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# Metaphors as Discourse Interaction Devices in Architectural Design

**Hernan Casakin**

School of Architecture, Ariel University, P.O. Box 3, Ariel 44837, Israel; casakin@ariel.ac.il

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**Abstract:** Metaphor is a fundamental heuristic supporting cognitive and communicative requirements in design problem solving. This reasoning mechanism helps structure how architects reason about problems, and how they approach design situations from novel perspectives. This paper investigated empirically the use of metaphors during the conceptual front edge design, known as the most creative stage of the process. Figurative phenomena were analyzed in their original context of occurrence. Emerging metaphorical expressions generated during communication interactions maintained by sixty architects were identified and examined based on protocol analysis approach. Metaphors were further categorized according to main experiential domains at different levels of detail, as well as in terms of image and conceptual descriptions. The study contributed to gain a deeper insight into the rhetorical potential of metaphor during design problem solving, and to strengthen its centrality in architecture.

**Keywords:** metaphors; discourse interaction; communication; architectural design; experiential domain

## 1. Introduction

The way we relate to the world and our basic cognitive processes responsible for the generation of meaning are fundamentally metaphoric [1]. The use of metaphor in daily language such as *love is a flame* reflects that abstract concepts can be expressed metaphorically. A major characteristic is that they facilitate understanding a concept through another concept that is not evidently associated with it [2,3].

As linguistic devices for communication, metaphors can be found in a diversity of domains like art, science, engineering and design. Lakoff [4,5] proposed metaphorical reasoning as a mechanism that makes possible to categorize experiences in terms of a conceptual system. The major argument was that metaphor affects not only communication, but also shapes how people think, and represent experiences in their minds.

According to the differentiation made in cognitive linguistic research between visual and nonvisual knowledge, metaphors can be classified into conceptual and image descriptions [1,6,7]. Conceptual metaphors are described as the mapping of intangible or abstract knowledge, where activities, events, ideas, or elements are viewed as entities or substances (e.g., BUILDINGS ARE SYMPHONIES: musical compositions projects onto buildings; rhythm onto organizational principles; and so on). Image metaphors, in contrast, are defined as the mapping of familiar and rather conventional mental images onto other mental images as a result of their shared visual appearance (e.g., BUILDINGS ARE SUNFLOWERS).

Due to their heuristic power, metaphors are considered by cognitive psychologists [8,9], linguistics [10,11], as well as scholars in the design domain [12,13] as efficient aids in creative problem solving. Design is a prime example of such type of problems. A characteristic is that they are complex and inaccurate, and thus it is not always possible to predict how to deal with initial design goals. Thus, designers make frequent resource of metaphors with the aim of framing a problem and searching potential idea-solutions [14,15]. The puzzling character of metaphors allows to explore unfamiliar

concepts, and to establish new relations with domains that are remote to the problem at hand [8]. Hence, metaphorical reasoning allows temporarily disregarding an objective interpretation of whether a problem exists [16].

According to Schon [17] designers make different interpretations of a design situation, while they engage on a 'reflective conversation' based on previous acquired experiences. In this context, the creation of metaphors can help to explore relevant aspects of a design situation, frame the problem according to personal views [18], and create new meanings [19,20].

In the architecture domain, metaphors play a key role in the early stages of the design process, which involve unconventional and creative thinking [21]. Due to their ambiguous essence, they are particularly useful heuristics for generating innovative design solutions [22,23]. The ambiguity of these tools together with the variety of concepts that can be retrieved from metaphorical sources is what guides the architect to produce different interpretations of a problem [16]. Since architectural design is an activity that commonly requires teams working in collaboration, metaphorical reasoning can also enhance communicative interaction to integrate individual knowledge, and thus contribute to a shared understanding of the problem [24]. Metaphors generated during design interactions can be either generated from mental representations stored in the mind of the architect, or stimulated by external inspiration sources from different experiential domains of knowledge.

Whereas a main goal of architecture is to produce outcomes with defined character, metaphors can help to confer strong identity to a building [25]. In different architectural movements, metaphors are used to emphasize certain features that are considered as the right way of designing [14]. The architectural design literature acknowledges well-known examples of buildings based on metaphors. To cite some, the Unité d'Habitation building by Le Corbusier was influenced by the metaphor, "a house is a machine for living in" [26,27].

Regardless of the recurrent use of metaphor in architecture, few empirical studies centered on the aid provided by this tool in the design process. Neo [28] investigated the function of tangible and intangible metaphors in design form generation. Hey et al. [13] demonstrated how metaphorical thinking helps to frame and clarify design situations, and to communicate design outcomes. Casakin [12,22,29,30] carried out a several studies in the architectural studio and found that these tools help in redefining design goals, restructuring design problems, and generating innovative ideas. He also showed that dimensional meaning profiles of metaphors concerned with sensory, functional, and structural evaluations were significant predictors of design performance [20].

