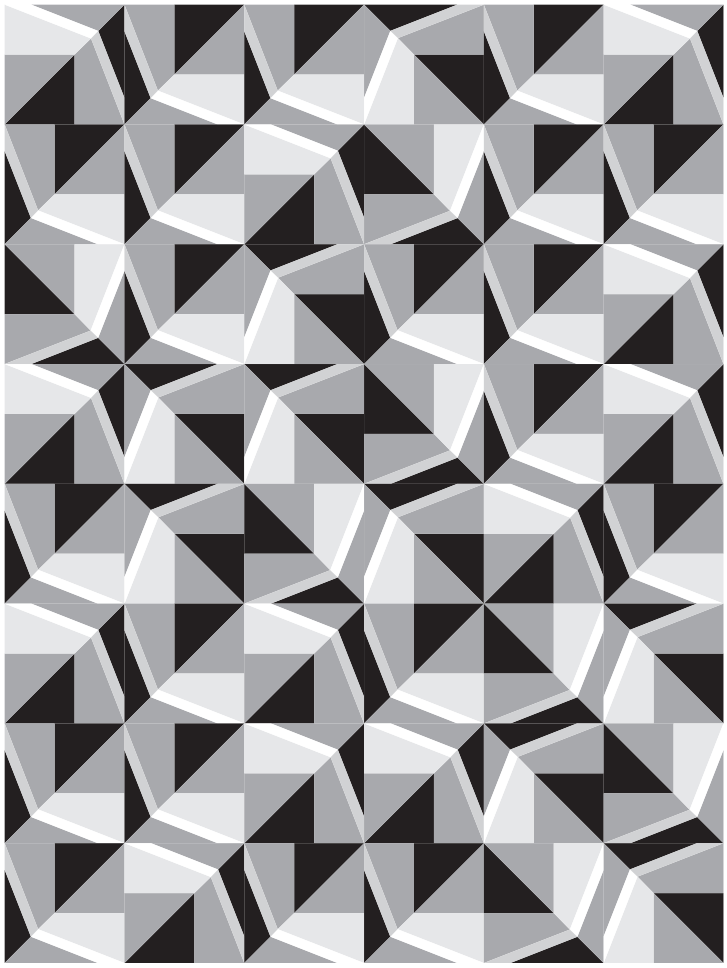
CREATING RELATIONSHIPS

A Primer for Understanding Formal Design Concepts



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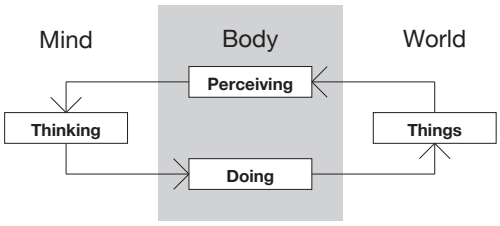
PERCEPTION & MEANING

The ultimate goal of design is to create things—objects and environments—that meet needs, support activities and experientially enrich lives. The test of a design is found in its perception and the meaning it affords. If what a person perceives meets their needs, supports their activities and enriches their lives—if it has meaning to them—it is for them a success. The goal of this first chapter is to present an overview of perception and meaning and the designer's role in its creation.

Mind/Body/World

There is the external realm of things (the world) and the internal realm of ideas (the mind) that are linked through the body. The body links things and thinking through doing (affecting things in the world and our relationship to them) and perception (the bringing of information from the world to our thinking).

The mind/body/world model shows the four elements (Perceiving, Thinking, Doing and Things) related to the internal environment of our minds, the external environment of the world and our bodies that connect and translate between them. In the simplest terms, the things of the world provide sensory input to our perceptual systems. Our perceptions provide the basic information for thinking. Our thinking results in action and our actions produce interactions with and/or new things.



The Mind/Body/World model provides a structure within which to describe the role and interaction of perception, thinking (the creation of meaning), doing and things.

The world contains all the things (elements, objects and environments) that provide stimuli to our perceptual systems. The fundamental stimuli provided by things and the user's interaction with them includes movement, temperature, texture, sound, taste, smell and light. Each of the stimuli can add to our experience and knowledge of things.

The body zone of the diagram includes perceiving and doing—the taking in of sensory stimuli and our behavior in the world.

Doing is the outward manifestation of our thinking. We do things in the world because they have meaning to us. Doing encompasses all physical interaction between our bodies and the things of the world. At the most fundamental level it includes moving, speaking, writing, drawing and making. All of these modes of doing are part of expressing ourselves. They are the essential processes that make ideas visible.

For the designer the act of doing takes on special importance because the doing associated with writing, drawing and making are the means by which ideas are made visible. In order to bring an idea into reality it must be represented so that it can be understood, evaluated, developed and eventually constructed. The representations that we show ourselves in the design process are not the end but the means. They are not statements of fact but questions about possibilities. They are one element in the cycle of thinking, doing and perceiving. The more possibilities from more points of view that we show ourselves the richer the design process and its products will be.

The interesting thing about doing is that our bodies and the instruments we use do not always produce what our mind asks or expects. This element of serendipity can be taken advantage of by looking at what is created to see what it actually is or could be instead of assuming it is what we intended. In this way serendipity can lead to insight.

Perception

A complex component of the Mind/Body/World model is perception—how our senses and thinking work together to gather information form the world. One part of this is how we take in information from the environment. Gibson (Lang 1987) presents an ecological theory of perception that organizes the senses into five perceptual systems. The systems are channels of sensation that gather the information provided by the environment.

The orienting system employs the inner ear and establishes body equilibrium by sensing the forces of gravity and acceleration. From this information we can establish the direction of gravity and changes in movement.

The auditory system employs the ear (cochlear organs, middle ear and auricle) to receive sound information that is carried through vibrations in the air. From this information we can establish the nature and location of vibratory events—sounds.

The haptic system employs the skin, joints and muscles (touch, manipulation and movement) to receive information. Through the haptic system we establish contact with the earth and have mechanical encounters with objects and environments to gain information about their shapes and material qualities.

The taste-smell system employs the nose and mouth to smell and taste things taken into the body. From this we can establish information about the composition of the medium and its nutritive and biomechanical value.

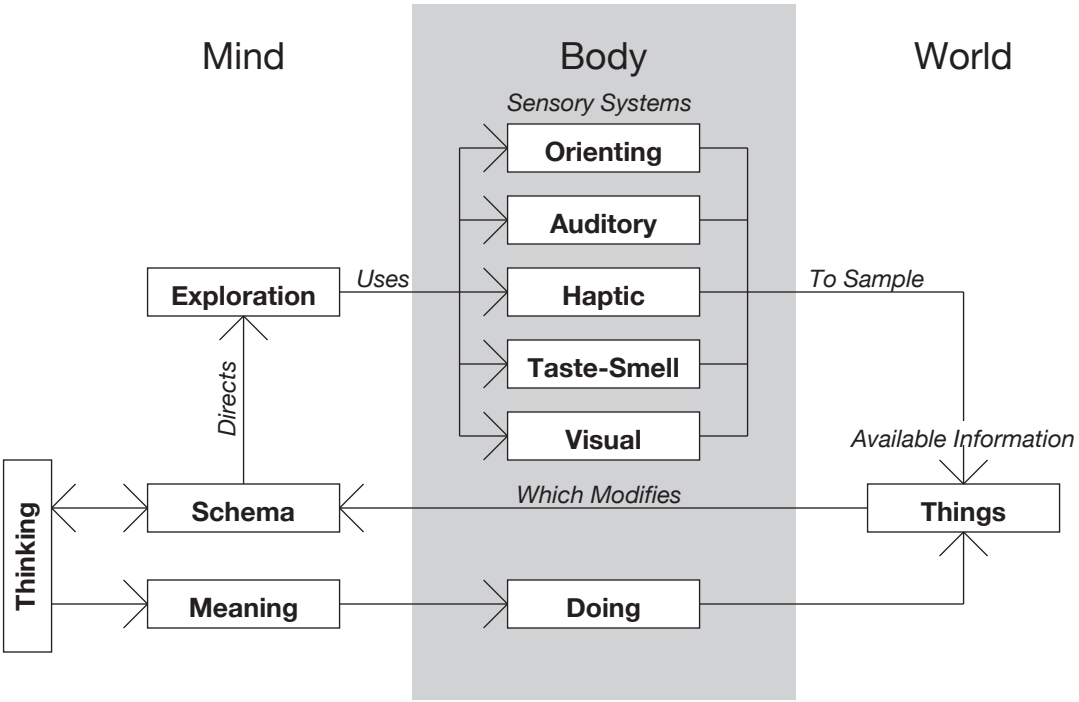
The visual system employs the eyes to sense the variables in the structure of the ambient light. This structure is communicated through the sheaf of light rays that reach the eye at any given point in time and space. The information carried by the sheaf of light is structured by the surfaces and edges of the world and is transformed when the viewer moves. From this information we construct the majority of our understanding of the world.

Perception starts with the information provided by the world to our sensory systems. Our mind uses this input in our thinking and directs the sensory systems to gather information. The cycle of gathering, thinking, gathering, thinking, etc. results in the creation of representations of the things of the world in our minds. It is these representations that form the basis for all other thinking and the creation of meaning.

Perception and meaning are intertwined. Perception includes both looking and seeing and our internal representations of things we see. These internal representations are the basis for the meanings that we assign. Perception is the gathering of information that meaning relates to our existing knowledge. Our knowledge is a construct of our individual, social and cultural experience that links us back to the world. Therefore, perception and meaning does not exist in the world or ourselves, but results from the interaction of the two.

We are surrounded by a very rich and complex environment of sensory stimuli. However, we pay conscious attention to only a small portion of that stimuli. Therefore, a perquisite of perception is awareness or attention. Those things to which we attend, shape the meaning we assign to the world. To change the meaning we construct we must change the concepts that direct our attention. This is fundamental definition of education.

A key concept associated with attention is inclusion —the things selected or attended by a designer or user. Therefore, inclusion has two distinct players—the designer and the user. The designer must establish a frame-of-reference or context and create or select the elements that will be composed. The elements chosen by the designer constitute the design vocabulary. The



choice of which elements to include and exclude is a very important and fundamental design decision.

The key problem of perception is to explain how the information received by the senses is given meaning. The solution comes from understanding that perception involves the mind, body and world. The mind directs the body to search available stimuli based on the perceiver's anticipatory schema (current understanding), the world provides sensory stimuli that are very predictable, the body picks up the stimuli through the sensory systems, and the schema is modified by the information gathered.

The anticipatory schema "is that portion of the entire perceptual cycle which is internal to the perceiver, modifiable by experience, and somehow specific to what is being perceived. The schema accepts information as it becomes available at sensory surfaces and is changed by that information; it directs movements and exploratory activities that make more information available, by which it is further modified." (Neisser 1976, 54) The elements of perception are continuously linked in a dynamic process.

What we understand about the world is some combination of things that can be understood directly from the environment and things that require understanding be supplied by the perceiver. A child does not walk off the edge of a porch because his perception of the edge, and its spatial implications, is evident. On the other hand, being able to read this text requires that the reader bring knowledge to the perceptual experience in order to make sense of these black marks.

One of the greatest impacts of learning something is that it changes our schema. This change means that we see the world in a new way. We attend to new things, make new distinctions and are aware of new qualities. Becoming a member of a knowledge community means expanding our schema for looking at the world.

Integrating this understanding into the mind/body/world model produces the diagram shown below. It expands the concept of perception to include the interaction of things, our schema and our sensory systems. It also introduces the concept of meaning as constructed by our thinking that is informed by the process of perception.

Things

We perceive things and construct meaning. This is an interactive process with things providing the sensory input. Things are the individual and distinguishable entities that can be perceived by our senses. Things can be described as an embedded system of elements, objects and environments where an element is a piece or component part of a larger whole that is perceived and attended to at a given point in time. It may be an object or environment but is at that time perceived as nested within and contributing to some larger object or environment. The choice to call a thing an element versus an object or environment is a function of both the nature of the thing and the point of view of the observer. For example, the leg may be perceived as an element within the chair, the chair as an element within the room, the room as an element within the building, the building as an element within the city, etc.

An object is a thing that can be seen or touched and occupies space. It is an entity perceived and attended to as a whole at a given point in time and space. Objects usually fit within our field of vision and are perceived as nested within an environment or context. You can usually see the perimeter of an object and separate it from its background. They are usually specific examples of basic level concepts such as chair, car, house, city, etc.

An environment is a surrounding context. It is larger than the visual field at any given point in time and space and is or can be experienced from within. It consists of elements, objects and a background.

