the psychologist may uncover a unique form of perception methodology, but not understand how to apply it. This is where the architect needs to intervene.

The architect becomes the practitioner of theories. Since the architect usually does not "deal" with the theoretical realm, he applies himself to the philosophical realm. In this case the architect becomes a professional in his own world, as is the psychologist. One can simplify this by describing the psychologist as an individual who is attempting to understand the meaning behind the behavioral aspects of the built form, while the architect is the one who concerns himself primarily with philosophical issues. One can observe extremes within the thinking process as well as the practice. The architect is able to describe a piece of architecture within a visual realm. The environmental psychologist constructs a theory from the abstract of the mind. By understanding the two practitioners, one can visualize achievements that would be possible by interweaving the two.

This thesis has explored and discovered the effects that come from indulging in both fields, the theoretical and the practical. By doing this, one can discover new methods of evaluating and designing architecture. Below is an outline of this past years study of a theoretical environmental situation. The study focused on the understanding of a complex environment.

The outline below is broken into two parts, a short
explanation of the theoretical exemplars and a longer
detailed outline that includes several other theories which
support this thesis.

**Refer to Appendix B for further theoretical explanation

THEORETICAL EXEMPLARS

**Thesis:** The optimal level of arousal in architectural form

-This is a theoretical model for the development of
architectural form within the environment. The concept
presents a theoretical situation for the development of
architecture and presents the effects of the environment.
The theory presented is also not to be considered a "cause
and effect" relationship, but rather it is to show the
possibilities of an environmental situation.

A simple definition of the arousal:

- **the intensity dimension underlying emotion**
  - For example, sleep has low arousal level
  - Very excited about something produces a high
  arousal level

The **theory of "active" observer (interactive theory)**

- The observer needs to maintain a certain level of
  stimulation
- Need for a constant stimulation
- The stimulation needs to be in a varying method

The **possibilities of environmental stimulation**

1.) What occurs when the environment is too simple, this
occurs with the repeating pattern of form or the
abstraction of form (simplification)

- Perceptual isolation (ie. International style of
architecture)
- Intellectual performance is slowed
- Low arousal level

2.) What occurs when the environment is too complex

- Perceptual overload (ie. an environment that is
  not balanced, but rather a constant "bombardment"
  of overstimulation: an example may be "Strip
  Architecture"
- Extreme arousal level

3.) Optimal level of arousal

- This is required for the stimulation of the
  intellect or cognitive thinking
- High arousal level
Paradigm--Environmental psychology
Theory--Environmental cognition (perceptual experience)
Hypothesis--Optimal level of complexity (OLC) is a method of achieving the optimal level of arousal

-methods of creating the OLC (perceptual dissonance)
  -contradiction
  -incongruity
  -novelty
  -diversity

-Within this optimal level there exist that theory of "balanced stimulation"
  -the idea is to introduce "highs" and "lows" as environmental stimuli
  -the levels of balanced stimulation will change over generations of adaptability

-theory of adaptation levels (AL)
  -how does the optimal level of complexity convert into a change in the adaptation level, which can be considered a "refinement" (Ex., a children story with simple plots vs. a more complex adult story with several plots)

-through the use of the adaptation theory the cognitive process (intellectual thinking) of the occupant will be "changed"

-through the use of complexity the environment can become more pleasurable
  (the optimal level of arousal could be one aspect of this positive preference)

-the preference can be considered beauty

-the OLC obviously is not the only method of achieving a more pleasurable form
  -there are other factors in the recognition of beauty such as:
    -an object that has some kind of representation or symbolic value (can be represented through the use of past events)
    -there are also factors that effect the beauty just as the OLC is effected, such as: harmony, balance, rhythm, etc...
DETAIL OUTLINE OF ENVIRONMENTAL THEORY

Why does complexity need to be studied in architecture?

---(is it possible for architecture to be too complex?
too simple?)