In spite of the extensive research on metaphors in the cognitive and linguistic domains, few studies tried to integrate cognitive theory with discourse analytic procedures in order to inspect their role in communication in general, and in the architectural discipline specifically [31,32]. This situation was reprobated by several scholars, who stressed the significance of the communicative contexts where metaphors are generated [33]. Therefore, metaphors should be examined from a situated contextual perspective. This was demonstrated by numerous works showing that specific disciplinary communities employ metaphor according to their explicit goals, motivations, and shared understanding for doing things [34–36].

Others investigated the role of metaphor in professional communication. Caballero [37–39] carried out a series of studies to explore from texts the way that figurative language is used by architects in building review. She found that architects make frequent use of conceptual and image metaphors to meet the two construing goals of the review genre, which are to describe and evaluate a building [31]. Caballero [37] also showed that image metaphors are prolific in the architectural discourse, and therefore they can become conventionalized. Based on texts illustrating some of the genres characteristic in architectural discourse that included technical and theoretical issues, a further study showed how architects use and reuse metaphors for the sake of explaining, describing and assessing a building [38].

Whereas these cognitive-linguistic studies were carried out in building review contexts, empirical studies on the use of metaphors in real contexts such as design problem solving are not frequent.

In a preliminary work based on three architects working as a team that served as a case study, Casakin [40] investigated the effect that text stimuli have on the generation of metaphors during a design session and organized the identified metaphors into major categories. It was found that most metaphors were generated based on the different stimuli available. Although this basic study was mainly explorative, it gave a first indication that designers were persuasive in the use of metaphors as a rhetorical tool, what contributed to support, communicate and exchange ideas during the problem-solving task.

One reason for centering on metaphorical language is because architectural discourse is highly figurative [41]. Looking at the figurative language used by architects can help to unveil how discourse interactions are articulated in design. Thus, by extending the pilot work carried out by Casakin [40], the aim of the present study is to gain a deeper insight into the figurative language used in the conceptual stage of the design process, characterized by the production of idea-solutions. One goal is to identify the type of metaphors produced by architects as they emerge during the design activity. This involves exploring figurative phenomena in their original context of occurrence, focusing on the cognitive and linguistic schemas that are implied in the identification of dominant metaphors.

Design is concerned with the production and development of visual representations for the sake of generating new forms, and to this end designers make frequent use of visual thinking [42]. During the communication exchanges, designers create and transform forms by an interplay of internal visual representations (imagery), and external visual representations (e.g., sketches and drawings) [42,43]. While designers are well-known for their visual thinking skills, whether these affect their tendency to employ metaphors that are essentially based on pictorial information was not studied yet. Therefore, another goal is to propose a framework to examine the kind of figurative language produced in this context, in order to understand what visual and conceptual metaphorical schemas are created. The research questions that guided our study are: What types of metaphors are generated during the discourse interactions maintained in the architectural design process? How the identified metaphors can be categorized in terms of experiential domains? and How these can be further organized according to image and conceptual schemas?

Consequently, the present study explores empirically the rhetorical potential of metaphor in creative contexts such as architecture, as a thinking and communication mechanism in design problem solving. The work offers a main framework for enhancing our knowledge about how metaphor, as a domain-specific tool, is approached in architectural design. Based on the main findings, implications for improving architectural education are suggested, especially for intervention programs in the design studio.

## 2. Method

### *2.1. Participants and Setup*

Sixty Master and PhD students belonging to the Faculty of Architecture and Urbanism, Department of Urbanism at TU Delft, organized into twenty teams of three members each, participated in the study. They were randomly approached in their offices and invited to take part in the experiment. In addition, the study was advertised in posters located on boards and electronic boards located in strategic points at the faculty building. Architects received a payment of 15 Euros as a reward for their participation. They were requested to generate as much ideas as possible to solve the design problem.

### *2.2. Design Task*

The task called for the redesign of the entrance area of the Faculty of Architecture and Urbanism, TUDelft University. This was one of the least used and less aesthetic parts of the faculty building. To this aim, participants were requested to propose design ideas about functions and spaces that could make the entrance area a more enjoyable place. Students were well acquainted with the physical,

cultural, and social aspects of the problem. However, due to the nature of the experiment, the produced solutions were expected to be schematic and therefore not completed in every detail.

### *2.3. Procedure and Instruments*

Participants were given a task sheet containing general instructions, a design problem, a map and photographs of the site and building, and a set of displays that eventually served as external stimuli. They were also supplied with a set of A3 sheets of paper, which they used to produce and discuss as many idea solutions as possible.

The sessions lasted about 30 minutes, from which 7 minutes were assigned to present a final solution to the design problem, including a brief description of how it works. Students were told to think aloud as the sessions were videotaped. The experimenter did not intervene, except when it was necessary to remind the participants to continue talking. Following the standard procedure used for the analysis of verbal data, the recordings were transcribed and analyzed independently by the author and another researcher who is an expert in linguistics and metaphors.

