On the formulation of spatial meaning in architectural design[1]

02

John Peponis[1+2], Chryssoula Karadima[2], Sonit Bafna[1]
[1] Georgia Institute of Technology
[2] National Technical University of Athens

Abstract

Spatial meaning is defined and the interplay between spatial meaning, spatial experience and design formulation is discussed.

Definitions

Architectural design implies a three fold spatial construction, of a complex material object, of an arrangement of space effectuated through the object and of a spatial experience engendered by these. Insofar as design is creative formulation, the logic of the construction cannot be purely derived as a parametric adaptation of principles, which are generic to at least some, if not all, other designs. Creative design must involve the definition of some new principles of construction. Through recognizing these we are also able to recognize intentionality as embedded in the object, whether perceived, occupied or explored through movement. In this paper we discuss how the three aspects of construction involved in architectural design are related. We suggest that their relation is constitutive of what we want to define as spatial meaning. We further suggest that at the deepest level, design formulation is not about the principles that generate, or order, each of the three aspects of construction taken separately, but about the manner in which the three aspects entail each other, resonate with each other, take each other into account.

The argument is organized as follows: First, context of the discussion is set and basic ideas are defined. Then, examples of designs are introduced in order to illustrate a distinction between meaning as it arises through the internal construction of the object and through referential relationships between properties of the objects and ideas expressed in other symbolic media. This leads to a more formal definition of spatial meaning based on the distinction between sense and reference. Once spatial meaning is thus defined we discuss its formulation in design in terms of an interaction between spatial motifs, spatial themes and evolving design languages. The focus

then shifts upon the entailment between the internal structure of objects and the spatial experience they generate. The importance of descriptive theories, which can bridge between the two, is underscored. However, as it is argued in the final part of the argument, descriptive theories must continuously be extended to allow for the fact that significantly creative designs authorize their own descriptions. The concluding section takes an overview of the key ideas discussed.

02.2

The terms configuration and "syntax" are central to the argument that will be developed, so that their explicit definition is needed. Consistent with Hillier (1996) configuration is defined as relations that take into account other relations. In the wonderful example offered by Hillier, the relation of two spaces, "a" and "b" is differentially qualified as being either symmetric or asymmetric, depending of whether both, or only one of them are also related to the outside. If only either "a" or "b" is related to the outside but not both, then one of the original spaces controls access to the other. Hence the asymmetric nature of the relation "a" to "b". If both are related to the outside, their direct relation is symmetrical. What is wonderful about this example is not immediately apparent. The original relation is not physically changed, and yet it becomes significantly qualified by taking into account other relationships. If "a" contained "b" and a third space was placed either around "a" or inside "b", the relation of containment between "a" and "b" would not be similarly affected. Containment is a transitive relation that cannot become symmetric. "Directly or indirectly accessible from" is a transitive relation that, as Hillier shows, can have symmetric and asymmetric modes. Thus, in the example offered by Hillier, configurational design moves affect the logical intention of a relationship, which is otherwise given. This is different from considering how design moves can add, or eliminate, relationships. Hillier's example is particularly appropriate when we look at space in terms of flows, including movement. Perhaps a first step towards a more general theory of configurational entailment would be to ask in what other ways can relations take into account other relations. Through inquiry into the possible modes of entailment between relations, the field of spatial morphology can be extended in new directions or interfaced with other fields of inquiry, including, quite notably, the study of design cognition.

Syntax is defined as relations that are consciously, if not reflexively, used to create a design. More precisely, syntactic relationships can be treated as subsets or aspects of a configuration. A subset of a configuration is simply a subset of the relationships that comprise the configuration. An aspect of the configuration is a way of looking at the configuration, as for example when we look at potential sequences of connections taking some position as our starting point, or when we look at a configuration in terms of relations of visibility as distinct from relations of

linear or convex connectivity. Thus, syntactic relationships are those subsets or aspects of a configuration whose description is consciously, or reflexively, embedded in the design of the object. One implication of the way in which the term "syntax" is used here is that the word will always directly refer not only to relationships between spaces, but also to the spatial disposition of the material elements that constitute a building and that give rise to the organization of space. In this sense, syntaxes cannot be dissociated from the geometry of the material body of the building, even though they may be aimed at the creation of relationships between occupiable spaces. Another implication of the proposed use of the term is to potentially render the terminology used in configurational studies of built space more in accordance with the terminology used in other fields, including, of course, linguistics. However, the proposed definition of syntax deviates from the slightly less clearly defined usage of the term in the literature hitherto associated with "space syntax". In that literature, the word "syntax" variably refers to either the principles that govern spatial arrangements, the configurational patterns present in an arrangement, or, more simply, certain kinds of relationships, such as those based on transitions, or direction changes imposed by the placement of boundaries in space.

02.3

Our definition of the terms configuration and syntax foregrounds the question of what the configurational consequences are of particular syntactic moves, whether these consequences are intended or unintended. This question, essentially a question of retrieving descriptions of the complex consequences of simpler compositional decisions, remains as fundamental to our argument as it is to the theoretical arguments presented by Hillier and Hanson (1984). The elaboration and continuous transformation of patterns during design involves cycles whereby the consequences of previous decisions are cognitively retrieved and the new understanding is reflexively re-embedded in subsequent decisions. The study of design formulation, however, requires that we look for more than description retrieval in design. Indeed, the critical factor in design formulation is the gradual emergence of a particular and motivated way of thinking about pattern, a particular way of becoming interested in configuration, a particular predisposition towards inflecting descriptions retrieved in certain ways.