-the need of understanding the behavioral aspect of the
design of complex forms; simple forms

-is there a limit to the complexity/simplicity
values?
-negative effects of the nature of the design

---(is there an optimal level of complexity?)

-can it be found that when creating a complex
environment it will become more preferable or beautiful
-the correct type of complex organization must be
found
-types of complexity
---(meaningful vs. destructive)

-how is each of the questions going to be answered
-material review (organization of support material)

Environmental influences:
Nature vs. Nurture
-Head Start Program

Complexity (perceptual dissonance)

-what produces this
---theories on how it is produced and perceived

Venturi
--contradiction
--novelty
--need to add to as an architect

what does C.N. Shulz say about complexity?
--Intentions in architecture

Berlyne (psychologist)
--structural
--diversity
--uncertainty (no patterns)
--interestingness = complexity (Day 1967 p.68)
--surprisingness
--conflict (not to be perplex)

Walker (Berlyne's *Pleasure, reward and preference*)
--optimal level of complexity
--preference (+ or -)
--plotted preference against complexity
  - the monotonically increasing function
  - an inverted U-shaped function
  - a double U-shaped function
--how can each of these occur in response to to stimuli
  - high or low stimulus range (how high does complexity go?)
  - what type of complexity is the stimuli

Beiderman (psychologist)
--RBC (recognition-by-components)
  - Miller 7±2 theory?
  - simplification of whole into parts
  - representing of simplified components
  - the reestablishing the whole with the simplified parts
--there is no max. complexity because it will always be simplified
  - is the level of simplification risen with the constant rising of the type of complexity?

-what are the effects of this

Following are examples of ambiguous objects that can be recognized

![Ambiguous objects](image_url)
Arousal Theory (essential for the stimulation of the participant in the environment)

---need to address questions of complexity and simplicity

- optimal level of arousal
- Yerkes-Dodson law (inverted U-shaped function)
  - "this is nice" optimal level of arousal
    PEAK OF BELL CURVE
  
  - "this is awful" Too high of arousal.
    OVERLOAD SIDE OF CURVE
  
  - "this is boring" Low arousal.
    DEPRIVATION SIDE OF CURVE
- overstimulation
  --- negative effect
  - "harmony and balance" needed (balance theory of stimulation; Wohlwill)
  - with the understanding of time there is a need in the inducement of less stimulation when over stimulation has occurred too long

Level of adaptation (understandable limits, perceivable limits)
- changing to accommodate with the environment
  - what changes the limits of this
  -- curiosity
  what provokes this
  -- incompleteness
  -- diversity
--incongruous  
--nonrepresentative things?

-always seeking out stimulation  
-this adversely heightens level of understanding  
-need for constant stimulation

--what are the limits of this?
--when can a positive stimulation be found?
--when or does the stimulus become negative?

BELOW ARE TWO FUNCTIONS REPRESENTING THE THEORIES ABOVE
Beauty (perceptual preference or pleasure?)
- pleasure to the mind
- how is this produced

- what makes one see this
--- theories on why this is seen

Berlyne
-- pleasingness = beauty
-- meaningfulness
-- personal "touch", not necessarily understandable
-- do not want the conflict (to much dissonance!)

Pratt (from Functions of varied experience)
-- pattern of the unexpected
-- deviations
-- symmetries

"unconscious inference"
-- pleasure
-- preference
-- pattern recognition (past experience
-- articulation (forms to have "engraved" meaning to
the subject)

** NEED TO IDENTIFY ASPECTS OF BEAUTY VARIABLES

- obviously more than complexity in forms
  - articulation (form of aesthetics?)
  - aesthetics
  - color chromas (how much of an effect can this
    provide in the beauty judgements and is this
    quantitative?)

- how do the laws of "good figure" relate to beauty?
  - continuation
  - repetition
  - completion ?
  - similarity (not necessarily simplicity)

*- needs to be stated that one variable is complexity,
  meaning that the complexity can influence the
  judgements of beauty

How is beauty related to complexity

- what are their similarities
Wohlwill
--three sets of perceivable complexity and beauty
  - nature only
  - man only
  - man and nature together

What do each of these terms mean in a whole

--can beauty be a result of complexity?
* to what degree is this true?