## 3. Identification and Categorization of Metaphors

The research was informed by the cognitive linguistic theory of metaphor originally developed by Lakoff and Johnson [1]. The analytical procedure included three major steps: (i) identifying metaphorical expressions generated during the design sessions; (ii) categorizing metaphors according to diverse experiential domains. (iii) classifying figurative expressions into image and conceptual metaphors, and analyzing how they relate to the experiential domains.

In the first step, 20 transcripts produced from the registers of the design sessions were analyzed. Criteria were established for the sake of distinguishing metaphorical language from non-metaphorical one. Expressions were tagged as metaphorical in cases that they represented any domain incongruity; i.e., "involving the understanding of and/or reference to an architectural entity, agent, or process in terms of belonging to an experiential domain different from architecture, irrespective of the degree of innovation of the metaphorical expression." [31] In that sense, conventional jargon terms related to a comparison of spaces to familiar entities were considered as having the same metaphorical importance as other less familiar expressions, concerned with a comparison of spaces to remote entities. The researchers analyzed independently the raw data produced by the participants in the design sessions. However, given that the identification of inter-domain incongruities is subjective and sometimes leads to disagreement, unclear expressions were discussed by both researchers until full agreement was achieved. Only in a few cases in which disagreement persisted, the expressions were not included in the study.

In the second step, a categorization system intended for organizing the identified metaphorical expressions generated during the design process was proposed. First, the researchers discussed different alternative groupings for organizing the metaphorical expressions identified in the previous step into different metaphor types. Thereafter, they discussed alternatives for classifying them into experiential domains (For an example see the work of Caballero [31,41] dealing with the identification and role of metaphor in the building review genre. Her analysis was carried out on a corpus of 95 reviews from six architectural design journals. In the present study, we attempted to classify all the metaphorical expressions into different groupings at three levels of abstraction. However, since it was not always possible to organize all the resulting groupings into these levels, in this work metaphors were analyzed at two levels of abstraction. At a general level, metaphors were organized into four experiential domains that were subclassified into 13 different types of metaphors (See Table 1). The diverse types of metaphors are presented in italics within quotes examples and between inverted commas in the main text, while the metaphorical schemas underlying them are shown in capital letters as is typical in cognitive notation.

In the third step, the figurative expressions were coded into image, conceptual, and other metaphors, based on the differentiation made in cognitive linguistics between the visual versus

conceptual type of knowledge associated with the metaphor [1,44]. Two researchers analyzed independently the figurative expressions produced by the participants. However, as noted by Caballero in some cases a sharp distinction between conceptual and image metaphor showed to be problematic for the architectural domain "due to the visual and aesthetic constraints of the discipline" [39], and she added that "the fuzzy boundaries between visual and conceptual knowledge ... are especially noticeable when these are seen in their context of occurrence". Thus, discourse contexts where metaphorical expressions take place can be very influential to perceive image–concept notions either as a polarity or as a continuum. Consequently, all metaphors identified in the transcripts—initially classified into three groups—were then coded according to four categories that included: (i) conceptual; in reference to the mapping of intangible or abstract knowledge; see extract 1 for an example; (ii) image; referring to the mapping of known and usually conventional mental images containing visual knowledge; see extract 2 for an example; (iii) dual - conceptual/verbal, in cases where both types of mappings were possible; see extract 3 for an example; and (iv) other, in reference to correspondence established with mental representations characterized by other senses; see Extract 4 for an example. Provided that whether a metaphor can be classified as image, conceptual, or dual can be sometimes a matter of disagreement, unclear metaphorical expressions were discussed by the two researchers until full consensus was achieved (See Figure 1).