Passages, figures and the doors themselves

The presentation of the argument will be facilitated by the introduction of some examples of designs addressing a relatively simple component of buildings, the door. As spatial devices doors are conditional controls over passages through boundaries, depending upon whether they are closed or open. However, they can also be treated as mechanisms that construct a spatial experience. In essence, we will take a simple relation between two spaces "a" and "b" and, rather than zoom outwards to show

how it can be affected by considering further relations to a space "c", we will zoom inwards to show how it is made. In this manner, a simple relation will in essence be interrogated as for the scope of its potential inflection and as to the manner in which it is defined within a domain of other relationships. In other words, consistent with the hypothesis that spatial meaning is configurational, we will show that elementary relations are not only the building blocks of more complex patterns, but also moments of compression of such complex patterns. Figure 1, shows two rectangular rooms linked by a simple opening, in the manner envisaged above. We can conceive of these as two convex spaces (1a). We can also conceive them according to the e-partition (Peponis et al., 1997); in this case approaching towards the threshold is interpreted as a gradual movement from areas providing less visual information about shape to areas providing more information (in Figure 1b lighter shades correspond to convex spaces which are visually linked to a greater number of corners and wall ends). The idea of threshold is thereby enriched by becoming embedded within a more complex underlying structure. If we allow that a door be placed on the threshold and also allow that door to modify the e-partition (without adding end points to represent the door itself), a much more complex pattern emerges (1c). This would continuously shift as transform itself as the door changes position. Thus, a door can be treated as a mere control over a threshold, or as a transformer of a more complex structure of visual fields. To look at doors as mechanisms that can construct spatial experience is to look for the underlying relational fields that may be modified as the door is pushed open by a moving subject.
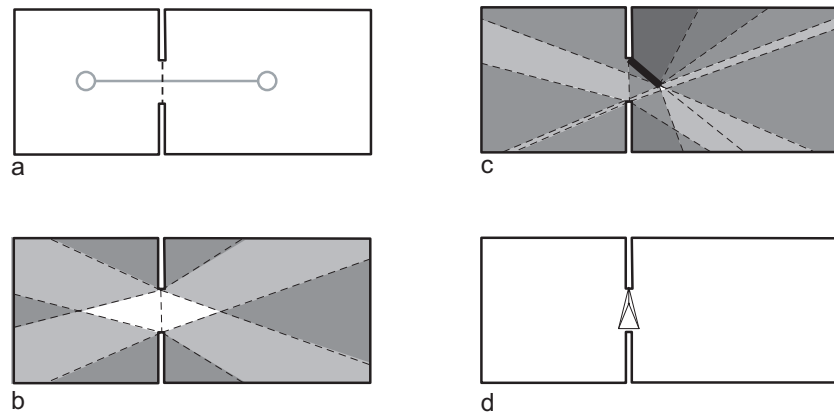

Figure 1: What relations is a connection made of?

Karadima has designed a number of doors aimed at the spatial experience of passage. Her doors imply even more complex underlying fields of spatial structure. One door, D1, is shown inserted in the simple plan discussed above (1d). As diagrammatically seen in a more detailed plan, door D1 (Figure 2) consists of a triangle ABC revolving around O. Elements AB, BC, and CA are transparent, as is the internal element AO. Elements OB and OC are mirrors on both sides. A vertical light source is located at the vertex of angle COB, so that light comes through surface

BC. The vertical door handles are located near edges B and C. The following conditions are generated along the passage through the door. As a subject approaches the door (2.1) visibility and permeability through the boundary occur opposite sides of the door surface. Mirror OB reflects the room from which the subject is about to leave. As the door begins to rotate (2.2), the subject is frontally reflected in the mirror. As the door rotates further (2.3) direct visibility into the room about to be entered is blocked. Mirror OB now reflects the back surface of the boundary about to be crossed. As the door continues to rotate (2.4), the mirror now reveals successive sections of the room being entered, while the prism of light coming through BC illuminates successive sections of space ahead of those picked up by the mirror and ahead of the entering subject. Once the subject releases the door after entry (2.5), the door swings back to the closed position; as a consequence, the subject is momentarily caught within the cone of light emanating through BC and is multiply reflected inside the angle COB. At this moment, the transparent section of the door that previously gave glimpses into the room about to be entered is entirely concealed from the subject.