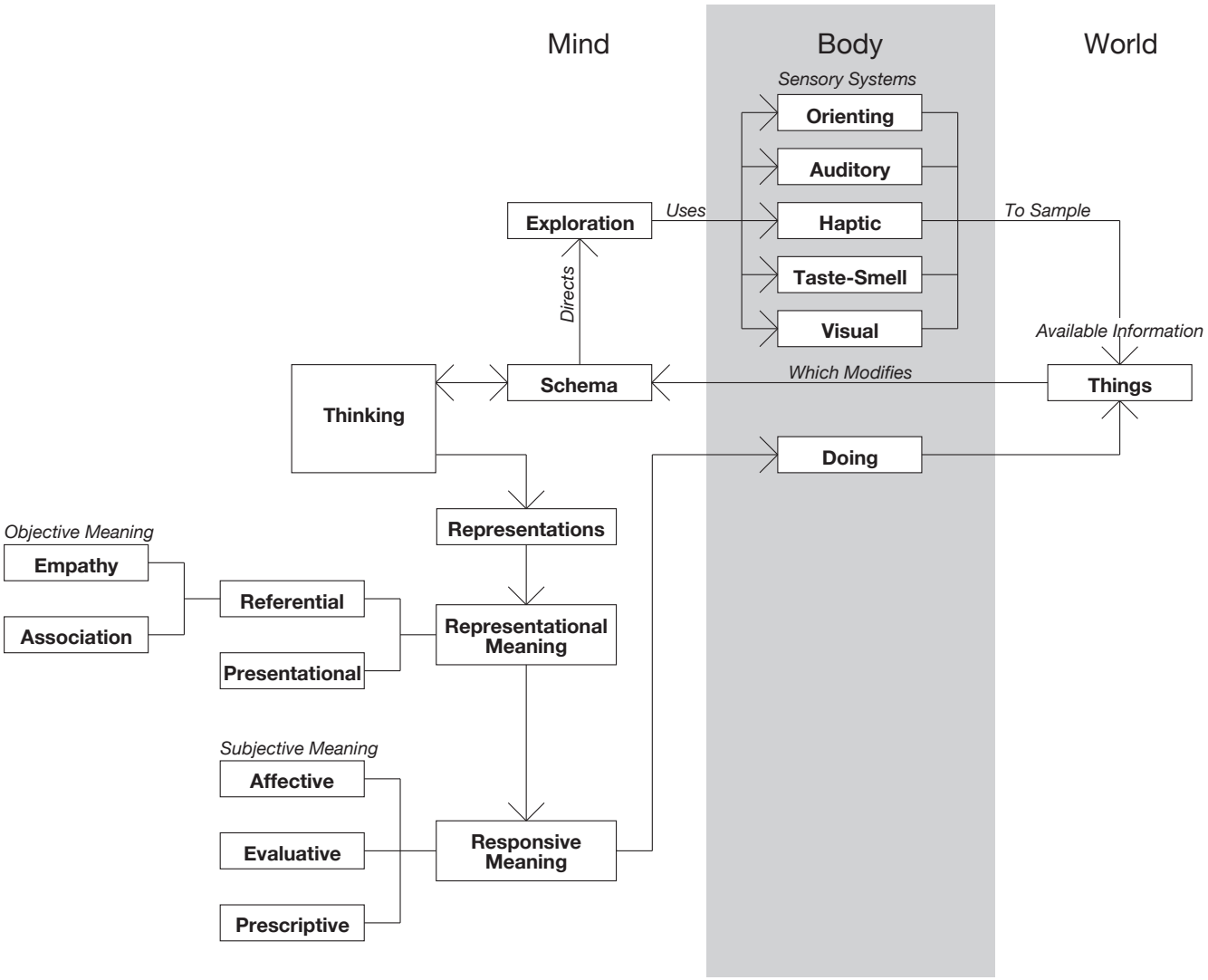
The products of the design process are things ranging from the representation of an idea in a drawing to the final constructed product. Things are ideas given visual form. Things are not separate from the design process. A designer must show him or herself the things that are being proposed continuously throughout the process. They must be visualized and tested through drawings and models and eventually in the real world through final construction. All of these representations of the designer's ideas must be continuously evaluated as part of the design process.

Meaning

Meaning is interpreted from and assigned to things based on their perceived attributes and the knowledge of the observer. Each thing (object or environment) affords or supports a certain range of meanings at any given point in time. The interaction of the observer with the thing results in the assigning of meaning by the individual.

Perception provides our minds with information from the world. Based on this information we create representations of things in our minds. We do not internalize the thing itself but construct a representation of it based on the perceived information and the structure of our current understanding and knowledge. The representations can take several forms with the most important for designer being figural representations that are recalled in the form of images. The meaning in figural information is communicated by the relationships between the elements. These relationships put limitations on the amount of information (uncertainty) that the image possesses—they define its level of complexity. They make it more understandable and limit the range of meanings that the thing affords. In addition, according to Guilford (1967) "relations" is one of the fundamental products of our intellect. Our mind perceives, identifies or constructs relationships between elements as a fundamental way of making sense out of the world. Therefore, learning how to create relationships between elements that are perceived by others is fundamental to learning how form can communicate meaning.

Based on the representations of the world constructed in our minds we assign meaning. In terms of our figural representations we construct representational and responsive meaning. Representational meaning is constructed from our internal representations of things and responsive meaning consists of internal responses to representational meaning that in turn result in doing. Using these



ideas to expand the understanding of meaning and integrating it into the mind/body/world model results in the diagram on the next page. The elements of the diagram are further described in the following.

Representational Meaning

The representations of thing within our minds provide the bases for our interpretation of its representational meaning. Presentational meaning is based directly on our internal representations that provide information about the nature, disposition and attributes of things. Based on its perceived attributes the thing is categorized according to known objects and events. At this level, understanding results in the ability to move through the world. Form is functioning as an abstract conveyor of information.

Referential meaning is based on the memories brought to mind by our internal representation of things. It is using past experience to give meaning to current perceptions. The internal representations may be either realistic or symbolic but must be recognized by the perceiver for meaning to be assigned.

Human beings have both physical and intellectual memory. Our physical memory is of our body and the effects of natural forces upon it. It produces meaning through empathy. Our intellectual memory is of things, places or events. It produces meaning by association and finds its reference in human culture.

Empathy is meaning based on bodily memories. It is meaning that is primarily independent of cultural determinants—it is universal. Empathy is shared by all people and gained through our bodily experiences of confronting and being in the world. It includes the experience of gravity and other natural forces. Our experiences with these forces can be described in terms of motion, weight and material—the basis of form's existential expression.

We move in relationship to gravity: we lie, we sit, we stand, we run, etc. We experience day and night and the differentials of light. We touch things and experience them as hard or soft, coarse or fine, wet or dry, etc. Furthermore we operate among objects in space: we move around things, up stairs, through passages, and lift and push on things. These all build our bodily memories of the world.

Through empathy we experience and use our surroundings psychologically prior to using them physically. We assign meaning

to figural representations based on our empathy with them—based on our bodily memories. For example, material can evoke empathic responses: wood can mean warmth; stone can mean strength or weight. The key issue with empathy is how something feels. It is an intuitive response to the physical meaning of things.

Association is meaning based on our personal, social and cultural experiences and knowledge. These associations could be of beauty, practicality (associations of utility), or negative (the pleasure of being shocked) (Lang 1987). Each of us has developed a wide range of meanings associated with the things and events in our lives. A house that reminds us of the one we grew up in or our grandparents house that brings back memories associated with those people and the events that took place in those environments. There are also culturally assigned meanings associated with things and events that have been named such as chair, flower, house, wood, etc. These names and the specific things they identify form conceptual categories that have cultural, social and personal meaning.

We recognize the thing or event and assign meaning. In addition, what is recognized can be a sign or a symbol. Something acts as a sign when it is an indicator of something. For example, a wet surface can indicate that it has rained. Something acts as a symbol when it possesses some assigned coded meaning. For example, a red light means stop.

Responsive Meaning

Responsive meaning is based on the representational meaning constructed by the observer. Our internal representations of the object stimulate memories, purposes and values that may result in or condition emotional, rational, physical and behavioral responses.

Affective meaning stimulates feelings and emotional states. The observer is excited, bored, pleased, sickened, exalted, etc. Affective meaning is a learned or chosen response based on experience.

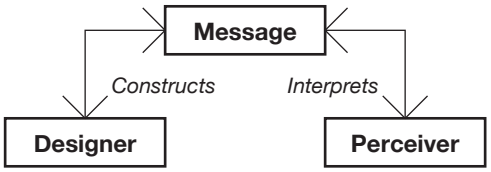
Evaluative meaning stimulates critical attitudes and ideas. Our representations evoke values, criteria, standards and attitudes. From these we conclude that a thing is good or bad, beautiful or ugly, novel or common, appropriate or inappropriate, etc.

Prescriptive meaning stimulates behavioral decisions. We do things because they have meaning to us. Our behavior is a reflection of what we value. Based on the representational meaning of things certain behaviors may be supported, influenced or prescribed.

Design & Meaning

As designers we can create things that have specific presentational properties or attributes and thereby support certain referential meanings. These meanings in turn support the assigning of responsive meaning. Learning about the relationships between the forms we create and the meanings they support is important because the goal of design is to create things that are qualitatively and quantitatively more meaningful—that speak to our emotional and intellectual needs, desires and dreams.

Based on this, a design as communication metaphor can be proposed. A designer creates things with the intention of evoking certain responses in the people that will eventually experience them. The designer is hoping to communicate his or her intentions through the physical form of the thing. The attributes of the things are perceived by the user and meaning is assigned—some communication has occurred between the designer and the user. The things designed and perceived have been the vehicle of the communication.



Communication in its simplest form can be described as who says what to whom. There is a sender, a message and a receiver. Someone conceives (the designer) a message that another perceives (the user). The message is transmitted through some medium (the thing). When a designer defines or creates the thing, he or she is constructing the message. When the perceiver interprets the thing he or she is interpreting what is perceived and constructing meaning.

The underlaying beliefs that produce this model are that things can convey meaning and that it is appropriate to evaluate a design based on the success of its communication. Given this position, if the designer's intended message is not perceived by the user then the designer has made unsuccessful decisions concerning the means at his or her disposal. The design as communication metaphor is used to guide much of the exploration and discussion within design and drawing studios. Its value is in linking a designer's intentions with his or her decisions.

Both the designer and the user can interpret things and assign meaning. The designer becomes another user or interpreter when he or she stops designing and examines what has been designed. When the designer looks at things as a user he or she is trying to see what is actually being communicated. It is difficult but essential for a designer to develop the ability to look at his or her creation in terms of its possible meanings and not only those that were intended.

A designer's decisions are made with the intention of communicating certain meanings. The intended meanings are based on the designer's interpretation of the form and his or her understanding of the users. The users perceive the thing and assign meaning.

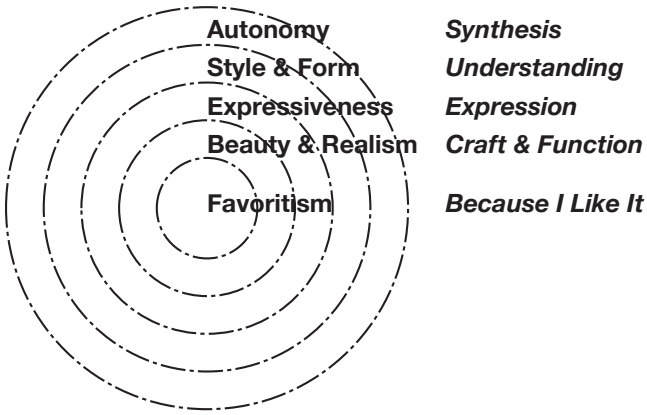
An object or environment is successful if the assigned meanings match the intended meanings. However, the meanings assigned by the user may or may not coincide with those intended by the designer. Therefore, it should not be assumed that intended meanings will always be correspondingly interpreted. A key goal of beginning design education is building an understanding of the relationship between form and its meaning.

BECAUSE I LIKE IT

We all respond to things we find pleasing. When asked why, our first response is usually "Because I Like It." This is the most fundamental and personal reaction to the things we perceive. However, when used by itself, it ends communication. The goal of design education is to make it the beginning of a much richer dialogue that will enhance our learning. The goal of this chapter is to present a theory of how "Because I Like It" fits into our development as designers and to identify points of view that can be used to broaden and deepen our dialogue.

Parson's Theory

In How We Understand Art: A Cognitive Developmental Account of Aesthetic Experience (1987) Michael J. Parsons proposes a theory for the cognitive development of aesthetic judgement. He believes that deeper understanding is reached through a sequence of steps with each step representing a new insight and conceptual platform upon which to built the next. The stages are a process of greater understanding that include a growing and expanding set of issues. The process is additive with each stage encompassing the preceding. Each stage constitutes a more inclusive whole, understands the subject more fully and adds new insights. Each stage increases the person's ability to take or understand the perspective of others.



The following will interweave Michael J. Parsons' theory and my interpretation of the theory in terms of design. The preceding diagram includes Parsons' stages followed by my names for the layers in italic. The model suggests ways that we might think about our growth as designers and provides points of view from which to see, think and talk about design.

Favoritism — *Because I Like It*

Visualize your favorite color.
Why do you like that color?

The only answer to this question is "Because I like it." It is the only answer because the reasons are so much a part of who we are that we cannot objectively separate them from ourselves. Favoritism is the most fundamental basis for aesthetic judgement.