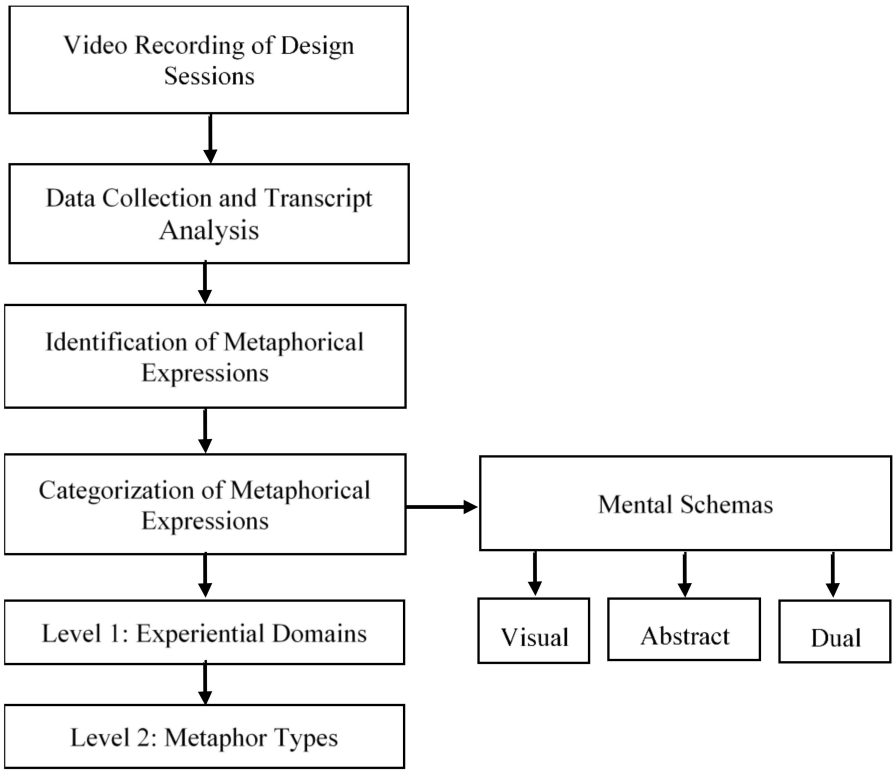


**Figure 1.** Description of the methodological path followed in the study of metaphors in architectural design.

Extract 1

E.1 Example of Conceptual Metaphors

Jimmy: "We want it [the space] to become more inviting and more relaxing, the ... yeah, mainly this, inviting so I think it's important to make it less formal and to make it maybe organic, playful, different functions."

Extract 2

E.2 Example of Image Metaphors

Peter: "Then I thought ... the boxes on the plaza are not transparent. I don't know different kind of boxes that you can move ... People can sit in here along these cracks."

Extract 3

E.3 Example of a Conceptual/Image Metaphor

Kate: "And also the connection with the city is not good connection. The best connection with the city is this one . . . So this should be the main entrance of the building this would be the main entrance from the center of the building."

Extract 4

E.4 Example of a Tactile Metaphor

Jane: "Yes and also with this . . . with this thing is the idea of soft and hard places."

The analysis of the transcripts of the design sessions allowed exploring the ontological and rhetorical implications of metaphor in architectural design. Consequently, the study of metaphor offered the grounds to inspect a comprehensive number of architectural issues belonging to this specific context of design communication.

### *3.1. Metaphor Types*

Depending on their characteristics, architectural metaphors can be organized into varied experiential domains, such as music, textiles, physiology and spatial mechanics [45]. In this study, 1636 metaphorical instances were identified, and classified into diverse types of metaphors that included two levels. In the first level, 13 types of metaphors were identified, from which 3 belonged to Motion category, 5 to Nature, 3 to Artificial, and 2 to Human activities. In the second and more refined level another 13 types of metaphors were identified, from which 2 corresponded to Nature, 7 to Artificial, and 4 to Human activities. In turn, the metaphor types were organized into four general experiential domains that included: Motion, Nature, Artificial and Human activities. (See Table 1).

In the following sections, we analyze the four experiential domains and the types of metaphors into which these were organized, and we offer examples of representative metaphorical expressions.

**Table 1.** Categorization of metaphor types into levels and experiential domains.

| Source Domains | Metaphor Types—Level 1 | Metaphors Types—Level 2 |
|---|---|---|
| MOTION | SPACE IS A FLUID | |
| | BUILT SPACES ARE KINETIC ENTITIES | |
| | BUILT SPACES ARE JOURNEYS/MOTION EXPERIENCES | |
| NATURE | BUILT SPACES ARE LIVING THINGS | BUILT SPACES ARE PEOPLE<br>BUILT SPACES ARE ORGANISMS |
| | BUILT SPACES ARE GEOLOGICAL ENTITIES/FORCES | |
| | BUILT SPACES ARE PLANETS | |
| | BUILT SPACES ARE LANDSCAPES/GEOGRAPHICAL ENTITIES | |
| | BUILT SPACES ARE WATER ENTITIES/FORCES | |
| ARTIFICIAL (THINGS) | BUILT SPACES ARE SHAPES & 3-D OBJECTS | BUILT SPACES ARE MAGNETS |
| | | BUILT SPACES ARE GEOMETRIC ENTITIES/FIGURES |
| | | BUILT SPACES ARE CONTAINERS |
| | BUILT SPACES ARE MACHINES | BUILT SPACES ARE COMPUTERS |
| | | BUILT SPACES ARE ELECTRIC ARTEFACTS |
| | BUILT SPACES ARE OTHER BUILT SPACES | BUILT SPACES ARE CITIES |
| | | BUILT SPACES ARE OTHER BUILDINGS (or BUILT SPACE IS AN ACTIVITY) |

**Table 1.** *Cont.*

| Source Domains | Metaphor Types—Level 1 | Metaphors Types—Level 2 |
| --- | --- | --- |
| HUMAN ACTIVITIES | ARCHITECTURAL PRACTICE IS AN INTELLECTUAL ACTIVITY | ARCHITECTURE IS LINGUISTIC COMMUNICATION |
| | | ARCHITECTURAL PRACTICE IS MUSICAL PERFORMANCE |
| | | ARCHITECTURAL PRACTICE IS DESIGNING GAMES |
| | ARCHITECTURAL PRACTICE IS A (MANUAL) CRAFT/MANIPULATING SPACE | |

#### 3.1.1. Motion Experiential Domain

The first experiential domain corresponds to Motion, which includes a set of metaphorical expressions evoking a kind of movement. It is by means of movement that we perceive and understand space. In our work, Motion category was organized into three types of metaphors highlighting dynamic aspects of the design situation that include: SPACE IS A FLUID, BUILT SPACES ARE JOURNEYS OR MOTION EXPERIENCES AND BUILT SPACES ARE KINETIC ENTITIES.