02.5

The plan of door D2 (Figure 3) arises from the intersection of two triangles, KLM and PQR, rotating around T, the point of intersection of the bisectors of angles QPR and LKM. Elements QR and ML have mirrors on their inner surface and are opaque on the outside. Elements PS, and KN are mirrors on both surfaces. All other surfaces are transparent. Passage through the door creates a shifting interplay of direct and reflected views, some of the latter extending forward, into the room that the subject enters, and some backward out from the room that the subject leaves. In this case, however, a more interesting network of relations of visibility is created is we suppose several subjects using the door at the same time. Subjects occupying positions p4 and p2 see each other's face diagonally and directly, a symmetrical relation, but occupy either opposite sides of the boundary controlled by the door, or the threshold itself, moving towards opposite sides, an asymmetrical relation (3.1). Subjects in positions p2 and p3 are fundamentally placed in an asymmetrical relation whereby the subject at position p2 directly sees the back of the subject at the more forward position p3; at the same time, they see each other's face through mirrors, a symmetrical relation (3.2). Subjects in positions p4 and p1 see each other's face through mirrors, but none is able to see the other's back, even though they occupy successive positions (3.3). More complicated patterns arise if we
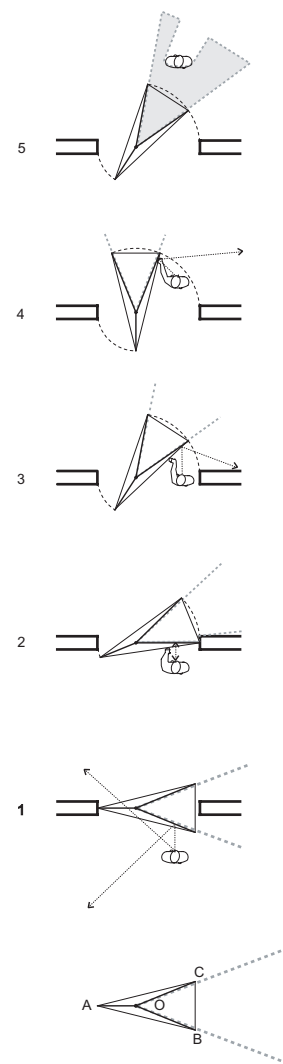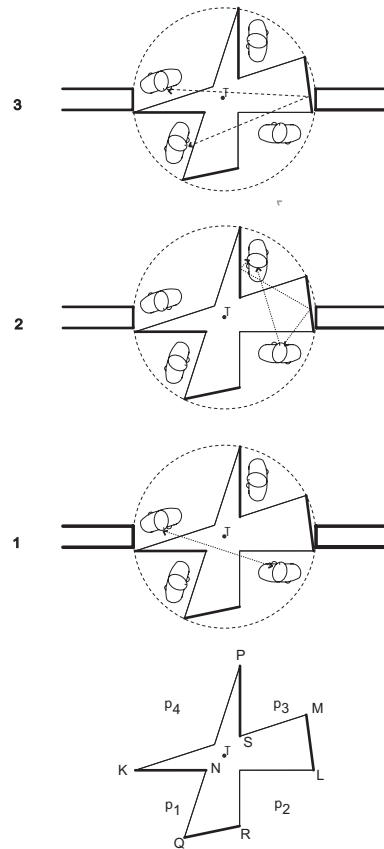

Figure 2: Door 1 / Prism

02.6

simultaneously consider relationships between three or all four subjects that could simultaneously use the door. But as no two positions are identical in terms of the patterns of visibility that they engender, no two subjects can occupy equivalent positions with respect to the door. Thus, whether successively moving across the boundary in the same direction or inversely moving across the boundary in opposite directions, the door positions subjects in relationships of fundamental asymmetry.

Figure 3: Door 2 / Overlapping prisms

From object to spatial sense

The two doors arrest attention upon an otherwise transitory moment and space, the threshold between rooms, the thickness of an opening in a boundary, often exceeded in a single step. Perhaps they initially do that merely by departing from familiar stereotypes. But once attention is arrested, upon which properties might it fall? First, the shape of the doors in plan is based on triangles. This runs against the normal expectation that doors should be treated as essentially flat two sided vertical objects mediating the transition from one side of a boundary through to the other. The triangular plan does not merely render the door volumetrically more substantial than the opening of the boundary into which it fits; it plays upon a more radical opposition between vertical plane and volume, hence between interior-less boundary and potential interior; it also implies an ambiguity between two cardinal directions (the axis of the boundary being crossed and, at right angles to it, the axis of the movement across) and three (the three axes of the triangle). Second, the dissociation of visibility and permeability implies a cognitive reconstruction of the automatic coordination between eye and feet associated with normal movement. To cross the boundary is not merely to enter into what is gradually visible, but also, to some extent, to rediscover and to reconstruct what is "gained in" and "lost from sight" though the very fact of entering. Third, the presence of mirrors conjoins the visibility of self with the act of passage, thus activating a familiar metaphorical extension

whereby to cross boundaries implies an awareness and perhaps a transformation of self. Fourth, as the doors revolve around an internal axis rather than a hinge at the edge, entering is associated with a rotation which always affects the spatial relationships between door and boundary on the side of the pivot across from the door handle; by implication, the subject does not fully occupy the domain of spatial relationships that is being transformed as the passage is negotiated.

Thus, the doors bring three correlates to the crossing of boundaries, the perception of the threshold as substantial, the reflection of self as a by product of passage, and the transformation and reconstruction of spatial conditions associated with crossing. In addition, the second door implies the possibility that the passage is also a structure of potential co-awareness tending towards the spatial differentiation rather than unification of those involved. Now, suppose that instead of focusing attention upon the doors themselves, the passages were considered in the normal way as connections between particular spaces, or rooms. As in all other cases, the situation and design of the doors will work with other aspects of building design to determine how rooms are defined by virtue of their location within an overall configuration; for example, whether it is possible to perceive certain external positions from certain positions inside them; the distance from which the presence of the rooms can be glimpsed; or, whether the entrance or exit are revealed or concealed as each room is occupied. The set of all the spatial relationships that are defined from inside each of the rooms "to" or "through" the doors is part of the set of configurational properties that define the rooms. As in all cases, relationships between rooms "through" doors are susceptible to greater or lesser variations over time, depending on whether the door is open, closed or ajar. However, a distinction can now be drawn between the relationships established through a door and the relationships activated when the door is being used. When we consider the door in terms of the connections that it makes, we consider how it contributes to an overall configurational pattern. When we consider it in terms of the relationships that are engendered as it is being used, we consider it in terms of the particular spatial experience that it constructs. In the first case we consider how the door plays within the overall logic of a configuration. In the second case we consider the internal logic of the door. The internal logic of the door imbues a passage between two given spaces with a particular sense, a sense that arises from the design of the artifact rather than from the functions and uses of the spaces that are connected through the artifact. The particular spatial experience of passage, the sense of passage, is an important aspect of spatial meaning.