I have always loved warm colors and red in particular. I cannot tell you why. My preference for Red is a fundamental part of who I am and I react with intuitive delight to things using warm vibrant colors.

Our judgements of good/bad like/dislike growing from this layer are based on what we like. If the work has red then I like it.

Intuition is an important aspect of "Because I Like It". Intuition is the synthesis of all our knowledge and experience in our subconscious. It is our accumulated wisdom. Therefore, our aesthetic intuitive response is both fundamental and valuable. It is at the core of all our personal aesthetic judgements. As designers, when our intuitive response is positive we are moving in the right direction and when it is negative we need to engage our analytical side, develop alternatives and seek input from others.

Implied in intuition is that the total of our knowledge and experience is not fixed. Each new understanding and experience has the potential for modifying the whole. This is why the understanding layer of the diagram is given added weight.

A drawback of the "Because I Like It" layer is that when someone else does not like what we do, it feels as if they do not like us. This is because we cannot define why we like it and therefore our likes and our egos become intertwined—we cannot be objective. All designers suffer these feelings. They never go away but they can be calmed by focusing on the other layers of aesthetic communication.

Communication at this layer is always operating in a world of black and white—either I like it or I don't. This is a particular problem in terms of communication and learning because there is no opportunity for dialogue—there is no opportunity to explore the question of "Why?". At most, statements such as: I like red; I like cats; I like natural wood; or I like Spanish style architecture provide facts about a person. If this factual information is compiled for a group of people patterns can be identified that may assist in making design decisions for the group.

Based on this layer, when a designer is asked why some decision was made, the only answer is "because I like it." To move beyond this dialog ending statement the designer must include other layers of communication.

Beauty & Realism — *Craft & Function*

Visualize your favorite color again.
Do you like all versions of that color?

Chances are that the answer is no. Some are too dark or light, too pale or intense or too muddy or clear. Your judgement is based on how close to the ideal color a particular instance comes. We have added accuracy to our liking of the subject.

Our judgements of good/bad like/dislike growing from this layer are based on how well something is represented and how positively we feel about the subject. If we like puppies and a puppy is the subject of the work and the puppy is represented accurately, then we like the work. On the other hand, if the subject of the work is not something that we feel is good then we do not like the work.

Communication within this layer in terms of design focuses on how well something succeeds in rightly representing an external object or follows a set of rules or constraints. This layer is focused on the object. It recognizes that there can be more than one of something and that they may be judged better or worse based on their craft and function. Communication compares the perceived qualities of a thing against its ideal representation or its ability to meet functional requirements.

The focus is on assessing the degree to which the craft or function of a thing meets external or internal levels of quality or compliance. Discussion is based on personal evaluation of the thing that we assume others will share.

The qualities that craft addresses include precision, realism and authenticity. We know what it means to do something well and therefore, inherently give value to something that exhibits a high level of craft. For example, when an class assignment is handed in, some of our first judgements respond to the level of craft exhibited by the model, drawing, presentation, etc. because we know what it took to achieve that end. It is the perceived care and skill embodied in the work that forms the basis for communication and evaluation.

Realism addresses how faithfully something represents something in the world. In drawing terms this means that it is more or less photographic. In architectural terms the building can look like some other work that you know and feel is prototypical—it has all the essential elements and properties that the thing should have. We all have constructed prototypical configurations of basic level concepts (Roth & Frisby 1986). These might include conceptual configurations for house, church, bicycle, table, tree, etc. At this layer the discussion can address how a given work varies from conceptual prototypes.

An area related to realism is authenticity that includes the materiality of the work. Materiality "reflects our intuition that for something to be real it ought to be (made of) 'stuff,' material having a palpability, a temperature, a weight and inertia, an inherent strength. . . . Part of our appreciating the materiality of an object has to do with our appreciation of the natural origin of its material and the manufacturing or forming process that the latter has evidently undergone." (Benedikt 1987, 44)

Something is authentic if it possesses or displays all the qualities of the material we take it to be. To tap on a visually massive element and hear the ring of a thin metal shell affects our evaluation of authenticity.

Function includes how smoothly something works, how well it serves its purpose, how well it follows the rules or constraints and its durability. Function is being used here in its broadest meaning to include any required performance quality.

Based on this level, dialogue encompasses the analysis of the thing in terms of how well it fits the model or meets the rules. The underlying assumption is that if we could clearly articulate the criteria we would all agree as to the object's or environment's success.

Expressiveness — *Expression*

Visualize your favorite color again.

Would it be a good choice if you wanted to express a cold winter's day or a hike through the desert?

Your judgement is now considering the appropriateness of a color relative to communicating of a feeling. We have added an appreciation of the role of decisions that support the expression of some quality. We understand that someone else can have a point of view and can communicate it to us.

Our judgements of good/bad like/dislike growing from this layer are based on the quality and success of the expressive communication. It also acknowledges that someone else—the designer/artist—can have a point of view different from ours.

Communication within the expression layer focuses on the quality of the experience produced—the more intense the better. This is based on the realization that a work can communicate something beyond the objective subject and that another person can have a point of view and communicate it to others through something. Things can "express aspects of experience, states of mind, meanings, emotions; subjective things." (Parsons 1987, 70) The insight of layer three is that there is an interactive relationship between the designer and the viewer mediated by the work. The interpretation by the viewer is on an emotional or feeling level that is intuitively grasped. If the work touches a strong and authentic emotional response it is good.

Dialogue begins to flourish in this layer because it involves interpretation by both the designer and viewer. Communication could include how something affects you, what qualities it expresses or what it is saying about the subject. What this layer lacks, that will be added in layer four, is the ability to objectively identify the attributes that afford the communication.

The issue of expression is a central theme in design dialogue. It is based on our interpretation of the weight, motion and material of things that is grounded in our bodily experience of living in the world. This bodily experience includes resisting gravity, wind and water, moving and lifting ourselves and other things and the physical associations we have with emotional states.

The first three layers can be interpreted as individual, quantitative and qualitative intuition. They are our direct response to things and experiences unfiltered by rationality.

Style & Form — *Understanding*

Visualize your favorite color again.

Is it warm or cool?
What is its compliment on the color wheel?
Was there a period in fashion, architecture, graphic design, etc. that it was in vogue?

These questions begin to analyze a situation and consider the reasons for choosing a color. Your aesthetic judgement is being influenced by rationality, the application of formal concepts, your knowledge of history and precedent, etc.

Our judgements of good/bad like/dislike growing from this layer are based on understanding gained by joining a community of knowledge. Something can be perceived as good if it reflects formal qualities, organizational attributes, historical precedent, theoretical or philosophical positions, etc.

Communication at the understanding layer relies on both the ability to analyze the subject and address its place in a larger social, historical or theoretical content. Discussions at this level take on an additional richness and meaning because "judgements (are) supported by reasons that point to concrete, intersubjectively noticeable features" (De Mul 1988, 61) of the object. The discussion is informed by rationality, the application of formal concepts, knowledge of history and precedent, etc. It addresses ideas about the work that can be substantiated by observation and analysis. It is an opportunity to bring depth and critical understanding to a subject.

Full participation at this level requires membership in a community of knowledge and attaining fluency in its language. This is a primary role of education in which opportunities to learn and practice the language are provided along with assistance in relating or translating between a student's current language and knowledge and that of the knowledge community. The following chapter ("Formal Concepts") identifies, organizes and defines the essential concepts that constitute the community of knowledge of visual design. These concepts are also a part of the communities of knowledge of the disciplines of Architecture, Landscape Architecture, Interior Design, Industrial Design and Graphic Design.

Example statements using formal concepts might include:
The strongly contrasting elements make clear the overall pattern;
The ambiguity of the spatial definition increases the space's perceived complexity;
It relates well to its context by matching critical dimensions of adjacent structures, being similar in scale and using a similar palette of materials;
It employes the essential formal elements of the Spanish style; and
It interprets historic forms in terms of contemporary technology.

This layer provides the words and concepts to describe what is intuitively felt in the first three layers—it provides the ability to identify the sources of our intuition or interpretation. Creativity at layer four comes from making connections between the concepts

being learned and the problem being explored. It will be personally meaningful because it will deepen your understanding. Specific solutions will be unique because they reflect your individual interpretation and valuing of the concepts and constraints being addressed.

A key indicator of growth in the understanding associated with layer four is the ability to make a greater number of distinctions. Becoming more knowledgeable also means acquiring a conceptual structure that supports one's ability to make more subtle distinctions.

Autonomy — *Synthesis*

Visualize your favorite color again.

The problem is how to communicate its exact qualities to others and help others communicate their colors to you.

If you were Gerritsen (1988) you would find the traditional three primary color wheel inadequate and would create a six primary color wheel composed of the three additive primaries of light (Red, Green and Blue) and the three subtractive primaries of black (Cyan, Magenta and Yellow) using color perception as the basis for the theory. This would define a new way of thinking about color that added to the knowledge shared by the design community.

Our judgements of good/bad like/dislike growing from this layer are based on the ability of the idea to add to the existing community of knowledge.

[The fifth] stage is characterized by an open structure of judgement. Whereas in each of the former stages a certain criterion played the role of an unquestioned belief that in the final analysis justifies the judgement, the fifth stage is characterized by a fundamental examination of these criteria themselves.

(De Mul 1988, 62)

When we are operating within fifth layer we are questioning existing understanding and making new relationships—we are synthesizing what we know in a way that creates new meaning for ourselves and others. It involves continually reexamining and questioning the criteria, concepts, and values shared by a community of knowledge in an effort to create new and more meaningful relationships. It is the interaction of who we are, our unique view of the world and some realm of knowledge. The community recognizes creativity that establishes new relationships and expands or alters their shared knowledge.

We understand ourselves by getting clear about our experience; and we do this by articulating our judgements and our reasons for them. We expect others to be able to understand these reasons, and to offer us reasons that we can understand. So we help each other, enlarging and clarifying our responses. . . . The essence [of this layer] is the seeking of reasons for interpretations and judgements, reasons which must in principle be available to anyone. To offer reasons implies engaging in dialog and being willing to reinterpret our experiences in light of what others say about them. . . . We distinguish judgement more clearly . . . from interpretation. Interpretation is the reconstruction of meaning; judgement is the evaluation of the worth of meaning. . . . We want . . . to ask whether the meaning is worthwhile.

(Parsons 1987, 150 - 151)

To operate at layer five is to consciously question existing relationships and create new ones. Layer five creativity is born of deep and personal understanding. It is the making of connections that did not previously exist and often calls into question aspects of a community's existing knowledge and understanding.

Studio Implications

One of the roles of the design studio and design education in general is to build and deepen an understanding of the vocabulary of design and the concepts it identifies—to engage students in the dialogue of understanding. The goal is to create the foundation for future synthesis.

The studio provides one of the most important opportunities for students to develop relationships through dialog and thereby gain membership in design's community of knowledge. The studio and the dialogue it fosters both within and outside its time and physical limits provide students a context for testing their understanding of the ideas and language of the community. This dialogue about and through the studio's explorations is critical. If we use this dialogue to discuss things that are meaningful to us then it will sharpen both our external and internal conversations—our seeing, thinking and talking.

Use the points of view identified in this section to expand the breadth of your dialogue. Work to understand, interpret and employ the language of the community. Finally, take responsibility for shaping the dialogue to address those things that you feel passionately about. Take a stand, define a concept and make your realization of the concept as clear and strong as possible.

Design dialogue is of little value if it is not about things that are important. To be concerned about design is to be concerned about making the world a place that is quantitatively and qualitatively better—a place that is beautiful and a pleasure to experience.

Design Dialogue

The quality of the studio as a learning environment is directly affected by your participation—the ideas you share verbally and visually. Interaction between you, your peers and the teacher is fundamental to the quality and richness of the studio. What I am proposing is that the studio should be first a conference room and secondarily a drafting room.

The value of communication lies in its ability to improve the quality of our thinking about the things we experience and design, to identify and understand the factors that contribute to our perceptions, and to enhance our ability to create experiences, objects and environments. The goal of communication is not agreement but the social discourse itself. It is the engagement of unique individuals in meaningful dialogue about things of value that enhance the quality of our lives.

This view of communication is especially valuable in an educational context because, as Kenneth Bruffee (1993) argues, education is the process by which students become members of a knowledge community—a group of people who share a set of ideas and a language for their communication—and that membership in the community is gained through dialogue with others. Furthermore, it is Michael Oakeshott's premise that thought is internalized conversation whose quality reflects the quality of our external conversations (Bruffee 1993). As we talk together we construct a community of knowledge and sharpen our ability to think. Design education provides a means to join the design community.

FORMAL CONCEPTS

The words we use and the concepts they identify affect how we see and think about the world. Each community of knowledge (e.g., Architecture, Physics, Sociology, etc.) has a language that is specific to that community or discipline. The shared language makes communication within the community more efficient and supports greater discrimination, subtlety and nuance. This chapter will identify, organize and define the fundamental formal concepts that comprise the language used by all design disciplines.