Expressions that correspond to SPACE IS A FLUID refer to space as a liquid solution, as shown in the following extract: "Actually I liked the idea of bundling the flows together". Instances of metaphors like SPACE IS A FLUID are *flow, overflow, stream, and flood*. The expressions that correspond to BUILT SPACES ARE JOURNEYS OR MOTION EXPERIENCES are helpful to understand space as a voyage or as an experiential. For example: " ... this level changes and takes you out of the borders." Experiencing movement as part of a journey is also implicit in terms like *routes, paths, direction, and circulation*. Other figurative expressions informed by motion hinge on the concept of kinetics. Metaphors in the form BUILT SPACES ARE KINETIC entities recall the idea that spaces are animated entities with a life of their own. Thus, rather than allowing movement of people, spaces moves by themselves. This is illustrated by: "This (space) starts very small and then curves around ... " The dynamic aspect of spaces is conveyed by verbs such as *move, surround, come in, come up, go through, stand, cross, circle around*.

#### 3.1.2. Nature Experiential Domain

The next experiential domain centers on Nature, and draws upon physical non-man-made phenomena, including geology, geography, astronomy, and biology. Therefore, this category was organized into five types of metaphors concerned with: BUILT SPACES ARE GEOLOGICAL ENTITIES OR FORCES; BUILT SPACES ARE LANDSCAPES OR GEOGRAPHICAL ENTITIES; BUILT SPACES ARE PLANETS; BUILT SPACES ARE WATER ENTITIES OR FORCES; AND BUILT SPACES ARE LIVING ORGANISMS.

Metaphorical expressions related to BUILT SPACES ARE GEOLOGICAL ENTITIES OR FORCES equate spaces to geological things or geological processes. This is illustrated by "it's like an explosion ... an explosion of the forest into the square". Instances of metaphors like these contain terms such as *hill, lava flow, rock, volcano, and eruption.* BUILT SPACES ARE LANDSCAPES OR GEOGRAPHICAL ENTITIES is represented by "one of the ways is like to make more islands for people". This environmental view of space is implicit in words such as *topography, elevation, forest, field, garden, landscape, and scenery*. BUILT SPACES ARE PLANETS reflects the coexistence of various realities. This is evidenced in the metaphor: "When you get there you feel like two different worlds". Metaphorical expressions incorporating natural sources concerned with water entities were labeled Built spaces are water entities or forces, and are exemplified by: "This (space) has something to do with waves ... maybe we can do something with green waves". Metaphors like these contain terms such as *ripple, wave, river, wavy,* and *tide*. Metaphors referring to BUILT SPACES ARE LIVING THINGS motivated some of the lexicon used by architects regarding either the behavior of people or the physical

structure of living entities. Accordingly, figural expressions of this type were reclassified into BUILT SPACES ARE PEOPLE, AND BUILT SPACES ARE ORGANISMS. An example of metaphors referring to BUILT SPACES ARE PEOPLE is "the funny aspects of the space". Metaphorical expressions like these are reflected in adjectives such as *playful, inviting, coherent*, and *logical*. Metaphors characterized by BUILT SPACES ARE LIVING ORGANISMS evoked the idea that spaces can be animated agents and as such they have a life of their own. An example is "this space is really organic".

#### 3.1.3. Artificial Experiential Domain

The Artificial experiential domain recurs to fields external to the area of nature and focuses on human-made aspects. Metaphorical expressions like this highlights morphological and functional element of the design. The Artificial domain was structured into three major metaphors that included: BUILT SPACES ARE SHAPES AND 3-D OBJECTS; BUILT SPACES ARE MACHINES: AND BUILT SPACES ARE OTHER BUILT SPACES. The first grouping included expressions that represent spaces as shapes or 3-D manufactured objects that specifically focus on formal and structural aspects, and were classified into: BUILT SPACES ARE MAGNETS; BUILT SPACES ARE GEOMETRIC ENTITIES; and BUILT SPACES ARE CONTAINERS. An example of BUILT SPACES ARE MAGNETS is, "There is nothing happening because this [space] . . . is not so attractive." Metaphors like this are represented by terms such as *attract and draw inside*. BUILT SPACES ARE GEOMETRIC ENTITIES stand for metaphors like "These dunes could be designed to have this idea of circularity." Additional terms that are enclosed in these types of metaphors are: *line, box,* and *cone*. BUILT SPACES ARE CONTAINERS is exemplified by "What you were doing I would say that is more like a boundary thing." This type of metaphors includes words such as *empty, fill, inside, enclose, hedge*, and *contour*.