02.7

02.8

Transient reference

The designs of the two doors have as a point of departure the myth of Opheus and Eurydice in at least two of its variations, one from the 1st and one from the 20th century: Ovid's account in Book X of the Metapmorphoses (Ovid, 1993: 325-328) and Jean Cocteau's film Orpheus (DVD, 2000) produced in 1950. Opheus, a poet, descended to the underworld in order to claim back to life his wife Eurydice, appealing to the power of love to unite even across the boundary of death; this had been previously testified by the abduction of Proserpina by Hades and the subsequent agreement that Proserpina should spend half the year on earth and half in the underworld. Orpheus' song induced Hades to grant him his wish provided that he would not look back to see Eurydice as she would follow him, until after they reached the upper world. At the threshold of the underworld Orpheus broke this injunction and lost his wife for a second time, permanently, after a momentary glimpse of her fading image. Orpheus thus occupies a significant semantic intersection. Having been on both sides of the boundary between life and death he was able to return to the living with the knowledge of the dead; at the same time, his desire to be joined with his lover in life remained unfulfilled but his love was transformed into inspiration and song. Treated as a liminal condition, the descent to the underworld is characterized by the impossibility of lasting sight for the poet and enduring voice for his lover: Orpheus can only see her momentarily, while she fades; her voice only becomes audible in a last "goodbye"; the environment is filled with darkness, mist and silence. Only the power of music is recognized across the threshold, only when transferred in song and its effects is the encounter of lovers sensible: in Ovid, the inner emotion that music brings forth is manifest through the cessation of all other activity and expressed in weeping. The descent to Hades is the liminal condition that produces and empowers the song: only the song and its power to move can potentially become immortal.

Critically examining works of art as potential programs for architectural design was part of an experimental inquiry motivated by three considerations: First, by provisionally removing the functional or typological conventions that are normally associated with design programs, attention is directed to the principles that govern architectural space as a symbolic form, thus opening up typologies and conventions to critical transformation. Second, by taking a work in another medium as a point of departure attention is directed to the fact that meaning is medium-dependent. Third, and by the same token, attention is directed to the way in which notational languages, including diagrams, can be devised in order to mediate an open ended exploration and articulation of not only design outcomes but also of design aims. Indeed the development of notations is a necessary complement of any reflexive approach to the dependence of meaning upon medium.

The relationship between the myth and the designs can be traced in some rather evident analogies. In the design for door D1, the boundary is traversed not through the side that provides direct visibility, but rather through the side that generates a mirrored reflection of self, by analogy to the way in which Orpheus carries with him not Eurydice, only transiently visible, but only a transformed sense of self as poet. The cone of light emanating from inside D1 momentarily absorbs the subject and then rotates back into alignment with the boundary, by analogy to the way in which liminality becomes associated with inspiration. The fourfold design of door D2 resonates with Cocteau's version of the myth. In Cocteau, the person of the poet is split between Cegeste and Orpheus, the former embodying poetic creativity, the later presented as Eurydice's husband who also falls in love with the Princes of death. The four characters are represented by the four positions defined by the door, while Heurtebise, the Princes' chauffeur and a messenger across the two worlds, is represented by the pivot at the point of intersection of the two triangular prisms. Cegeste, in position p3, sees himself frontally on a mirror and the Princes, at position p1, obliquely reflected through successive rotated mirrors. Orpheus, at p4 also sees himself frontally on a mirror while looking at Eurydice diagonally, at p2. The Princes, at p1 sees Cegeste both directly and reflected upon mirrors, and Orpheus reflected in mirrors. At p2, Eurydice follows Cegeste, and directly sees him in profile, while also diagonally looking at Orpheus' face. The overall pattern of multiple reflections and transparencies and the effect of the rotation of the door creates a fluid, all encompassing, space corresponding to the manner in which reflection and flux are conjoined in the movie to represent death. Ultimately, the physical boundaries associated with the door appear dematerialized and the bodies of the subjects come to the foreground as the main points of reference.

Spatial meaning

How does the preceding analysis help us to formulate the idea of architectural meaning? By conventional accounts, to mean is to refer. Architectural designs engender meaning only in so far as they can direct attention to something beyond themselves. At first glance it would, therefore, appear that the two doors are meaningful only in the context of their reference to the myth of Orpheus. The reference, to restate, is developed in the medium of space. It seems to be maintained via the relationship between spatial relationships embedded in the myth and the structure of spatial experience offered by the design, which in turn is a product of two other co-extensive, yet distinct, spatial structures—the geometrical form of the object (the door), and the space that it demarcates.

And yet, the idea of meaning as reference is not entirely satisfactory. First, it is too uncomfortably dependent upon the knowledge of the object of reference; it implies that any one ignorant of the motivating story of Orpheus is not in a position to find the designs meaningful. Second, it diverts attention from the designed object to the object of reference, with the implication that meaningfulness is entirely disengaged from the quality of the design. It allows a design with belabored or unintuitive reflection on the myth to be as meaningful as an imaginative or creative effort.

02.10

Following developments in theories of linguistic meaning, we suggest that rather than see meaning exclusively in terms of reference, it would be useful to consider meaning also as inclusive of a certain sense. This need not imply a necessary ontological commitment to the abstract, non-psychological entity that Frege (1999) had originally proposed; it simply requires our admitting of an internal component to the concept of meaning, in addition to the external one covered by reference.