Community Of Knowledge

Membership in a community of knowledge involves learning the community's language and developing an understanding of the concepts that it identifies. The community of knowledge that will be addressed is that of Visual Design as it relates to the disciplines of Architecture, Landscape Architecture, Interior Design, Industrial Design and Graphic Design.

What we see and think about our perceptual experience of the world would not be an issue if we never talked with others or wished to learn from or create something for someone else. Within our personal world it is only necessary to act in response to what we perceive as positive or negative. Once we extend beyond ourselves, we need the ability to discuss our perceptions and positions with others and understand their perceptions—we need the ability to communicate with each other.

The language we use directly affects the success of our communication. Our level of understanding of a community's language can either obscure or clarify—it can help or hinder communication. The degree to which we understand the language and concepts of a community of knowledge is directly related to our ability to learn and develop within that community.

The goal is to identify concepts that help us see, think and talk about visual design and organize the concepts to create meaningful relationships in our cognitive schema. In other words, the goal is to learn the concepts and develop an understanding of their interrelationships.

Identifying & Organizing Formal Concepts

A formal concept is a word that identifies the essential qualities shared by a group or class of things or visual phenomena. A concept is not tied to a single instance of a phenomena. It identifies the essential traits that have infinite permutations and presents an area of exploration for designers.

There have been many books written on visual design in which the author identifies a set of formal concepts and presents their implications and challenges for the designer. In my masters thesis *Ideas Into Things: A Theory and Vocabulary for Visual Design Education* (1989), I surveyed seventeen such books and identified over one-hundred terms. In the process I learned that different authors used different terms for the same phenomena and that the authors almost never made an attempt to define hierarchical relationships between the concepts. There are two examples of books in which the author has organized concepts into a hierarchical relationship. The first is *Basic Visual Concepts and Principles for Artists, Architects, and Designers* (Wallschlaeger & Busic-Snyder, 1992) that is an excellent resource for any beginning design teacher. The second is *Archetypes in Architecture* (Thiis-Evensen, 1987) that identifies and relates the essential elements of architecture.

The task that I set for myself with my masters thesis was to choose an appropriate set of terms and organize them hierarchically. The goal was not to invent new concepts but to choose those that were most meaningful and organize them to support teaching, learning and understanding.

Organizing the concepts requires the identification of the most encompassing concepts—the ones under which others could be organized. One way to approach identifying and organizing the formal concepts is to identify the essential attributes or qualities of things. In examining the list of formal concepts and looking at

things, I concluded that there are seven fundamental concepts that comprise the minimum set of independent variables that are always present in something—they are the essential attributes of things. They are also the essential areas for decision making for any design—they are the means at the disposal of a designer. I further propose that all other formal concepts can be grouped under the fundamental concepts. The fundamental concepts are: Size; Shape; Material: Context; Number; Variety; and Relationship.

It is through decisions concerning these concepts that things take specific and perceivable form. For example, until a designer chooses to make four inch (Size) yellow paper (Material) squares (Shape) and place them in a line (Relationship) within a sheet of paper (Context) there is nothing to respond to. There is not one more or one less concept to be addressed. Test the hypothesis, See if there are situations where one of these qualities is missing or if there are situations that require an additional fundamental quality.

The designer makes decisions with the intention of communicating something to the user. When a user is confronted with the specific thing he or she perceives its attributes and assigns meaning.

Expanding & Relating The Concepts

The fundamental concepts seem simple enough however, their extension, understanding and development include over one hundred other concepts that together begin to describe the breadth and richness of things. The problem is to make sense of what can easily become an overwhelming number of ideas.

The fundamental concepts are independent in that you can change the size and not the shape, material and not the size, etc. Furthermore, they are interrelated in that changes in one can affect the perception of others. For example, a yellow square in a black context appears more brilliant that the same square in a white context.

Given this as a basic structure, the other formal concepts can be related to the fundamental concepts as indicated on the facing page. The concepts identified in the concept map are defined in the following pages.

Possibilities & Limitations In Design

Formal concepts are not goals—they are not solutions in and of themselves. Goals set targets for things and formal concepts provide ways of addressing goals—they are the means at the designer's disposal. Things result from decisions concerning formal concepts in terms of goals. Means are formal concepts that can be employed to meet goals and create things. They are a vocabulary of ideas that may be used when appropriate and useful. Formal concepts are appropriate if they help create things that meet design goals. They are useful if they support our design thinking and aid in communicating design ideas to others.

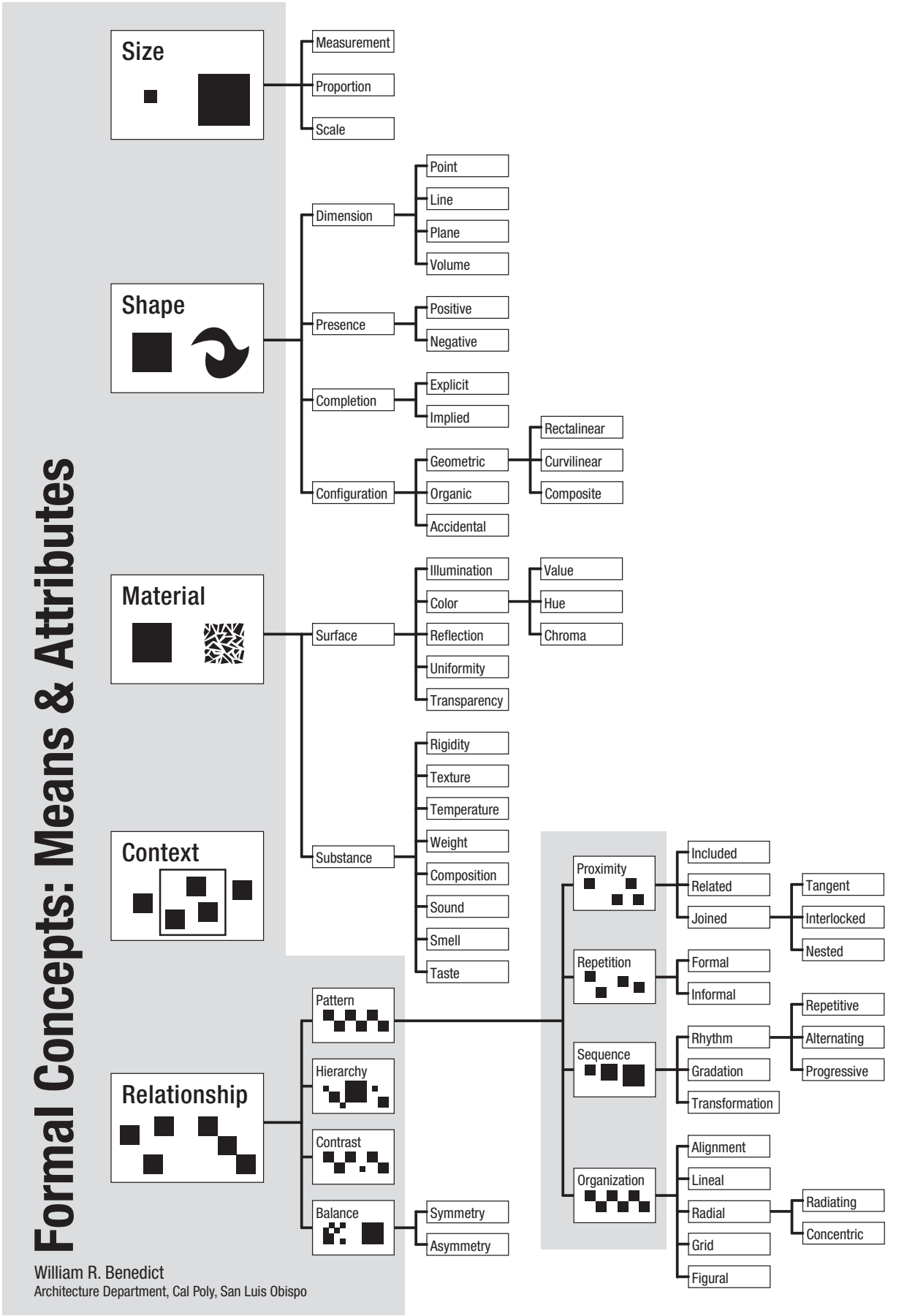
Formal concepts support the rational and feed the intuitive. In rational terms they help us isolate parts and see the world from a particular point of view. In doing so they open our eyes to possibilities. During the time they are being explored on a conscious level they are helping us build our understanding and knowledge. This understanding is then available to our unconscious thought processes—the intuitive. Our flashes of insight, gut feelings and intuition are the products of our minds ability to see patterns and make connections within our vast store of knowledge.

Formal concepts are essential for design communication. The terms that identify the formal concepts constitute the fundamental vocabulary of design discourse. Each term identifies a key idea that can be used in describing what we see and experience. They allow us to identify specific visual phenomena and attach words whose meanings are shared by those involved in the community of design. You will spend the rest of your design life using and trying to understand these formal concepts.

Concept Maps

Concept maps are a way to visualize the relationships between the concepts of some body of knowledge. Concept maps reflect a valuable and powerful way of relating concepts. Use them to construct your current understanding of any area of your knowledge. As your knowledge grows, modify the maps to document, clarify and extend your personal understanding. The last chapter chapter entitled "Concept Mapping" provides information about how to construct a concept map.

The concept map and definitions used in this section do not include all the formal concepts but identify what I understand as the most essential. The map organizes the concepts into a hierarchical structure. The map and definitions are a work in progress and reflect my current understanding of the formal concepts essential to beginning design. The challenge is for you to understand and make sense of the concepts. In doing so, modify or extend my map or develop one that is more meaningful to you.



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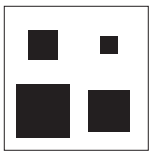


SIZE

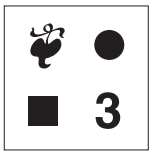
The quality of a thing that determines how much 2- or 3-dimensional space it occupies.

Size defines the measurement, proportion or scale of a thing's boundaries, edges and surfaces.

Measurement: The size of a thing as defined by a standard unit (e.g. feet, meters, miles).

Proportion: The ratio of the size of one thing to another thing in terms of measurement or number. A ratio of part to part, part to whole, whole to whole or whole to context.

Scale: The relative size of a thing to a person, another thing or the context. The human experience of scale can range from intimate to monumental.



SHAPE

The appearance of a thing defined by its perceivable boundaries, edges and surfaces—by its outline.

The qualities of dimension, presence, completion and configuration result in a shape that affords certain meanings. These meanings are often assigned by culture and given a label such as dog, chair, car, etc. The meanings afforded by shape can be seen as falling along a Representational/Symbolic/Abstract continuum. A shape is representational (classical, figural, other-referential, historical, consumed for what it means) if it is recognized as looking like something in the natural or man-made world. A shape is symbolic (type or archetype) if it has a codified meaning which stands for something else and requires prior knowledge of the code. Both representational and symbolic shapes have been assigned labels and meaning by culture. A shape is abstract (modern, iconic, self-referential, consumed with what it is) if it contains minimal representational or symbolic content.

Dimensions: The quality of a shape that depends on the relative size of its height, width and depth.

Point: Non-dimensional. Affords the perception of location, center, point or place.

Line: One-dimensional. Affords the perception of direction, path or edge.

Plane: Two-dimensional. Affords the perception of area or surface.

Volume: Three-dimensional. Affords the perception of space or mass.

Presence: The quality of a shape that depends on it being composed of surfaces (positive) or defined by other shapes (negative).

Positive: A shape composed of surfaces that occupies space—mass. Our experience of it is from the outside.

Negative: A shape defined by other positive shapes—void. We can experience it from within.

Completion: The quality of a shape that depends on the degree to which it's edges or surfaces are complete, defined or perceivable.

Explicit: A shape whose boundaries are completely defined (e.g., a square defined by four continuous connected lines). The shape is closed.

Implicit: A shape whose boundaries are incompletely defined (e.g., a square defined by four points). The shape is open.

Configuration: The quality of a shape that depends on the formation of its defining outline or external surfaces (Geometric, Organic, Accidental).

Geometric: A shape whose defining outline or external surfaces are composed of straight lines and segments of circles or flat planes and segments of spheres.

Rectilinear shapes are composed solely of straight lines and flat surfaces. Curvilinear shapes are composed solely of arcs and segments of spheres. Composite shapes are composed of both straight lines and arcs or flat planes and segments of spheres.

Organic: A shape whose defining outline or external surfaces are composed of complex curves.

Accidental: A shape whose defining outline or external surfaces are a seemingly random combinations of geometric and organic elements.

MATERIAL

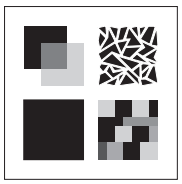
The qualities of a thing afforded by its surface and substance.

Things must consist of matter to exist physically in the world. The physical existence of things is perceived directly through our sensory systems. As a result they are perceived as having a palpability, temperature, weight, inertia, inherent strength, etc.