The second grouping of the Artificial domain comprised expressions that refer to spaces as mechanical entities. Thus, in metaphors organized into BUILT SPACES ARE MACHINES, spaces are characterized by the function or behavior of artifacts or devices working automatically. These were classified into: BUILT SPACES ARE COMPUTERS; BUILT SPACES ARE ELECTRICAL ARTIFACTS; and BUILT SPACES ARE ELECTRICAL ARTIFACTS. An example of a metaphor concerned with the former is "[the built space] is a computer chip." Related metaphors encompass terms such as *board*, *configuration*, *interface*, *hardware*, and *motherboard*. BUILT SPACES ARE ELECTRICAL ARTIFACTS is explicitly illustrated by "there is a kind of tension, so there's current here, and current here and something happening in between." Metaphorical expressions like these embrace words as analogous to *current, activate,* and *tension*.

The third grouping—BUILT SPACES ARE OTHER BUILT SPACES—comprised expressions reflecting the view that certain designs can be described in terms of other types of designs. This metaphorical schema refers to either an urban or an architectural typology that is different in some way to the problem at hand. Accordingly, these were classified into: BUILT SPACES ARE CITIES; and BUILT SPACES ARE BUILDINGS. An example of metaphors of the first type is "You can make some kind of village here . . . ". Metaphors like this consisted of words such as *village* and *street*. A representative metaphorical expression for BUILT SPACES ARE OTHER BUILT SPACES is, "I think well you could think about a sort of bike tower". Terms reflecting this type of metaphor in reference to other spaces in the square are *studio tent, tower, pavilion,* and *palace*.

#### 3.1.4. Human Activity Experiential Domain

The fourth experiential domain—Human activity—refers to the manipulation of space in any form, either conceptually or practically. The figurative categories that best represent this domain are: ARCHITECTURAL PRACTICE IS A (MANUAL) CRAFT and ARCHITECTURE PRACTICE IS AN INTELLECTUAL ACTIVITY. Metaphors about ARCHITECTURAL PRACTICE IS A (MANUAL) CRAFT are mainly concerned with the action of modifying space. This expression refers to turning spaces into malleable and flexible artefacts that can be modelled or transformed and is depicted in

the example: "this part connects to the entrance." The plastic view of space is illustrated by verbs like *attach, break, bridge, connect, make flexible* and *fill*.

The second grouping concerned with ARCHITECTURE PRACTICE IS AN INTELLECTUAL ACTIVITY relates to knowledgeable acts and was classified into: ARCHITECTURAL PRACTICE IS LINGUISTIC COMMUNICATION; ARCHITECTURAL PRACTICE IS MUSICAL PERFORMANCE; and ARCHITECTURAL PRACTICE IS DESIGNING GAMES. An example of Architectural practice is linguistic communication, where space is compared to text, is given by "you can also dictate one major access that all the flows go through." Similar metaphorical expressions denoting the idea of architecture as speech included: *language, abstract, emphasize, formulate, translate* and *give meaning*. ARCHITECTURAL PRACTICE IS MUSICAL PERFORMANCE evokes the idea of space as musical composition, and is illustrated by, "parking is a kind of a linear, like a rhythm . . . " Finally, an example of ARCHITECTURAL PRACTICE IS DESIGNING GAMES is: "It would be nice . . . to find a more regular grid in order to put these spots for example the boxes for fun game." Metaphorical expressions of this type are represented by terms such as *puzzle, adventure* and *game.*

### *3.2. Concept and Image Metaphors: Metaphorical Domains*

The metaphorical instances identified in this study were coded into image, concept, dual (image/concept) and other sense metaphors. An analysis was carried out to explore how these metaphor schemas relate to the four experiential domains defined before. Table 2 illustrates the cumulative counts of the metaphor schemas corresponding to the different domains. From the 1636 instances, 16.7% corresponded to Nature, 39.4% to Artificial, 16.7% to Motion and 27.2% to Human activity. From these, a 33.6% were concept metaphors, 27.3% were image metaphors, 37.6% were dual metaphors, and only 1.5% corresponded to other senses metaphors. Thus, when considering all domains together, the most dominant mental schemas of the were characterized by dual metaphors, followed by concept metaphors.

A chi-square test of independence was calculated comparing the frequency of schema representations for metaphors in the experiential domains. These frequencies were significantly different (x2 (9) = 483.65, $p < 0.001$). In the Motion and Nature domains, image metaphors were significantly higher than the other metaphor schemas; z = 3.9, and z = 6.2, correspondingly. In the Artificial domain, dual metaphors were significantly higher than the others; z = 8.1, whereas in the Human activity domain concept metaphors were significantly higher than the rest; z = 9.6.