In the case of architecture, the internal component of spatial meaning can be defined as a structure linking three patterns of relationships: first, relationships that constitute the architectural object as a spatial construction; second, relationships that constitute the embodied experience, perception and understanding of space as a consequence of inhabiting the object; third the organization of occupiable and explorable space. Spatial meaning, in the deepest, and perhaps most distinctively architectural sense, can be defined as the structure of entailment between these patterns of relationships. The external component of spatial meaning is a mapping between the organization of space and the logical structure of other domains. In the example discussed here, the recognition of reference is not supported by commonly shared conventions and hence referential meaning is tenuous. When we deal with more conventional design tasks, the recognition of reference is supported by the manner in which spaces become conventionally labeled as behavioral or functional settings, or the manner in which representations are inscribed in form through decoration or through iconography. The systematic correspondences between the social labeling of spaces according to use and stable configurational relationships, as originally studied by Hillier and Hanson (1984), are examples of referential meaning stabilized by cultural convention. Of course, the main thrust of Hillier and Hanson's argument is to show that such stable correspondences are not wholly arbitrary but are constrained by the manner in which spatial patterns become socially intelligible as domains of co-presence, co-awareness and movement. In our terms, they show that reference is not independent of sense. The advantage of evoking the distinction between sense and reference, however, is that it allows us to focus more clearly on relationships that are internal to the object of architecture and thereby more germane to making formulation in design possible.

Translations into design

The door designs and the context of their production are now familiar enough that we can take them as a point of departure in order to discuss what is involved in design as formulation. At the outset there seems to be no architectural material available, only a narrative about specific events, a myth about music and poetry, love, loss, the power of art to metaphorically express feelings that are not directly available to the senses. Surely, the narrative encompasses spatial references, some positional (the world of the dead is "below" and Orpheus' journey is described as a descent and ascent), some descriptive (the world of the dead is dark, shadowy and silent), some interactive (Eurydice will follow Orpheus but Orpheus should not look at her). However, these spatial references are not literally transferred as programmatic design parameters – desiderata. At the earliest stages, the myth is interrogated for aspects of spatial structure that would be relevant to designing spatial meaning, rather than merely catalogued for its overt spatial references. The earliest process is therefore "constructive" in two directions, not only towards an as yet unavailable design, but also towards a design-relevant reading of available material.

02.11

The most elementary referential function leading from myth to a specification of what is to be designed is the idea of passage not as a mere transition but as a complex event arising from the conjunction of spatial transition and a transformation of self. The association between passage, transition and transformation of self might perhaps be considered as a deeper spatial metaphor (Lakoff and Johnson, 1999), which is already potentially available as a designer begins to read a myth. However, as demonstrated by the diverse lines of design development presented above, the metaphor is utterly unspecific from the point of view of designed form. The set of door designs also arises from a decision to take the underlying metaphor as a premise for developing designs of a building element, not a building, however simple. This decision is external to the reading of myth and rests on two rather generic intuitive questions. First to inquire how far complex insights can be compressed into extremely localized structures. Second, to see how far spatial meanings can be embedded in the design of an object, which works to structure and transform space. These questions converge towards a more complex question: how to orient design creativity towards innovation at the level of the elementary but fundamental relational structures, such as a door, that are otherwise taken for granted when more complex designs are being produced. Taken together, the idea of passage with its metaphorical extensions and the idea of compressing complex spatial relationships into a redefinition of an elementary structure, specify a certain orientation of the reading and a certain direction for the design imagination, but little else. We may perhaps characterize this orientation as the resultant of two spatial motifs, passage, and configurational compression.

02.12

The door designs subsequently operate upon the following constraints drawn from the reading of myth. First, that visibility and permeability should, to some extent, diverge. Second, that passage should become associated with a mirrored reflection of self. Third, that mirrors should momentarily bring together in sensation the not merely distinct but also mutually exclusive relationships that normally define a transition across a boundary, thus conjoining passage not to succession but to simultaneity, however fleeting. Fourth, that, insofar as the passage should be simultaneously crossed by several subjects, the subjects should be differentiated rather than unified by virtue of their co-presence. The first constraint is an adaptation, perhaps a willful adaptation, of the injunction that Orpheus should not seek to confirm through sight that Eurydice follows him. The second is an adaptation of that idea that while in the underworld, Oprheus becomes more aware of his art and the power of his art. The third, is an adaptation of the idea that Orpheus succeeds in momentarily relating, through his art, two worlds that otherwise do not communicate. The fourth is an adaptation of the fact that even the exceptional event of art becoming sensible in the world of the dead does not succeed in canceling out the basic distinction between the dead and the living. However well these constraints may encapsulate structural aspects of the myth, they do specify definite design desiderata. However, they still do not specify a particular form, or a particular syntax. We may think of these constraints as spatial themes.

Syntactic relationships begin to be defined once the triangular shape of the door is posited. With reference to myth, the triangle expresses the fact that Opheus and his art are added as a mediating third term to the binary opposition of two separate worlds. From the point of view of the normal conception of doors, the triangle challenges the idea that the door could be treated as either a continuation of, or an interruption of, a fundamentally two-sided boundary. As previously discussed, the door and the passage that it defines become primary relational structures in their own right. From the point of view of design, however, the major consequence of the triangular shape is to initiate an inquiry about the way in which desiderata that were previously unspecific could be realized in particular syntaxes. Positing the triangular shape initiates a process whereby loose topological or projective intuitions, the motifs and themes acquire specific geometric form. The process whereby looser intuitions acquire specific geometric form does not merely involve increased specification. Rather, as specific geometric patterns are explored, new configurational constraints and possibilities are discovered which are worked into the intended meaning of the design.