The perceptual systems are channels of sensation that gather the information provided by the environment. The auditory system gathers the nature and location of sounds. The haptic system employs the skin, joints and muscles (touch, manipulation and movement) to receive information. Through the haptic system we establish contact with the earth and have mechanical encounters with objects and environments to gain information about their shapes and materiality (solidity, viscosity, texture and temperature). The taste-smell system gathers information about the composition of material. The visual system senses the variables in the structure of the ambient light.

From the information gathered through the visual system, we construct the majority of our understanding of the world. The visual system is the dominant system in analyzing and employing the attributes and means that are being described. However, to understand the materiality of the world we must employ our other sensory systems. In response to this, the category of materiality has been divided into surface and substance. The concept of surface is based on our visual perception of material. The concept of substance is based on our haptic, auditory and taste/smell perception of material.

As a society or culture, we name combinations of surface and substance qualities (e.g., paint, stone, brick, paper, wood, water, etc.) The names can hinder us from paying attention to the experiential qualities of things. These experiential qualities—the materiality of things—constitute essential attributes that affect our response to things and powerful means at the disposal of a designer.



Surface: The qualities of material that are perceived through our visual perception of surfaces.

What we perceive visually are surfaces. Based on our visual perception of surfaces we develop an understanding of the shape, location and distribution of two- and three-dimensional things. The process begins with separating a thing from the environment through the recognition of its bounding occluding edges. Once a thing is identified we can examine its surface properties. The qualities of surfaces that can be visually perceived include illumination, color, uniformity, reflectance, and transparency.

Illumination: The quality that describes a surface's orientation and location relative to light sources.

Illumination produces value changes that describe a surface's boundaries, orientation to light sources, creates shadows, indicates the location of light sources and the relative distance of objects from light sources.

We perceive surfaces not because of their absolute but their relative value. Abrupt shifts in brightness define edges. Gradual transition in brightness indicates a curved or round surface. Shadows tell us about the shape of the casting object and the surface upon which the shadow falls. Brightest signals the relative closeness of a surface to a light source.

Color: The quality that describes the integration of the value, hue and chroma of a surface—the three fundamental dimensions of color that are all present all the time.

Value (Tone): The quality that describes the lightness or darkness of a surface. The surface is dark. Value is the most essential and fundamental way we perceive surfaces.

Hue: The quality that describes the wavelength(s) of light that a surface absorbs and reflects. The surface is red.

Chroma (Saturation, Purity): The quality that describes the intensity, brilliance or purity of the hue exhibited by a surface. The surface is a muted red.

Reflectance: The quality that describes the degree to which light is absorbed or reflected by a surface.

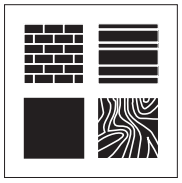
The reflectance of a surface falls on a continuum from absorbent to reflective. The reflectance of a surface can be described as matte, dull, shiny, lustrous, polished, etc.

Uniformity: The quality of a surface which describes the distribution and evenness of its color, illumination and/or reflectance.

Surfaces fall on a continuum from uniform to variegated depending on the perceived scale and pattern of changes in its color, light and reflectance. Surfaces may be perceived as smooth, textured, speckled, spotted, patterned, etc.

Transparency (Opaque/Translucent/Transparent): The quality that describes the degree to which light is transmitted through and bent by a surface.

Opaque surfaces only reflect and absorb light and cannot be seen through. Translucent surfaces do some combination of reflection, bending and transmission of light. Translucent surfaces tend to obscure what is on the other side. Completely transparent surfaces allow maximum light to pass through with minimum bending allowing the perception of surfaces behind without distortion.



Substance: The qualities of material that are perceived through our haptic (touch, movement), audio (sound) and taste/smell systems.

Rigidity: The quality that describes the resistance of material to deformation.

A material can range from rigid to fluid. It is perceived through our haptic senses by touching, prodding, pounding, etc..

Texture: The quality that describes the three-dimensional variation of a material's surface.

It is the quality of being smooth or rough, course or fine and the form of the texture (rippled, pebbled, granular, etc.). Texture is perceived through touch—the pressing and/or rubbing of our body against a substance.

Temperature: The quality that describes the degree to which a material is of higher or lower temperature than the skin.

A cool surface is one that draws heat from the body—it is cooler than the body. A hot surface radiates heat to the body.

Weight: The quality of material that is acquired through lifting or movement.

The weight of material can be measured objectively but our sensory knowledge of material is based on years of manipulating things. We lift and move ourselves and other things on a daily basis.

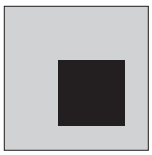
Composition: The quality that describes a material's quantitative and qualitative makeup.

A material may range from one that is uniform or homogeneous to one that is made of parts. The latter may be referred to layered, laminated, crystalline, granular, modular, etc.

Sound: The qualities of material that are taken by our auditory system into our bodies. The echo of steps in a stone cathedral or trickling water.

Smell: The qualities of material that are taken by olfactory system into our bodies. The smell of cedar or fresh paint.

Taste: The qualities of material that are taken by our taste system into our bodies. The taste of salt.



CONTEXT

The quality that describes the location and orientation of an element relative to the observer or frame-of-reference.

All things must be some place and be perceived within some context. The context can be established or recognized by the viewer. The context attended by the viewer then becomes the reference for the recognition of an element's location and orientation.

Reference: That which frames our attention and establishes the context within which a thing exists. The reference can be the observer/user or frame-of-reference.

Observer/User: The person perceiving and/or using the element, object or environment.

At the most basic level the observer defines the context and the things within it are perceived as having some physical relationship. Terms such as front - back, up - down, left - right, above - below, etc. describe the relationship of the things to our bodies. In addition the observer may relate the perceived things to some rational system such as Cartesian coordinates (X, Y, Z axis), measurements (feet, meters), compass (east, west), map coordinates (longitude, latitude), clock (clockwise - counterclockwise), etc.

Frame-of-Reference: A perceived or acknowledged context that includes within it an attended thing or things.

Those things outside the frame-of-reference are or have been excluded from consideration and/or attention. The boundary may be cultural (i.e. picture frame) or physical (i.e. what we can see). The designer does not control the viewer's perception of the frame-of-reference, but can influence it through the manipulation of pattern, hierarchy and contrast, control of the observer's movement, control of the visual field relative to the observer's location, and the creation of figures or things which afford recognition and thereby attract attention.

Location: The physical position of a thing relative to some reference.

The location of an element can be in relationship to the viewer, other things and/or the context.

Orientation: That quality that describes the direction in which a thing's edges, surfaces and axes point relative to some reference.

The orientation of an element can be in relationship to the compass, the viewer, other things and/or the context.

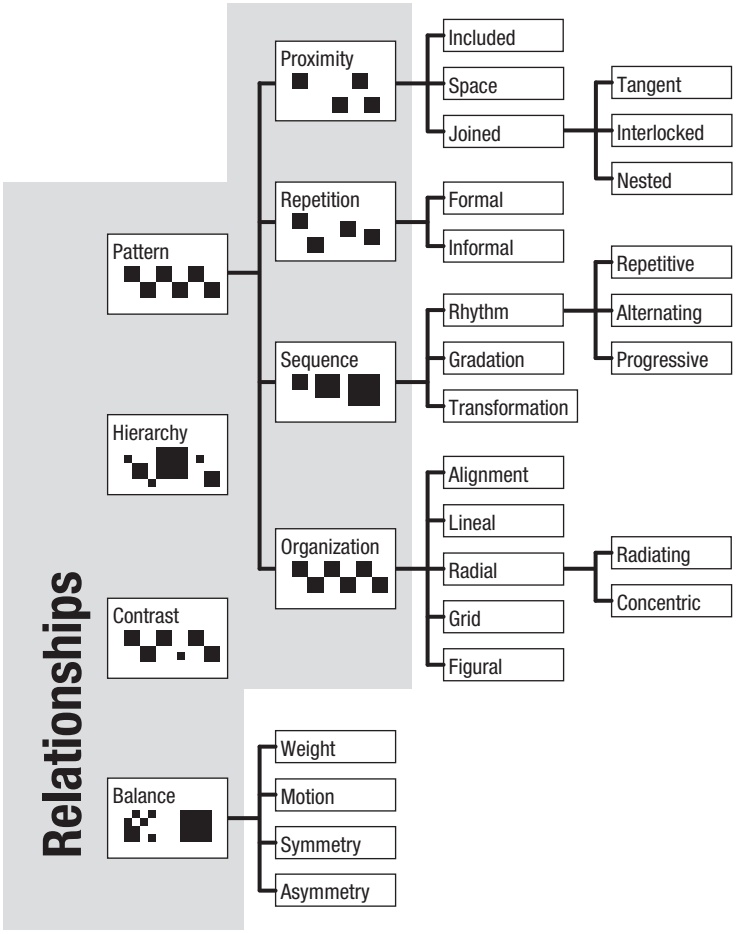
RELATIONSHIP

For something to exist it must be somewhere and if it is somewhere it has some relationship to other things or the person perceiving it. Relationships identify phenomena that afford the perception of association or connection between things. The perception of relationship is necessary for meaning to be afforded or constructed because elements without relationship are perceived as random and meaningless.

There are four fundamental kinds of relationships. They are all operating at some level all the time. They include relationships of pattern, hierarchy, contrast and balance.

Pattern must be perceived for contrast or hierarchy to be perceived. Contrast is created by deviating from a pattern. You cannot create a contrast if there is nothing established to contrast with. Hierarchy is the systematic control of contrast. In the simplest terms, pattern affords relationships of commonality while hierarchy and contrast afford relationships of differentiation.

Relationships of balance employ some combination of pattern, hierarchy or contrast to achieve equilibrium.

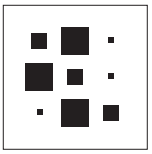


PATTERN

A set of predictable relationships between things.

A pattern is a perceived or intended system of relationships between things. To perceive a pattern is to extract some underlying ordering system or shared qualities exhibited by some set of things. To recognize a pattern is to know when something breaks the pattern or if asked to add an element, to know where and how to add the element.

The concepts that fall under this concept are developed in subsequent pages.



HIERARCHY

The quality that affords the perception of the relative importance of things.

Hierarchy is the systematic control of attributes to afford the perception of relative importance. It is the essential means by which the viewer's attention can be affected because we tend to look first at those elements that are dominant.

CONTRAST

That quality that affords the perception of difference between things.

Relationships of contrast show variation that ranges from subtle changes in amplitude or gradations to complete opposition or the unexpected. Contrast breaks the pattern. It introduces surprise or variation in a system of relationships.

The concepts of pattern and contrast are interrelated. For contrast to exist there must be a pattern or established relationships for the contrast to break. The clearer the normative relationships the clearer the contrast can be.

BALANCE

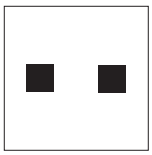
The quality that affords the perception of equilibrium within some attended set of things.

Balance is based on weight and motion—the two existentially based expressive meanings that things can afford. For a composition to be perceived as balanced it must possess a distribution of weight and motion that appears to be in equilibrium. Our bodies provide the basis for assigning weight to and sensing balance between things. Our understanding of balance is based on our bodily experience of resisting gravity. Because of this, we try to find balance in all things. It is so fundamental that we do it automatically.

Weight is based on our sensory knowledge of material gained through years of manipulating things. We lift and move ourselves and other things on a daily basis. Each has a weight and inertia that builds in us an acute awareness of the heft of things. We also develop associations between value and weight. Things that are light in value are felt to weigh less than things that are dark.

Movement forms our basis for interpreting motion. We feel it as lineal, radial or sequential—we walk in a line, point in a direction, spin around and do things in some order.

Balance can further be categorized as being symmetrical or asymmetrical—the balance of like things versus the balance of unlike things.



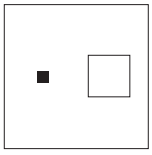
Symmetry: Equilibrium produced by the similar or identical location of like things relative to a point or line.

The weight, motion and location of the elements creating symmetrical balance must be the same for the rules of symmetry to be met. Symmetry may be formal or informal where formal symmetry is composed of identical elements and informal symmetry is composed of very similar elements.

Symmetrical balance is one of the most powerful relational concepts that a thing can exhibit. It is based on our experience of our own bodies and those of other living things. Because our understanding and recognition of symmetry is so fundamental and clear it should be used with great fidelity.

Lineal Symmetry: The repetition of similar or identical things with respect to a line or axis. This brings together the concepts of repetition and lineal structure. This is also called bilateral symmetry.

Radial Symmetry: The balanced repetition of similar or identical things with respect to a point. This brings together the concepts of repetition and radial structure.



Asymmetry: Equilibrium produced by the relative location of unlike things.

The weight and motion of elements creating asymmetrical balance are different. The concept of center of gravity or a fulcrum allows the different elements to appear in balance.