**Table 2.** Experiential domains and mental schemas.

| Experiential Domain | Mental Schema of the Metaphor | | | |
|---|---|---|---|---|
| | **Abstract** | **Visual** | **Dual** | **Other** |
| Nature | 103 | 128 | 42 | 0 |
| Artificial | 90 | 187 | 368 | 0 |
| Motion | 89 | 108 | 76 | 0 |
| Human activity | 267 | 24 | 129 | 25 |

## 4. Discussion

Design problem-solving is an activity that must integrate multiple aspects of the building into a satisfying solution. This includes imaging how a design can respond to different goals and requirements. Given the intricacy of design, the present study proposed a main framework to investigate how metaphors as a communication tool, were used by the architecture community for understanding and discussing key aspects of the task in the early stages of the creative design process. Findings showed that architects draw upon a broad scope of experiential domains, which helped them to deal with the design problem regarding aesthetic, functional and behavioral considerations. Among

these, there are four major domains characterizing the figurative repository of architects that included: Motion, Nature, Artificial, and Human activities.

While analyzing these metaphorical domains together, it was found that the most dominant schemas were characterized by dual metaphors, followed by concept metaphors. Thinking in terms of concept or dual metaphors maybe particularly helpful in the early stages of the design process, where design problems are fuzzy and ill-structured, and design solutions are schematic and ambiguous. On the other hand, it is interesting that the level of abstraction of the metaphor was related to the type of domain to which it belongs. Hence, in the Human activity, usually involving abstract knowledge, domain conceptual metaphors were dominant. However, in the Motion and Nature domains, usually concerned with visual knowledge, image metaphors were prolific. However, in the Artificial domain, which was the richest domain regarding the number of metaphors generated during the process, dual metaphors were most dominant. Again, it seems that metaphors that can be interpreted using either visual or abstract knowledge can be convenient at the front edge design process, where ideas are still under development.

That most of the metaphors corresponded to the Artificial and Human activity domains, and specifically to BUILT SPACES ARE SHAPES AND 3-D OBJECTS AND ARCHITECTURAL PRACTICE IS A (MANUAL) CRAFT/MANIPULATING SPACE, can perhaps be explained by the idea that, over all, architecture is an activity mainly concerned with the manipulation and fabrication of spaces and artefacts.

Moreover, the fact that Motion was one of the experiential domains identified in this work is not completely unexpected, given that movement allows observing and understanding a building and its internal space [46]. Architecture can express or convey movement without really moving. Everyday metaphors demonstrate that an experience of implied architectural motion is constantly present [40,46]. That architecture can embody implied movement was extensively acknowledged through history [47–49]. In fact, a frequent use of terminology describing motion of static objects can be found in architectural discourse [50]. However, bearing in mind that architectural buildings and spaces are intrinsically inert objects, referring to them in terms of motion is, at the least, intriguing and challenging. What precisely is meant by motion, and how metaphors are used to denote movement is a question that this study attempted to deal with. Motion certainly represents the human experience of space, and this was reflected in figurative expressions such AS BUILT SPACES ARE JOURNEYS, MOTION EXPERIENCES, KINETIC ENTITIES; and BUILT SPACES ARE FLUIDS. While communicating movement during the design sessions, architects mainly focused on its appearance, i.e., how it looks. However, a more detailed exploration showed that architects also had a concern about how movement functions and behaves.

The natural sciences is another domain of knowledge that demonstrated to have an important effect on the lexicon used in architectural design problem solving. According to Caballero [45], by drawing concepts and ideas from nature, in particular from biology and botany, architects were able to refine their anthropomorphic views about the discipline. In the present study, however, the terminology used by the architects during the design process was characterized by metaphors related to not only biology, but geology and geography fields. A concern for the environment emerged in North America as a reaction to the Modern movement in the 1960s–70s, and then spread to Europe and the rest of the world, remaining relevant until the present [51]. In our research, the majority of the metaphors in the Natural domain, including BUILT SPACES ARE LANDSCAPES OR GEOGRAPHICAL ENTITIES; BUILT SPACES ARE PLANETS; BUILT SPACES ARE GEOLOGICAL ENTITIES OR FORCES; AND BUILT SPACES ARE WATER ENTITIES OR FORCES all reflected a particular interest to the relation between architecture and the natural environment. Moreover, other built spaces were seen as living organisms, either in reference to physical attributes that included a description of the structure of living things, or by means of their behavior or emotions. In this sense, a personified view of spaces enabled to characterize them according to different human features.