In the simpler prismatic door, D1, for example, the mirror is placed between the pivot and the edge carrying the handle, at an oblique angle relative to a subjects' approach towards the door. One implication of such placement is that the vertical plane of the mirror rotates as a direct function of the force applied by the hand of the advancing subject. Another implication is that the subject is frontally reflected on the mirror only when the plane of the latter is aligned with the plane of the wall. This condition does not correspond to rest, as would occur if a mirror were to be placed on an otherwise flat door. It arises after the process of transition through the boundary is initiated. In the more complex door, D2, several relationships are made possible only through very specific geometrical decisions. For example, the rotated position of mirror QR as compared to ML with respect to the center T, and the "out of step" position of mirror KN as compared to PS, create a situation where positions p1 and p3, diagonally across each other, are not directly visible, but only visible through reflections, while positions p2 and p4, also diagonally across, are directly visible.

As Eucledian, projective and topological patterns coalesce into a specific pattern, the simple syntactic relationships are interpreted and elaborated within the context of more complex syntactic constraints derived from retrieving descriptions of configuration. For example, the way in which positions p1, p2, p3, p4, in D2, are linked into a complex configurational pattern of direct and mirror-mediated visibility is quite sensitive to proportional measure, both of angles and of the lengths involved, including the radius of the circle described by the door. Similarly, proportions determine at what point along the path of entry, the direct diagonal view into the next room through the glazed part of the door, is no longer available, or how extensive the reflection of the back surface of the boundary being crossed can become. The emerging relationship between dimensions, geometric shape, and their projective or topological implications marks the point at which underlying spatial intuitions acquire a specific syntactic structure. This is the point at which design intentions are sufficiently embedded in the medium of design as to provide a sense of intellectual control over design decisions. In the terms introduced above, this is the point when spatial motifs and themes are specifically manifest as designs.

The first component of spatial sense, the recognition of deliberate intentionality in the assembly of the object, now becomes clearer. One can read the designs as sets of shapes placed in deliberate geometrical relationships with each other; indeed, as we have stated above, those geometrical relationships are what carried the burden of the referential relationship. Considered as components of design moves, however, the shapes are not merely geometrical; they come pre-constituted, as it were, as semantically charged forms that cannot be further decomposed without loss of meaning. The moves made during the course of design development, as well

02.13

as the emergent shapes of both the elements and the spatial relationships between them, however unpredictable and seemingly arbitrary, are made within a design space that is geometrically restricted. The result is that the shapes, as they emerge, create a grammar—a phenomenon that is analogous to identifying a sequence of phonetic units in the more or less continuous stream of sounds that constitute spoken language. That the observer can reconstruct the presence of a syntax and a grammar is dependent upon the manner in which the logic of construction of the object interacts with the spatial experience generated by the object.

The spatially mediated homeomorphism between the structure of built form and experience

The possibility of moving analytically from a discussion of form to a discussion of experience is of some interest from the point of view of a theory of design. Indeed, to design architecture is to embed certain configurational properties in material constructions in order to have particular effects upon structures of experience, feeling, or understanding. In the process of design formulation the relations between the structure of objects and the structure of experience through space is continuously being negotiated in both directions. Potential experiences are explored through specifying syntactic relationships and the construction of objects. Potential objects are explored through specifying syntactic relationships and patterns of experience.

An important consequence follows from the above, regarding our theorizing about the generative principles that govern design. Quite obviously, a design, or set of designs, cannot be understood as a list of properties. In any given form, arbitrarily many properties can be discovered and even designs generated based on the same rules can be characterized by very diverse combinations of such properties (Peponis, 1999). Design can much more usefully be understood in terms of the interaction between the properties discovered in objects and the generative principles that produce the objects. In turn, the generative principles that characterize design do not only bear on the domain of the object and its internal construction, but also on the experience sought. In practical terms, this means that the geometries in terms of which we describe objects must also lend themselves to the description of experiences. From this point of view, descriptive methodologies that incorporate theories of how space becomes culturally intelligible and usable (Hillier and Hanson, 1984; Hillier 1996) have a critical contribution to make to design studies, which we are only beginning to explore.

The work associated with the literature on "space syntax" suggests that the experientially relevant descriptions of built space significantly bear on topological and projective structures, while the buildings and building elements themselves are

metrically specified. From this point of view, the object is always cognitively more than the experience that it engenders. At the same time, the generative principle is always more generic than the precise formation of the object. In this gap between a topologically or projectively specified generative principle and the final metric geometry of the object there always is scope for the intuition of open-ended potentiality. Design is not a process of attaching topologically or projectively specified generative principles to an underlying intuition and then proceeding to further specify these principles into a metric geometry. Rather than think of the process in terms of successive steps towards specification we have to think it in terms of underlying tensions between distinct levels of formalization. Each level is intelligible, within the process of formulation, thanks to the provisionally stabilized mappings to other levels.

The relationship between the structure of the object and the structure of experience, as mediated through the structure of space provides a clue as to the foundation of the reflexive understanding of the object. In the preceding argument, the effects of the doors were first described in terms of certain discontinuities of experience that occur along the path followed by a subject that walks through them. The objective presence of these experiential thresholds, whether they bear on visual, tactile, or kinetic affordances of environment is not in doubt. From the point of view of understanding, however, the key issue is to account for the cognitive transition from a potential awareness of a sequence of such thresholds to the abduction of an integrative idea that makes sense of the design and of the experience as a whole. In the example offered here, one trigger towards such a reconstruction is provided by the interplay between the variability of experience and the constancy of two bodies, of the door and of the advancing subject. Essentially, reconstructive understanding is initiated by asking whether the diversified experience could be brought under the purview of an overall organizing concept, commensurate with the integrity of the subject, the object, and their interaction. In the particular example, the integrity of the object and the action is already embedded in language. A door is a named component of the building, as are the behaviors of coming through the door, opening it or closing it. The particular doors under discussion enrich the perceptual and experiential expectations associated with doors in general. This initiates the reconstruction of spatial meaning as defined above.