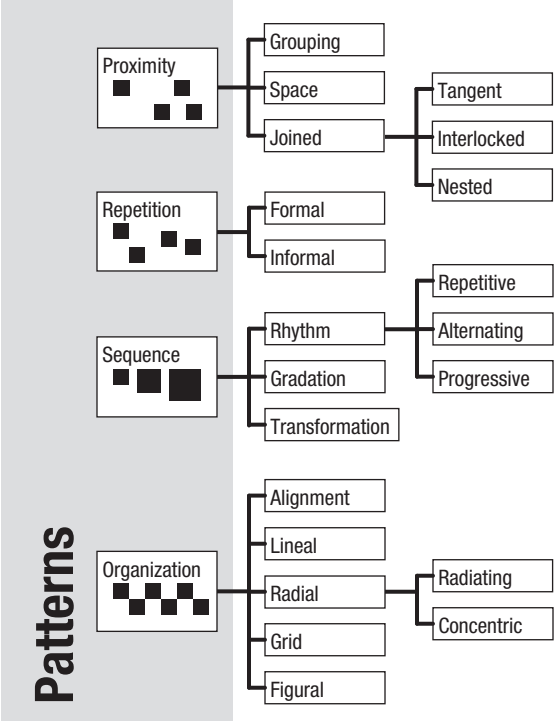
Asymmetrical balance is generally harder to achieve but affords a greater dynamic quality.

FUNDAMENTAL PATTERNS

A pattern is a predictable relationship between things. It is a perceived or intended system of relationships between things. To perceive a pattern is to extract some underlying ordering system or shared qualities exhibited by a set of things. To recognize a pattern is to be able to know when something is out of place or how another element would be added.

The fundamental formal concepts available to create pattern are proximity, repetition, sequence and organization.

The concepts of proximity and repetition are always present in some form: things are always in some physical proximity to each other: and things have attributes that will be compared for similarity.

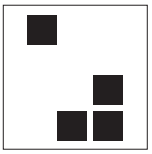


PROXIMITY

The distance between things.

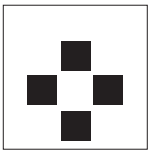
Proximity affords the perception of relationship between things through the distance between them—their relative location. The smaller the distance between things the stronger the relationship. Pattern is created through similarity in the proximity of things.

All things within a given frame-of-reference have some proximity to each other. Those things that share a common proximity tend to be seen as a group. In addition, there is a point at which the size and alignment of things in relationship to their proximity defines a positive space between them.



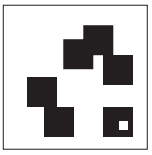
Grouping: Two or more things that share a common spacing (locational density).

A group of things is perceived as being related and defining some area, figure or shape. The more tightly packed the things, the greater the relationship. The boundary of the group is defined by a change in the spacing; the greater the change the more clearly the group is perceived as a figure or shape. The concept of group is related to that of repetition in that it results from the similar or exact duplication of the distances between things.



Space: Shape defined by the proximity of two or more positive things.

As positive things come close to each other the space between them can takes on the qualities of a spatial figure or negative shape. The perception of the space as a figure is dependent on the scale and proportions of the space to the defining positive surfaces, the proportions of the space itself and the shape and orientation of the defining surfaces. This is related to the issue of closure under the attribute of shape.



Joined: Things in physical contact.

Two or more things can be joined together by the sharing of one or more surfaces and/or edges. This is in one sense the ultimate in close proximity. Once things come in contact with each other they can produce a variety of visual effects including tangency, interlocking and nesting. A key quality of joined things is the degree to which they retain their individual identity versus creating a new form.

Tangency: The touching of the edges and/or surfaces of two or more things.

Contact can vary from a point to the sharing of entire surfaces. The shared surfaces can range from closed to open. Tangency can afford the perception of addition, mounting or integration/fusion.

Addition: Tangency in which the things are of equal size and retain their individual integrity.

Mounting: Tangency in which the things are of unequal size with the largest acting as a platform to which the others are attached.

Integration/Fusion: Tangency in which the things are first perceived as a whole or figure.

Interlocked: Two or more things sharing a portion of their area or space while retaining their individual identity and spatial definition.

Interpenetration: The sharing of space by things as one passes through another. The shared space may belong equally to both things, be dominated by one or produce a third thing.

Subtraction: The taking over or omission of a portion of a positive thing by a negative thing.

Surrounded: Subtraction that results in the remaining positive thing enclosing all but one side of the negative thing.

Nested: The location of a smaller thing within a larger one.

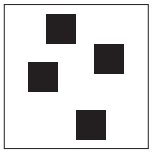
Nested includes the ideas of layering and/or unfolding over time and space. The layers may be simultaneously experienced or they may become visible only through some movement or sequence.

REPETITION

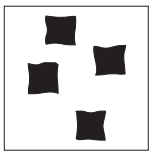
The sharing of one or more attributes by two or more things.

Repetition can be through the size, shape, material, and relationship of the things. The more attributes and relationships shared between things the clearer the pattern. The degree of similarity existing between things dictates it's classification as formal or informal.

The development of fractal theory can be thought of as extending the concept of repetition to self similarity at all scales.



Formal: Repetition of identical things.



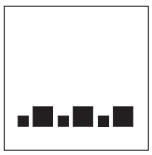
Informal: Repetition of things that share one or more of their attributes.

The fewer attributes shared the less formal the repetition. Repetition requires the sharing of sufficient attributes to be perceived as being of a kind.

SEQUENCE

The ordering or response of things to a phenomena which produces movement or the perception of process or change over time and/or space.

Movement which involves change over time can be in the direction and focus of the eye, the location and position of the body, the location and orientation of the thing, and/or the attributes of the things. Each of these movements or changes requires time to complete and perceive or is a record of an event having occurred over time. Sequence also involves change that may appear as a series of operations or a process that transforms a thing into something different. Sufficient steps or qualities of the sequence or process must be visible for the conceptual manipulation to be evident. The more integral and/or logical the thing is in its location in and contribution to the sequence or the more visible the process, the clearer the pattern.

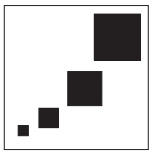


Rhythm: Sequence created through the repetition of a set of things.

Repetitive: Rhythm of things with similar or like attributes: A A A A.

Alternating: Rhythm of multiple things with similar or like attributes: A B A B A B A.

Progressive: Rhythm of a graduated set of things: A B C A B C A B C A B C.



Gradation: Sequence created through a gradual change in any or all attributes except for shape in a series of things.

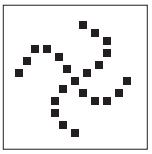
In gradation the shape of a thing stays the same but its other attributes change. The bird changes from white to black or the square from small to big.

Transformation: Sequence created through a gradual change of shape in a series of things.

Transformation requires that the shape of something change into something else—something morphs into something else. A bird changes into a frog or a square into a triangle.

ORGANIZATION

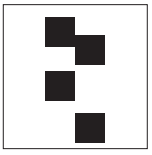
An organization is perceived as a system or structure to which things respond through their selection, attributes or alignment. Organization affords the perception of relationship between things through their response and contribution to a common overall framework, which may be a visible part of the phenomenon or made visible by the distribution of things. The things may be chosen or included because they fit or are associated with the organization. Their attributes may be established and their configuration determined by the organization. The organization may be formal or informal depending on whether the things respond to the structure precisely or approximately. The more formally the things respond to the organization the greater the perception of relationship. The stronger the visibility of the underlying structure the greater the variation it can hold. Pattern is created by the perceived response of the things to the organizational structure.



Alignment: The quality that describes the relationship between the edges, surfaces and axes of things and the context.

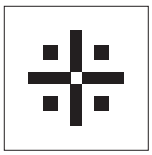
When there is alignment between things the eye is drawn from one to the other. When a number of things are aligned there is a continuity created that can lead the eye along the series—it creates movement or direction. This concept includes the Gestalt concept of continuity.

It is impossible to see the example above as other than two intersecting lines. You cannot see it as separate squares. In fact, it is easiest to see the example as a wavy "X". Gestalt psychology found that we simplify the visual field into the fewest figures possible. In a sense, all pattern concepts provide ways to afford the simplification of a visual field by creating relationships between things and thereby providing the viewer a way to group things into simpler wholes.



Lineal: The responding of things to a reference line, axis or datum.

The line may be a visible part of the organization or implied by the position of the things. The things may respond formally or informally to the axis.



Radial: The responding of things to a point, its radii and/or its concentric rings.

Radial organizations can take one of two forms or a combination of the two: radiating and/or concentric.

Radiating: Organizations that employ or respond to lines starting from, pointing at or passing through the point.

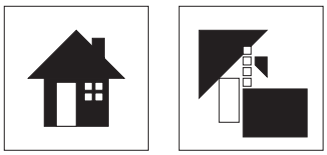
Concentric: Organizations that employ or respond to lines that form rings around the point.

Grid: The responding of things to two or more sets of intersecting lines or cells.

The grid can be implied by the location of the things or it can be explicitly made physical. The grid may be easily recognizable or ambiguous and difficult to discern because of the interrelationship or complexity of the elements. Grid lines may be orthogonal or angled, straight or curved, aligned or offset, or regular or irregular in their spacing.

The world of grids goes far beyond the simple square grid that is illustrated. A study of Tessellations will greatly expand your view of grids. Tessellations are simply shapes that when repeated fill a surface without gaps. The name comes from the word tessella, the small square tile used in ancient mosaics. The edges of a field of tessellations define a grid. Each tessellation can contain any combination of shapes that fill it. The work of M. C. Escher uses tessellations.

Three-dimensional grids enter the world of volumetric shapes that pack in space without gaps. Self all space filling shapes include the cube or rectangular volume, truncated tetrahedron, rhombhex dodecahedron, truncated octahedron and rhombic dodecahedron. There are also pairs and sets of three volumetric shapes that completely fill space.



Figural: The responding of things to a figure.

A figure is any archetype, typology, style, configuration, shape, representation or motif that affords meaning to and is recognized by the observer. It requires knowledge of the figure by the observer/user and sufficient definition for closure or recognition to occur. The illustrations above both have identical things. The one on the left is figural, the location of the elements makes reference to the figure of a house. The one on the right is not figural—it is abstract—it references nothing.

The continuum of figural structures closely parallels the abstract/symbolic/representational continuum of a single thing. A figural composition is able to evoke a rich set of meanings not inherent in the basic form itself by referring to other ideas within the culture or personal memory.

COMPLEXITY

In discussing or designing things there must be concepts that point at both the parts and the whole. The formal concepts presented in the previous chapter are most effective in identifying and evaluating the attributes of the parts but not the impact of the whole. The goal of this chapter is to look at some traditional concepts that point at the whole and propose that complexity is an effective concept for understanding and evaluating the overall impact of a thing.

An Encompassing Concept

A normative theory is one that addresses what ought to be—what "good" is. They are theories of judgement taking positions on the merit, worthiness, goodness, badness, or desirability of actions or outcomes. Terms for qualities associated with positive formal experiences include unity, variety, contrast, harmony, balance, scale and proportion. That is to say, a thing will be judged as pleasing in terms of its formal qualities if it exhibits some combination of these attributes. They are concepts that address the overall quality of a thing.

Unity means oneness, consistency or integration. It is when each element plays an important part. Unity as a normative position holds that a thing should posses coherence or wholeness to be experientially pleasing. The elements of the design look as though they belong together—there is a visual connection beyond mere chance that caused them to come together. An important aspect of unity is that the whole is predominant over the parts—you see the whole before noticing the individual elements.

Unity and variety are often linked. Unity constrains or controls variety, whereas variety provides the interest within unity. Unity tends to make things more alike where as variety tends to make things different. Variety as a normative position holds that the elements of a thing should exhibit some level of variety.

Where variety identifies small differences, contrast describes large differences. It often implies opposites. Contrast is the other side of unity, and as a normative position maintains that unity is boring, and that only through the introduction or juxtaposition of disparate elements can a thing achieve a pleasing formal quality.

Harmony as a normative position holds that a thing should exhibit some level of similarity between its elements to be pleasing. Elements that are harmonious are those that go together—that share an appropriate number of attributes or qualities.

Balance as a normative position holds that a thing should exhibit equilibrium between the forces of weight and motion created by the elements of the composition. It is the achievement of stability between opposing visual forces. Things perceived as balanced are felt to be stable and comfortable while those which are not are unstable and create a sense of tension.

Scale as a normative position holds that the elements of a thing or the thing itself should be of some size relative to something else. When something is out of scale it possesses a poor relationship to something else. Scale as a normative issue is usually related to the experiential qualities of a thing.

Proportion as a normative position holds that the elements of a thing and the thing itself should exhibit certain dimensional relationships. Proportioning systems have been developed based on the human body, the Fibonacci series of numbers, the Golden Section, etc. Once defined they are used to establish the size of things and their size relationships to other things.

The concepts of contrast, balance, scale and proportion are included in the formal concepts presented in previous chapter. They certainly are concepts that some people emphasized as important to our experience and appreciation of things but they are not concepts that encompass the whole. Scale and proportion only help in evaluating or deciding on a thing's size. Contrast and balance only help in evaluating or deciding on the relationships between the elements of a thing. While each of these formal concepts is important, they do not serve as meaningful points of view from which to evaluate things as a whole.