The experiential domain labelled Artificial contained metaphors referring to human-made things. This was the larger set of the study and was organized into figurative expressions highlighting morphological and functional aspects of the design that included BUILT SPACES ARE MACHINES; BUILT SPACES ARE SHAPES; AND 3-D MANUFACTURED OBJECTS, and BUILT SPACES ARE OTHER BUILT SPACES. In expressions that represent built spaces as machines, architecture was associated with mechanical artefacts. The industrial revolution of the nineteenth century witnessed fast developments in the engineering domain, a consequence of which was the appliance of mechanical principles to architecture, which are common in architectural literature until today [52]. Equating built spaces to machines stressed functional over formal aspects of the design outcomes. Examples in history can be found in buildings such as the Unité d'Habitation, and the Villa Savoy by Le Corbusier, who believed that it is possible to adapt a number of mechanical services from ocean liners to redefine the concept of the dwelling. His revolutionary view led to the well-known metaphor "a house is a machine for living". Other illustrative examples are the innovative architectural structures of Viollet-le-Duc, who believed in an integration of the architectural and the structural engineering professions [53]. In contrast to these, figurative language expressing BUILT SPACES ARE SHAPES AND 3-D MANUFACTURED OBJECTS AND BUILT SPACES ARE OTHER BUILT SPACES focused on the external appearance of the design. Expressions from this category are probably not easy to perceive as metaphors. One main reason is that when comparing buildings to geometrical objects or to other building types, entities in the comparison belong to the same or near domain [24]. In this respect, many architectural notions expressed by these types of metaphors are automatically assimilated as part of a disciplinary acculturation process. As a result, architects tend to employ figurative expressions based on these metaphorical schemas even without noticing it [45]. Consciously or not, the use of figurative expressions in the Artificial domain spanned from schemas (BUILT SPACES ARE OTHER BUILT SPACES AND BUILT SPACES ARE SHAPES and 3-D MANUFACTURED OBJECTS) that accounted for the interest of the architects about how spaces look, to dual schemas focusing on not only on the appearance of spaces, but also how they work and behave (BUILT SPACES ARE MACHINES).

Metaphorical expressions categorized in our study as Human activities suggested that architectural practice can be seen as the manipulation of space in any way, either conceptually or practically. The figurative language used in the design discourse indicated that architecture can be seen not only as a craft activity dealing with the transformation of malleable space, but also regarding more knowledgeable actions by means of which architecture can be compared to language, or even to musical composition. Most expressions instantiating Architectural practice is a craft, and Architectural practice is an intellectual activity were mainly related to the design activity per se than to a concrete outcome. As such, they generally involved metaphors denoting actions of different kind. However, metaphors prominent in architectural practice is a (manual) craft/manipulating space suggested an interest not only in the design activity, but also in concrete knowledge concerned with the design outcomes.

## 5. Conclusions

Studying metaphors from a discourse perspective contributed to go beyond disciplinary jargon, to inform how these rhetorical devices are employed in design problem solving to articulate the worldview of architects. From this view, the study offered a novel framework to identify main genre conventions, to show what the most usual types of metaphors considered during architectural discourse interaction are, and how these can be grouped into main categories at different level of detail.

One of the critical issues in the initial stages of the design process is how to structure design problems, which by default are ill-defined. In this regard, architectural problems have no fully formulated initial requirements and clear goals. For these reasons, they cannot be solved by the use of completely automated algorithms. The present study demonstrated how designers employ non-routine thinking through different types of metaphors when they need to define and frame many aspects of the problem at hand, and to develop and share idea solutions. The relevance of metaphors in design was evident in the vast number of figurative expressions from diverse experiential domains

generated during this stage of the process. Another contribution of the research is that it strengthened the view that architectural design language is dynamic and in continuous development, and managed to show that designers borrow concepts from other disciplines and domains of knowledge, to adjust them ad-hoc as requested by the specific needs.

Even though the description and categorization of metaphorical instances are restricted to the architectural design discourse, the study attempted to call attention about the importance of contextual and cultural disciplinary factors in metaphor research in general. While for an architect some metaphorical expressions may result conventional, this might not be necessary the case for someone who does not belong to this professional community. Thus, investigations about metaphor must be situated within disciplinary contexts, and the criteria used to categorize and organize metaphors should mirror their peculiarities.

Another novel input of this work consisted in identifying the type of abstract-visual schemas used by architects during the design activity. The study showed that although architects employ image metaphors extensively to deal with design problems, the use of not only dual but also conceptual metaphors appeared to be more frequent in most experiential domains. This finding might be surprising provided that architects are generally educated to think visually, as well as encouraging since the use of abstract knowledge can be beneficial mainly at the early stages of the process, where the design problem is still fuzzy.

In sum, by departing from the works of Lakoff and Johnson and by combining discursive and cognitive perspectives, this study offered a new framework that was not used before in the design context, that contributed to enhance our understanding onto how metaphor, as a domain specific tool, is approached and used in problem solving in architecture. The findings also suggest important implications for improving architectural education, mainly in the design studio. Making teachers aware about the importance of metaphors as a communication tool in design would make them keener to promote their use not just for the embellishment of language, but mainly as a powerful heuristic in problem solving. A major challenge for intervention programs supporting the use of metaphors in the architectural studio would consist in encouraging students to break preconceptions and fixation to specific solutions that are known a-priori, and try to think "out-of-the box". This could be achieved by devising a series of exercises where students are exposed to stimuli belonging to several domains, using various types of representation, and different levels of abstraction (including those that are remote to the architectural problem), which should be used as inspiration sources. On the other hand, since a relation was found between the level of abstraction of the metaphor and the type of domain to which it belongs, using stimuli from certain domains might be preferred over others. Students could then be trained to retrieve metaphorical concepts and principles from the available sources, and establish structural relationships with the problem at hand.

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