How far do designs authorize their own descriptions?

If there is scope for design formulation to encompass spatial meaning, in the way discussed above, does it not follow that the structure of the designed objects themselves should, to some degree, dictate the analytical-descriptive frameworks that we apply towards comparative understanding? The answer to this question is

02.16

clearly affirmative. Based on the example of the door designs, a number of observations are possible. Quite crudely, our analysis suggests that the very elementary relation of a transition across a boundary can be configurationally structured in different ways. Quite clearly, these configurational structures may not automatically affect the social logic of the overall patterns of connectivity, as for example discussed in the theory of building genotypes (Hillier and Hanson, 1984; Hanson, 1984). This has nothing to do with scale, that is, with the level of resolution at which we have to develop the analysis in order to capture effects such as those discussed here. It would be quite possible for effects that are determined at very fine levels of resolution to have significant implications at coarser levels, as it would also be quite possible for the local constitution of relationships to affect the global logic of arrangements. For example, the work presented by Bafna (2001), suggests that Mies' domestic designs were significantly affected by the manner in which transitions were defined, whether as a consequence of eliminating corridors, or as a consequence of developing a language of free standing walls. The questions of how different aspects of the geometry of architecture and architectural experience interact and how this interaction crystallizes in culturally, functionally, or behaviorally significant invariants should not be confused with the question of which aspects of geometry can bear spatial meaning as a result of design formulation. Indeed, distinguishing these two questions is a precondition for asking the further question of how individual works, or limited design worlds, interact with broader cultural or social structures, within larger patterns of evolution of designs.

More specific, but also generalizable, implications regarding descriptive theory also follow from our analysis. One consequence of using mirrors, for example, is that lines of visibility and lines of accessibility do not necessarily coincide when we consider the relation of visibility polygons (isovists) to their roots. The more important question raised by the door designs, however, bears on the question of simultaneity, the simultaneous occurrence of different conditions. In the literature on "space syntax" simultaneity is implicitly handled in rather static ways. For example, a visibility polygon includes all the points that are simultaneously visible from a given position; a convex space can simultaneously be connected to a number of adjacent convex spaces; the point of intersection of linear elements simultaneously belongs to two lines. Such elementary definitions of simultaneity lead to the identification of special points or areas; for example: the points from which more spatial information is available in the visibility polygon, the convex spaces which are locally central by virtue of a greater number of connections. The door designs suggest that a different approach to simultaneity, quite familiar from other fields of literature, could be usefully incorporated in our descriptive methodologies. Simultaneity could be defined in terms of different processes, characterized by rates

of change, reaching limit conditions at the same time, or within a relatively short interval of time. For example, the door generates two main processes of change: the portion of the wall of the first room that is visible in the mirror sweeps from position "a" to "a' " ; mirrored visibility then jumps up to "a" " on the wall of the second room; at the same time the portion of the wall of the second room visible through the glazed aperture sweeps from interval b1 to b2 and b3, until it disappears (Figure 4). The frontal mirrored view of the entering subject becomes available at a limit condition, as the mirror plane gets aligned to the plane of the boundary, as the diagonal view through the glazed part of the door disappears and as the sweep of the reflected view of the wall cross the axis of movement of the subject. The idea of rates of change is fundamental to the manner in which Gibson (1986) links the study of visual fields to the perception of spatial structure. Occluding edges are the locus of rates of change as we move: they are the locus of the appearance or disappearance of objects of surfaces into our field of view. While the rate of change itself is a function of metric properties, the occluding edge, as a point of reference, is stable over a relevant interval of time. In a similar way, our concept of simultaneity does not require that we fully incorporate into our analysis continuous processes that are not easily describable with a language or discrete relationships represented in graphs. While several dense processes of co-variation may be going on through space, the simultaneous reaching of limits is spatially localized and can be incorporated within a discrete analytical language. Thus defined, simultaneity is quite distinct from synchrony. Simultaneity is about coincidence between the limits of processes, it requires that we take into account preceding conditions in order to characterize a condition of interest. Synchrony is about relationships that apply together at the same time, regardless of preceding conditions. Synchrony describes positions in themselves as defined by multiple relationships. Simultaneity describes positions as individualized within a process of movement involving co-varying spatial relationships. This definition has a bearing on an otherwise independent analysis presented by Stavroulaki and Peponis (2003) in another contribution to this symposium.
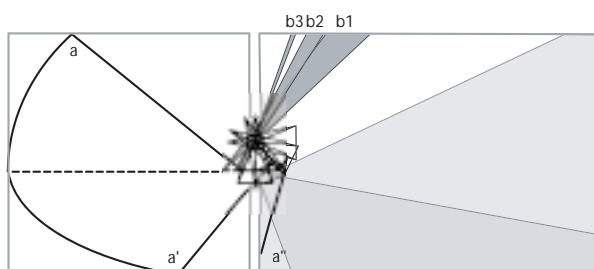
02.17

Figure 4: Co-varying rates of change in the mirrored and the occluding visual fields

Thus, to some extent, design formulation authorizes its own descriptive questions. As elements, relationships and syntaxes are only provisionally or potentially available prior to design formulation, so descriptive frameworks are provisionally stabilized as we enter the process of description retrieval. To suppose otherwise would be to prevent morphological theories from reaching levels of detail, specificity and resolution that would engage design formulation.