-can pleasingness be related to interestingness in a meaningful manner

What does novelty have to do with either theory

-does this bring in the "ever changing" concept forth

-novelty = interestingness
IV THREE ENVIRONMENTS

1) The over-simplified designed
2) The over-complex designed
3) The optimal level designed

The over-simplified environment:

This type of environmental setting can be viewed in some of the abstract pieces of architecture, as below. This type of situation does not enhance the intellect, but rather "shuts-down" the cognitive ability of the person, (see appendix A for evidence of this). The concept of designing and constructing an environment like this was not recognized in Corbu's plan of Paris or the "blocks" seen on the next page.

Some criteria for this type of environment

- never changing pattern of information
- monotonous sound and temperature levels.
- too much symmetry
- abstraction without articulation

This type of environment can have secondary information that is unique, but the result is still the same. The etchings and articulation of a surface is the second interpretation.

This environment is described as mundane, banal or even insipid.

Loss of self, individuality
The over-complex environment:

This type of environment is most obvious in the "strip architecture" that is seen in the surrounding cities. Also, one can view the chaotic arrangement of the cities and the perplexity of the signage and traveling. Amos Rapoport (1971) describes the complexity of the city as the unique quality of the place. The chaotic environment, such as Times Square in New York, this type of environmental setting cause the phenomena of perceptual overload. Below are some example of varies compositions of architecture. Within this environment a person can become overwhelmed to the point were there can be irreversible psychological damage.

Some criteria for producing this type environment.

- extreme noise levels (sensory overload)
- too many pieces or too many types
- no orientations to begin from
- contradiction of materials
- diversity of methods of construction
- incongruity in patterns (no pattern established)

The contradiction of elements can cause the perplexity (eg. the overlaying of grids or obscure angles onto a very simple form). See drawing below.

This type of environment can have the same number of elements, but having them in order or not becomes the significance.

- randomizing vs. articulation

The drawings below show, very simplified, what the difference of the two terms.
Langner, Jules. "Fantasy in Steel, Concrete, and Broken Bottles." Arts and Architecture; September 1951, vol. 76, p. 27.

A scene from The Man Who Was Thursday at the Chamber Theatre, 1923. Production by Alexander Tajrov, stage design and costumes by Alexandre Vesnin.
The optimal level environment:

This type of environment, unfortunately is the most rare of the three types. Examples of this type of design can be seen in scattered pieces of architecture throughout history, but one will not find any major movements that looked to produce this goal in environmental design solutions. The era of the Renaissance can be described as the as the development of the achieving of this goal. The idea that beauty becomes an intellectual process and that the mind has supreme power. Below are a few of the most popular intellectual compositions. Most of these pieces were unique to that time period. Hal Foster (1987) describes this type of uniqueness "neo-futurism". The concept behind this type of entails constricting a totally unique form that does not have any immediate representation. In this case the mind or cognitive processes become aroused to the point of awareness of the environment.

Some results of this type of environment

- high arousal levels
- more intellectual occupants (this is not the result of the architecture, but of the environment situation)
- more understanding of the environment around one.
Alexandr, Viktor, and Leonid Vesnin. Sketches for the competition project for the Palace of Labor in Moscow, 1922–23. Above: Perspective. Pencil on tracing paper. 46 x 59 cm
V PROJECT No. 1: PSYCHOLOGICAL EXPERIMENT NUMBER 1

This was the first of two scientifically constructed experiments that measured the response to diverse pieces of architecture. The reason for conducting this, was to develop a beginning to the construction of a theory in architecture and psychology. The construct behind this "invention" was the concept of complexity and beauty were related. For example, when an object becomes more complex it tends to become more beautiful. This theoretical assumption lead to the development of this experiment. In addition, the results show that the optimal level of complexity in relation to the presented object, or models. The dependent variable for this was "beauty".