This leaves the concepts of unity and harmony. These two concepts have a long history in the community of visual design.

To discuss what produces either quality requires a discussion of the seven fundamental formal concepts of size, shape, material, context, number, variety and relationship.

The limitations that the concepts of unity and harmony possess have been highlighted by critiques such as those presented in *Complexity and Contradiction in Architecture* (Venturi, 1966) and many other publications. Both unity and harmony emphasize consistency and integration or similarity between elements. They give preference to the sharing of attributes as opposed to contrast and contradiction. They are inherently normative—they take the position that unity or harmony are good and disunity and dissonance are bad. Finally, they tend to be kept intentionally ambiguous because to define them would be to reduce their effectiveness as concepts that can accommodate a significant range of options.

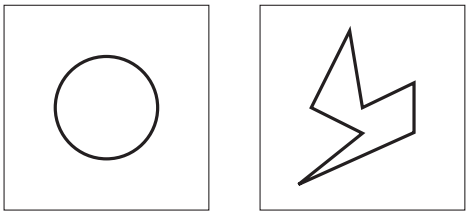
I would propose that the most effective formal concept for evaluating visual things as a whole is complexity. That the level of complexity exhibited by things directly affect people's interpretation of what is beautiful or pleasurable. That the most important formal decisions a designer makes are those that establish a thing's level of complexity and therefore, understanding and being able to manipulate the level of complexity of things is essential for a designer.

There is not a normative position in terms of a specific level of complexity. The normative position is that each thing should exhibit the appropriate level of complexity given its intended purpose and audience. The following will define a continuum of complexity, identify the factors that contribute to complexity and propose a model for its understanding and continued exploration.

Defining The Complexity Continuum

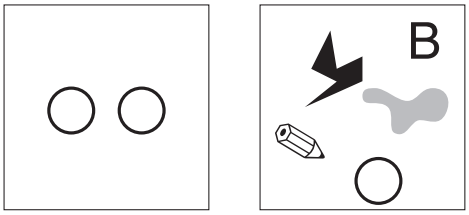
The word complex comes from the Latin complexus and its stem complectere, complecti meaning to encompass, encircle or embrace. "Complex refers to that which is made up of many elaborately interrelated or interconnected parts. (Webster's New World Dictionary) Complexity is a measure of the number of elements and the relationships between the elements. As the clarity of the relationships decreases, the complexity increases. Minimum complexity exists when all elements exhibit common qualities and respond to a single unifying law. Greater complexity exists if elements manifest a variety of attributes, exhibit varied relationships and support multiple interpretations.

Stated in the simplest terms, complexity is the number of parts, and the differences between them. If we start with a single element, we can describe its form in terms of size, shape and material—it has some configuration, dimension, color, texture and substance. The simplest shape is the one with the fewest edges and surfaces that is homogeneous in terms of color, texture and substance. An element becomes more complex as the number of edges and surfaces and the differences between them increases.

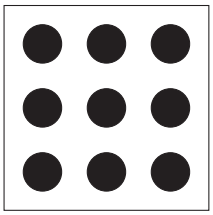


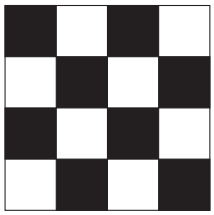
For example, the circle (2-D) and sphere (3-D) are simple shapes having one continuous edge and/or surface that can be described in terms of a single point. Regular polygons are more complex than circles and irregular polygons are even more complex.

For multiple elements the means available to control complexity continue to be number (the more elements the more complex) and difference (the greater the difference between elements the greater the complexity) with the addition of relationship (the more ambiguous the relationship between elements the greater the complexity).



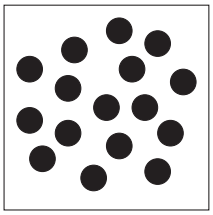
The simplest organization is one composed of identical circles related through a single organizing principle—a dot pattern. The dot pattern also has a clear distinction between the figure or positive element (the dot) and the ground (the surface upon which the dots sit). The activation of the ground as a figure increases complexity.

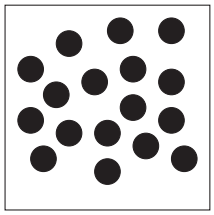




For example, the checkerboard is more complex not only because it consists of more complex elements but because the figure and ground can be reversed—there are both positive and negative figures.

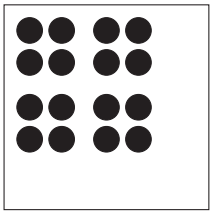
Before continuing, the concept of number must be qualified. We have a variable threshold in the vicinity of seven, plus or minus two, for recognizing a specific number of elements (Barratt 1980). This means that our response to number "may be regarded as 0, 1, 2, 3, 4, 5, 6, 7, plenty, multitude." (Barratt 1980, 27) The concept of plenty being the point at which the addition or subtraction of one element ceases to have a precise effect.

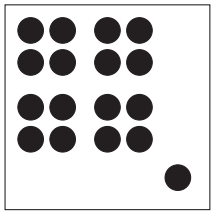




For example, a group of sixteen elements may not be perceived as different from one of seventeen elements. Therefore, the concept of number in relationship to complexity must take into consideration the viewer's capacity to perceive the number.

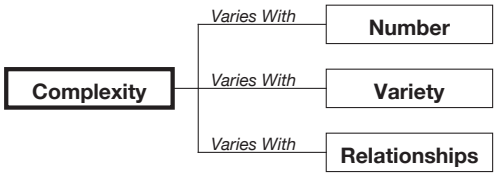
The factor of relationship can also counteract the simple number plus variety equation of complexity. If we understand the relationship between the elements then we no longer pay attention to the individual elements. We pay attention to the whole created by the relationship that joins them together. Perceptual studies have shown that parts are perceived in relation to conceptual wholes and that perception favors organization into simple whole figures as a way to make sense of any given pattern or array of elements. This means that as the perception of relationship between elements increases complexity decreases.





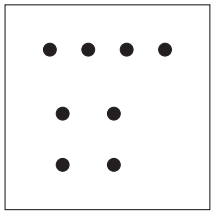
For example, taking the group of sixteen elements and organizing them into a pattern of elements consisting of four circles each reduces the apparent number to four. Given this, the addition of one makes a big difference.

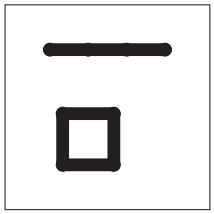
Therefore, complexity can be explored as the interaction between the concepts of number, variety and relationship.



Complexity & Completion

Completion has to do with the degree to which things are visually defined. Things can range from visually open or implied to closed or explicit. Our perceptual system strives to organize the visual world into the simplest most inclusive things possible. For example, it will see four equally spaced dots as a line or the corners of a square.





The complexity of things is directly related to the ease with which we can organize them into simple wholes. Therefore, a square defined by four connected lines is simpler than one defined by four dots—explicitly defined things are simpler than implied things. The process of making sense out of a visual field engages us. If it is easy to understand, it does not hold our attention. If it offers only one possible interpretation as to the whole it is less engaging than something that supports alternative interpretations.

Complexity & Surprise

Everyone has a unique personal history and base of knowledge that affects their interpretation and response to each new object or event. Based on our history and knowledge each new object or event is to some degree understood and to some degree a surprise. A way of describing the relationship between complexity and experience is through the concept of surprise where surprise is the "way we feel upon discovering that our pictures of reality depart from reality itself." (Casti 1994, 3) The degree to which something surprises us is directly related to its perceived level of complexity—familiar things offer little surprise.

We learn from each event as it occurs and, therefore, events simplify with experience. An event that may be too complex at first occurrence becomes progressively simpler with subsequent occurrences. Some events lose complexity gradually, some do so suddenly through an insight, others grow in complexity as experience makes visible levels of complexity not seen at first and still others are so complex that they are never understood.

What we learn from each event is held in the surprise that it contains. If we can precisely predict something then we already know it and therefore it carries no information for us—it carries no surprises. However, for people to learn something it must be related in some way to our current understanding. Something that is all surprises can not be understood and therefore can teach us nothing. For surprise to be meaningful in must come in some context that we can understand. Complexity is a measure of the proportions of understanding versus surprise that each person perceives in any event.

Each person has a unique cognitive structure that is a result of their personal, social, and cultural experiences. What might be complex to one person may be simple to another. Therefore, complexity is a function of both the stimuli and the perceiver and an exploration of complexity must take both into consideration.

Complexity & Description

If a simple organization has the properties of predictability and redundancy then it can be easily described where as a random organization is difficult to describe. Therefore, complexity can be characterized as being "directly proportional to the length of the shortest possible description of that object." (Casti 1994, 9) An organization is random if it requires that every element in the organization be individually described—"an object or pattern is random if its shortest possible description is the object itself. Another way of expressing this is to say that something is random if it is incompressible." (Casti 1994, 9)

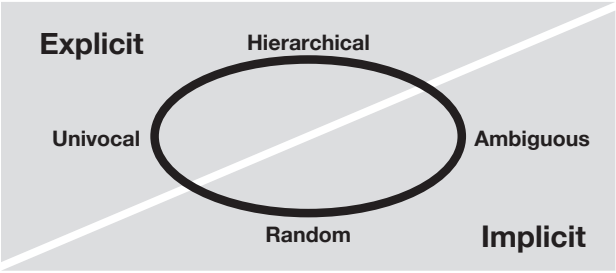
For example, an organization of four elements would be considered simple of it could be described as four dots marking the corners of a square. The organization would be considered complex if its description required the individual description of each element. The organization includes a five pointed star located two inches down and one inch in from the upper left corner of the piece of paper plus the curving line of variable width that starts at one inch in and . . . . etc. A complex organization exhibits no pattern. There is no gestalt or relationship evident.

Complexity & Three-Dimensions

Number, variety and relationship constitute the means a designer employs to control complexity. The ideas discussed so far apply to both two- and three-dimensional things. However, three-dimensional things add consideration of the observer's point of view at any point in time and space. As we move through space or around things what we can and cannot see changes. This change is controlled by occluding edges. When we approach a doorway we slow a little and focus on the limits of the opening. We do this instinctively out of self preservation because we know that some unseen person or thing might appear through the door. The edges of the door frame that define the opening are occluding edges. They are the edges that define the limits of the surfaces that can hide or obscure something from our vision. It is at these edges that something concealed will first become visible. It is at these edges that new information will appear—they are the potential source of surprise. Therefore, the number of occluding edges in a three-dimensional environment is related to the perceived complexity of that environment. The simplest three-dimensional environment is one that is defined by continuous surfaces—one in which there are no occluding edges.

Complexity Continuum

Complexity can be modeled as a continuum along which a designer may move in response to his or her value system, the problem and the client's value system.



The model proposes a circular continuum with four regions: univocal, hierarchical, ambiguous, and random. These regions are divided into those that are explicit (clearly stated visual phenomena) and implicit (suggested or unclear visual phenomena). The univocal region contains the most explicit visual phenomenon—a pattern with clear figure ground differentiation. For example, a dot pattern in which all dots and the distances between them are identical—there is both attribute and organizational redundancy. In this region the designer is controlling the content and its organization and producing a single clear intelligible communication.

The hierarchical region contains structures ranging from those employing one organizational principle and a limited hierarchy created by the manipulation of element attributes to those containing multiple organizing concepts, elements, and disruptions. The

hierarchy of visual importance would provide the rational and organizational coherence and guide the viewer through the variety. In this region the designer is controlling the content and its organization, producing a multifaceted, clear and more explicit, intelligible communication. At the interface between hierarchy and ambiguity, the relative clarity and intelligibility of the hierarchy would diminish or not include all the parts.

In the ambiguous region, multiple hierarchies would compete for attention requiring the viewer to choose between or resolve competing alternatives. The designer is creating an "open work" (Eco 1989) which presents a field of possibilities open to many choices and interpretations. In this region the designer is presenting some intended content organized more implicitly, producing a multifaceted open communication. The intention of the designer is evident and gives coherence or a sense of belonging to the elements, but leaves open a variety of interpretations. At the interface between ambiguity and randomness the intention of the designer fades and control over alternative interpretations decreases.

The random region includes organizations from those with many competing hierarchies and elements to those in which every element competes equally for the viewer's attention. Alternative interpretations become so numerous that any sense of direction or control by the designer is lost and the viewer must impose any meaning or order. At the point at which randomness becomes so complete as to prevent the imposition of any meaningful order, a shift takes place. Either the existing frame-of-reference is abandoned and a new one is established to allow intelligibility, or the phenomenon is classified as a texture or homogeneous and thereby made intelligible. This overall texture or homogeneous visual quality (Arnheim 1971) is the lowest grade of order and is an informal pattern using similarity. Thus we have gone full circle and returned to the region of the univocal.

Objects and environments can be seen as falling along this circular continuum from univocal through hierarchical and ambiguous to random and back to univocal. The point of entry, direction of movement, and point of exit from the system depends on the set of values and processes appropriate for the problem, designer and client. Each product will have some balance of predictability versus surprise. It is the responsibility of the designer to understand the complexity continuum and make or guide choices that will result in objects or environments that have an appropriate level of complexity.