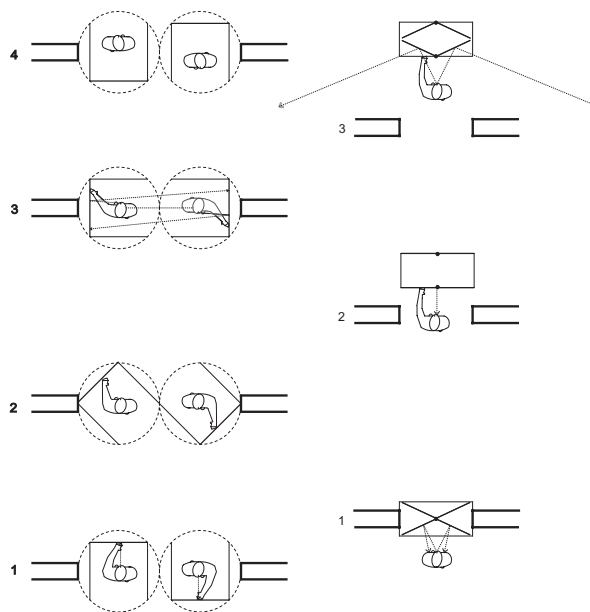**Concluding comments: Design language, sense, reference and exemplification**

How can the formulation of spatial meaning be succinctly characterized? One way to look at design is as an arrangement of shapes into spatial relationships. From this point of view, design languages are best understood in terms of the rules that apply to the arrangement of shapes into such relationships. We have used the term syntax to refer to the rules consciously applied by a designer. The deployment of rules, however, is supported by a certain motivation. In the example discussed here, the motivation bears on a complex homeomorphism between the spatial construction of a built object and the structure of spatial experience, as mediated by the structure of space produced by the object. By implication, the motivation is not defined at the level of a specific language, but rather at the level of topological or projective relationships, which already carry metaphorical extensions. The interaction between evolving spatial motifs and evolving design languages is what design formulation is about.

In the process of design formulation diverse spatial relationships are not merely juxtaposed, or superimposed, but rather allowed to interact into a configurational pattern, where each relationship is qualified by the others. Thus, designs come to exemplify configurations, that is, modes of entailment between relationships. In order to define spatial meaning with greater precision, we have adapted the distinction between sense and reference (Frege, 1999). We have used the word reference to describe the relationship between the object being designed and meanings already available in other symbolic forms, or other spatial conditions. We have used the word sense to describe the way in which the internal construction of the object, the logic of the spatial relationships that it concretizes, and the relationships that it is a term of, qualify the spatial behaviors and functions supported by the object.

Our argument has emphasized the formulation of meaning as spatial sense. This is for a good reason. Functional and behavioral requirements and design desiderata are quite substantially determined in advance of the design and socially or culturally specified and constrained. Designers have much more freedom to formulate the sense, the mode, in which such requirements are present in the final object. Thus, sense is the aim and the substance of spatial motifs. Insofar as motifs

02.18

can be realized in several design languages, sense itself can be seen as a criterion for interrogating and further exploring design languages. However, the same sense can be engaged through several design languages. Karadima, for example, has also designed a number of other doors, schematically presented in Figure 5, which can probably not be treated as manifestations of the same language as the doors more extensively discussed here, but which are aimed at the same sense of passage.

02.19

Figure 5: Doors 3 and 4 explore the same spatial motifs and themes as doors 1 and 2 but in a different language

We therefore have individual designs that can lead to other designs subject to the same geometrically specific design language driven by the same spatial motifs. We also have designs aimed at the same sense but operating according to different geometrical languages, designs that interpret the same motifs according to a different set of geometric constructs. To understand languages regardless of the motifs and the sense that motivates them is to miss the logic of design formulation. Conversely, to imagine motifs independently of the design languages in which they are realized is to not engage design as a specific constructive process.

Notes

[1] The first author acknowledges that the ideas developed in this paper bear the influence of discussions with Yves Abrioux, and Noele Batt as well as Yves Marie Visetti. The way in which these discussions have filtered into the paper may not yet resonate with the specific theoretical frameworks that they explore. Ken Knoespel's contributions to the work discussed is too pervasive to be acknowledged in detail.

References

Bafna, S., 2001, "Geometrical intuitions of genotypes", in J. Peponis, J. Wineman and S. Bafna (eds.), *Proceedings of the 3rd International Symposium on Space Syntax*, Ann Arbor, University of Michigan, Taubman College of Architecture and Urban Planning, 20.1-20.16

Cocteau, J., 2000, *"Orpheus",* 1950, in *The Orphic Trilogy,* Home Vision Entertainment, Criterion Collection, DVD

Frege, G., 1999, "On Sense and Reference", in M. Baghramian (ed.), *Modern Philosophy of Language*, Washington DC: Counterpoint

Gibson, J. J., 1986, *The Ecological Approach to Visual Perception*, Hillsadle, New Jersey, Lawrence Erlbaum Associates

Hillier, B., 1996, *Space is the Machine*, Cambridge, Cambridge University Press

Hillier, B. and Hanson, J., 1984, *The Social Logic of Space*, Cambridge, Cambridge University Press

Lakoff, G. and Johnson, M., 1999, *Philosophy in the Flesh*, New York, Basic Books

Ovid, 1993, *The Metamorphoses of Ovid*, Translated by Allen Mandelbaum, New York, Harcourt Brace and Company

Peponis, J., Wineman, J., M Rashid, M., Kim, S. H. and Bafna, S., 1997, "On the description of shape and spatial configuration inside buildings: convex partitions and their local properties", *Environment and Planning (B): Planning and Design*, 24, 761-781

Peponis, J., 1999, "The Logic of Space and the Reason of Design", in *Proceedings of the 2nd International Symposium on Space Syntax,* Brasil, Fundacao de Apoio a Pesquisa di Distrito Federal – DFAP/ DF, 5.1-5.19

02.20