The construction of the experiment follows:

*-25 models, such as those on the following pages, were presented to approximately 77 people.

*-Approximately 35 people individually made a complexity judgement on each model.

Questions asked:

Question #1: Could you place the objects in order from the most simple to the most complex.

Question #2: Give me a number for each object representing it's complexity. Let the most simple object be one. There are no correct answers, these are your judgements. If you feel two objects are equally complex, give the same number to each.

You do not have to use integers. For example, you could describe an object as being 2.5. Remember the most simple is "one" and the other objects should be compared to it.

*-Approximately 37 people individually made beauty judgements on a 1 to 10 scale for each model.

(The judgements were made for each piece as an object and as a model of a small structure).

Questions asked:
In this experiment the subjects will be allowed to view a unique random selection of five objects before they are tested. The subject will be able to view these five objects at the same time that the experimenter is describing the experiment. After viewing the objects the subject will then be screened so that they cannot view any of the objects. The subject will be given one object at a time with no time limitation to make their beauty judgment. The objects will be given in a random order for each subject and no order will be duplicated. The objects will be placed on a paper that indicates their given alphabetical letter. The experimenter will present the objects in the random sequence that has been given and write the numerical response of the subject next to the letter of the object on the random ordering sheet.

Instructions for subject: In this experiment you will judge the beauty of objects such as those in front of you. I will be presenting you one object at a time and I want you to judge the beauty of each object on a one-to-ten scale, with the one being the least beautiful and ten being the most beautiful. Remember, you will judge their beauty on a one-to-ten scale. Are there any questions?

("thing" model beauty)

In this experiment the subjects will be allowed to view a unique random selection of five models before they are tested. The subject will be able to view these five models the same time that the experimenter is describing the experiment. They will be told that these are models of things that are about the size of the room that they are now in. This means that they would be able to walk inside and around the built form. After viewing the models the subject will then be screened so that they cannot view any of the models. The subject will be given one model at a time with no time limitation to make their beauty judgment. The models will be given in a random order for each subject and no order will be duplicated. The models will be placed on a paper that indicates their given alphabetical letter. The experimenter will present the models in the random sequence
that has been given and record the numerical response of the subject.

Instructions for subject: In this experiment you will judge the beauty of models such as those in front of you. These models represent things that are about the size of this room. I will be presenting you one model at a time and I want you to judge the beauty of each model on a one-to-ten scale, with one being the least beautiful and ten being the most beautiful. Remember these models represent things about the size of this room. You will judge their beauty on a one-to-ten scale. Are there any questions?

*-Post experimental interviews, questions:

For this part could you please write statements that best answer the questions about your evaluation of the objects.

Question #1: In this experiment what criteria did you use to make the beauty judgements?

Question #2: Many people say that there is a relationship between beauty and complexity. How would you describe the relationship between beauty and complexity?

Question #3: Please identify how you distinguished the complexity of each object.

Question #4: Please explain how one object has more beauty than another.
The results of the study, graph function, indicate that a regression began to appear at the last two objects. This shows that the peak of the "bell" curve as mentioned previously, was at this point. One can also see that there was no significant difference between the objects and models.
VI  PROJECT No. 2: A TWO WEEK HOUSE DESIGN

This was the first specific architecture project that began to evaluate the theory of cognitive arousal. Although this was not the first piece of architecture, the pieces for the psychological experiment were previously constructed, this was the first "wholistic" environmental design that exploited the idea of complexity. The idea in the house was not to reestablish metaphors of the basics in house form, but to use simple geometric elements or spaces and juxtapose them to create the uniqueness needed for the perceptual dissonance or high arousal. The placement of the forms create diverging axis that cause the perplexity, which influences a high arousal. One can see the effects of the design evaluated in the following pages. The design was submitted to the Innovations in Housing Competition.

The program: Design a single family residence with less than 2000 sq.ft. The given site measured 8' x 120'.