Summary

All things in the world exhibit some level of complexity. Designers establish the relative complexity of things as a result of decisions concerning the number and variety of the elements employed and the relationships between them. Understanding complexity is essential for a designer because it is directly related to the perception of a thing as beautiful or pleasurable. Choosing the appropriate level of complexity for a given situation and being able communicate it to others is a fundamental skill for any designer. It is a manifestation of the designer's ability to shape the visual world to achieve a desired end.

Characteristics of Complexity Continuum Regions

Univocal	Hierarchical	Ambiguous	Random
Maximum order	Clear order	Alternative orders	No order
Maximum intelligibility	Clear intelligibility	Somewhat intelligible	No intelligibility
Total predictablility	Good predictability	Somewhat predictable	No predictability
Minimum information	Range of information	Lots of information	Maximum information
Elements of equal importance	Elements have hierarchical importance	Elements have alternative hierarchies of importance	Elements have equal importance
Total redundancy	Considerable redundancy	Limited redundancy	No redundancy
Explicit/Closed	Somewhat Explicit/Implied	Implied/Open	No Gestalt/Larger Whole
Single meaning	Hierarchy of meanings	Alternative meanings	No meaning
No visual sequence	Clear visual sequence	Alternative visual sequences	No visual sequence

CONCEPT MAPPING

Concept mapping provides a visual representation or road map of our understanding or knowledge of something. It is a useful tool for externalizing and clarifying the understanding of concepts and their interrelationships. Concept maps allow us to simultaneously see multiple relationships and thereby evaluate a system of ideas as a whole.

Introduction

Our knowledge of things (Novak & Gowin 1984) is constructed from our perceptions of objects and events where an object is anything that exists and can be observed and an event is anything that happens or can be made to happen. Our constructed knowledge takes the form of cognitive structures—systems of interrelated concepts. These frameworks of knowledge (Wesley & Wesley 1990) provide the basis for learning and integrating new knowledge. A concept map attempts to show a set of concepts and the relationships between them.

"A concept is an abstraction; it pulls together a lot of facts. It organizes them and perhaps makes sense of them." (Hyde & Bizar 1989, 9) It is a regularity in objects or events designated by a label (chair, love). Concepts are constructed by people, societies and cultures. They organize our reality and direct our perceptions of the world.

Educating is the process by which we actively seek to change the meaning of experience. Meaningful learning occurs when we choose to relate new knowledge to relevant concepts and propositions we already know. "Concept maps . . . represent meaningful relationships between concepts in the form of propositions" (Novak & Gowin 1984, 15) where a proposition is "two or more concept labels linked by words in a semantic unit. For example, "sky is blue" would represent a simple concept map forming a valid proposition about the concepts "sky" and "blue." (Novak & Gowin 1984, 15)

Concept Maps & Learning

"The best way to help students learn meaningfully is to help them explicitly see the nature and role of concepts and the relationship between concepts as they exist in their minds and as they exist "out there" in the world or in printed or spoken instruction." (Novak & Gowin 1984, 24)

Concept mapping "will help students to extract specific concepts (words) from printed or oral material and to identify relationships among those concepts." (Novak & Gowin 1984, 24-28)

"Concept maps present a way to visualize concepts and the hierarchical relationships between them." (Novak & Gowin 1984, 28) It supports visual thinking by allowing the visual perceptual system to take in and the mind to process multidimensional relationships simultaneously.

Concept mapping externalizes concepts and thereby affords the perception of new relationships and hence new meanings—concept mapping can foster creativity.

Concept maps provide a basis for dialog concerning the validity of linkages, missing linkages, missing concepts and the meaning of concepts. Learning is an individual activity that cannot be shared but meaning must be shared, discussed, negotiated and agreed upon. Concept maps facilitate both individual learning and the creation of shared meaning.

Concept Maps & Memory

"Organization

The brain spontaneously imposes its own subjective organization on all material it remembers. . . .The more we deliberately organize the material, the more we are helping the memory process. . . . Moreover, the very activity of organizing the material is itself helpful in memory.

Keywords

Keyword notes are far more effective than phrases or sentences. The brain automatically drops the inessentials. . . .The [key] words are rich in imagery, . . .[and] the very act of extracting the key words involves you more in understanding the material and further increases the depth of processing.

Association

Since words and ideas that are closely associated are recalled together, it helps memory if they are put together visually in the notes.

Clustering

There are seldom more than seven or eight sub centers, so the material can be organized into a number of easily remembered chunks."

(Russell 1979, 176-177)

George Miller (Russell 1979) showed that our immediate memory is limited to seven items plus or minus two. The critical issue is the number of "chunks" and not the quantity of information in a chunk. Therefore, effective memory can be increased by reorganizing the information into larger but not more chunks.

Visual Memory

"Since visual images are much better recalled than words, the more visual the mind map is made, the better."

(Russell 1979, 177)

Use color, because it is remembered more than black and white, to reinforce different themes and differentiate between groups of concepts by outlining, putting on a background and/or sharing a common color. Use images such as three-dimensional forms, diagrams, pictures, etc.

"Outstandingness

Whenever an item is outstanding in some way or another, it is better remembered. . . .[Every map] should be unique; you should use different key words, different colors, and different shapes.

Conscious Involvement

The more you participate actively and consciously, . . . the better. . . .Wherever possible, think of original ways to note the material. The greater the originality and creativity, the greater the interest, and the better the memory."

(Russell 1979, 177)

A Map of Mapping

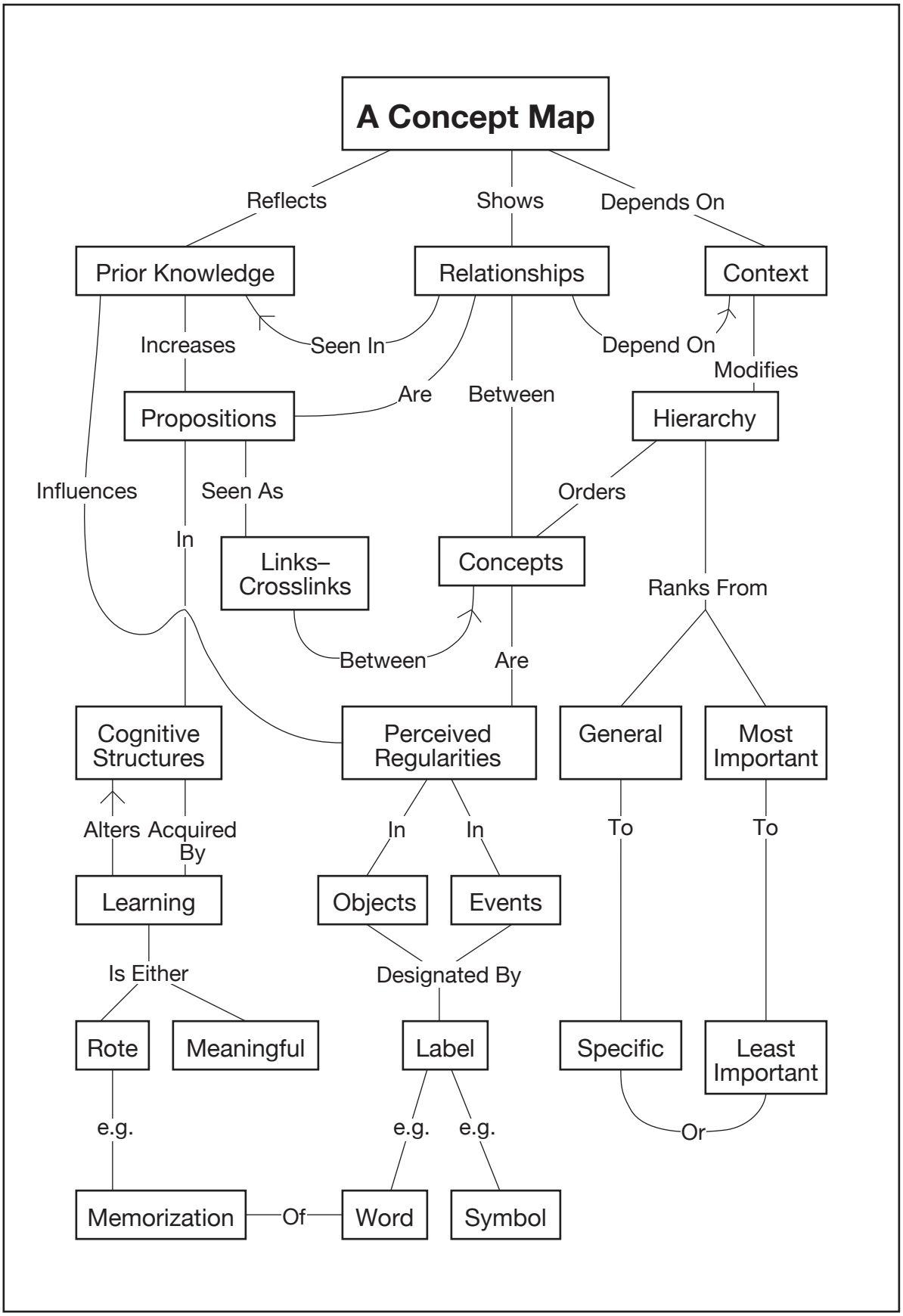
The concept map on the facing page is taken from the article "Concept mapping: A Brief Introduction" by Walter and Beverly Wesley (1990, page 4). It is both a good example and a map of concept mapping.

A concept map will include a number of concepts, show the relationships between them and reflect their relative degree of generality. General concepts go at the top with more specific concepts hierarchically ordered below. The concepts in the example are placed in boxes with relationship noted by connecting lines and words. Connections between concepts are linear (vertical) as well as horizontal. The horizontal connections or cross links show relationships between concepts across the major segments of a map. The linear links are shown with straight and the cross links by curved lines. This allows the map to be read as a sentence or series of sentences. For example, the center section of the example can be read:

"A concept map *shows* relationships *between* concepts *which are* perceived regularities *in* objects *and* events *which are designated by a* label*, for example a* word *or other* symbol*."*

(Wesley & Wesley 1990, 3)

Many people indicate that concept mapping gives increased personal control over learning and makes it more meaningful—produces a deeper understanding of the material. The major complaint is the time required to construct a map—an indication of the time required for true conceptual learning.


A Concept Map
Reflects
Shows
Depends On
Prior Knowledge
Relationships
Context
Increases
Seen In
Depend On
Modifies
Are
Between
Propositions
Hierarchy
Influences
Seen As
Orders
In
Links–
Crosslinks
Concepts
Ranks From
Between
Are
Cognitive
Structures
Perceived
Regularities
General
Most
Important
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Or
Memorization
Of
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Symbol

Making Concept Maps

The following provides some suggested steps that support the process of creating a concept map.

Step 1: Identify the major concepts.

The dominant concepts often appear in titles, subtitles and leading sentences in paragraphs. Choose the key concepts carefully and list them. Are any key concepts implicit—implied or understood but not directly stated in the reading or presentation? Are you mistaking an object or event for the more inclusive concepts those events or objects represent? Concepts are usually abstract nouns such as honesty, democracy, beauty, function, structure, wall, color, chair and drawing.

Do not try to select the concepts one at a time and put them into the map as you go. This linear approach will cause problems because the map is holistic. You must consider all the concepts and search out patterns before you attempt to construct a map of their relationships.

Step 2: Map the concepts from most inclusive (abstract) to most specific (concrete).

Do you know what the author means by each concept you have identified? Construct brief definitions based on the text and augmented with a dictionary or other resources.

Rank order other concepts in terms of importance and inclusiveness—put the most inclusive concept at the top and list the others in order below. Remember that concept maps should be hierarchical; that is, the more general, more inclusive concepts should be at the top of the map, with progressively more specific (concrete), less inclusive, concepts arranged below them. Begin building the concept map working from the most important concept down the ranked list.

Have you redrawn the map again and again to more clearly represent your understanding of the hierarchy and relationships? Expect to take more than one try to construct a map. Use overlays of tracing paper to alter and refine the map until it presents the relationships clearly and efficiently.

Step 3: Link the concepts with a line and linking words.

Choose linking words carefully. Examples of linking words include: needed by, made of, changes, can be, as in, from, contain, determines, have, increased by, indicates, is, used for, is where, would become part of, tries to, is either, are involved in, takes place when, affects, with, for, produces, combined to form, beginning as, such as, separates, influence selection of, is evaluated by, etc.

Step 4: Branch out from each concept to include definitions, illustrations, and factual information.

"Generally speaking, the more specific information that can be included in a concept map the more useful the map will be as a study guide and writing guide." (Clarke 1990, 169) Identify any specific examples that may help clarify the map. The examples may be objects or events.

Step 5: Use crosslinks to analyze additional relationships.

"Working from top down usually explicates the main relationships. Other relationships (links) appear when one looks at two concepts on an evolving map and asks, Is there a connection between these two concepts?" (Clarke 1990, 169) Look for cross links between concepts in different sections of the map.

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