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THE ARCHITECTURAL EXPERIENCE OF THE KASBAH OF ALGIERS: INSIGHTS FROM LE CORBUSIER'S EXPERIENCE AND NEUROARCHITECTURE

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This paper contributes to a deepening of the knowledge about how architectural experience can be described in neuro-phenomenological terms, through the development of a cognitive-phenomenological approach to examining architectural experience through text-based analysis. It aims to develop an assessment tool to produce knowledge about one's personal experience and perception of the built environment by exploring the impact of its spatial properties on an individual, taking as a case study Le Corbusier's experience of the Kasbah of Algiers. The results demonstrate that this city has the power to stir emotional engagement that arises from: a high cognitive-affective reaction towards the dynamic interactions between the curved contours of its streets; the harmony of its colours; the magnitude and vastness generated by its panoramic views towards the sea; its proportions in relation to the dimensions of the human body in different postures; the contrasts of the height, light, dimensions and ambiances; and the spatial navigation that favours the act of walking to discover the Kasbah and unveil its mysteries. These properties exist as complex networks of interconnected physical and atmospheric elements, and they involve integrated perception under the influence of previous knowledge, beliefs and aspirations to shape Le Corbusier's architectural experience of the Kasbah.

Key words: **Le Corbusier; Kasbah of Algiers; spatial properties; architectural experience; content analysis.**

INTRODUCTION

Le Corbusier is one of the most polemic and influential architects of the 20th century. His clearly evolved architecture, art and dogma have inspired many scholars to investigate his career in order to understand the influences behind it (Gerber, 1994, p. 377). His architecture evolved from purism and white cuboid forms in the 1920s, to more curved and sculptural forms after the 1930s, whereas, his urban-planning switched from "*Baroque-type grids with diagonals, symmetrical designs on cruciform or linear axes*" to "*juxtaposed nets style with different geometries for vehicles and pedestrians, often based on curvilinear, trigonometric and linear forms*" (Steyn, 2010, p. 118).

Le Corbusier's travel notes and sketches show how much traveling around the world impacted him as both an artist and an architect. His visits to countries such as Brazil, Argentina and Algeria appear to have influenced his perception of architecture, hence giving birth to his second architectural language, with expressive, plastic and liberated vocabulary (Sobin, 1994). His experience of North Africa, especially of the Kasbah of Algiers and the M'zab, made him appreciate the value of vernacular architectures (Steyn, 2014, p. 134). De Maisonseul, Le Corbusier's guide in Algeria, claimed "it seems clear that his journeys to Algiers were a key factor in the evolution of Le Corbusier's work, in what could be called its humanization. It is the man he became in Algiers, architecturally and plastically" (Bonillo, 2012). Le Corbusier visited Algiers for the first time in 1931; the city fascinated him while wandering through the maze of its narrow alleys and densely packed dwellings, he even described it as "*the most beautiful city in the world*" (Roy, 2001, p. 12).

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Many scholars have investigated the undeniable impact of the Kasbah of Algiers on Le Corbusier's works and philosophy. They emphasize that the architecture and the urbanism of this city had a deep decisive influence on a number of his design concepts and projects after 1930 (Steyn, 2010; Gerber, 1993). Embracing this hypothesis, in this paper we wonder what makes the Kasbah so appealing that it earned the praise of Le Corbusier. What properties shaped Le Corbusier's architectural experience of the city and engaged his sensibilities?

This paper suggests that an analysis of Le Corbusier's experience of the Kasbah of Algiers will lead to the identification of the atmospheric and physical spatial properties that had an impact on his experience there. It develops a qualitative cognitive-phenomenological approach in order to study the impact of the built environment on spatial experience, through a text-based, thematic content analysis using knowledge from cognitive neurosciences. Thus, writings from Le Corbusier about his experience of the Kasbah are analyzed in order to identify and discuss the spatial properties that shaped his experience of this city. The impact of the built environment of the Kasbah of Algiers is open to interpretation using discoveries from cognitive sciences.

In the following section, we introduce several discoveries in the cognitive study of architecture, and propose the application of these findings in the interpretation of Le Corbusier's experience of the built environment in the Kasbah of Algiers, with the aim of enriching our understanding of the reception of these encounters in general.

densely packed high blank-walled houses, climbing the slope from the sea-side to the hill-top. It is considered one of the finest coastal sites on the Mediterranean Sea. The Kasbah still retains its architectural integrity: its features of the traditional urban design and architecture of North Algeria, as well as its aesthetic features and the original materials, have been preserved (UNESCO).

The Kasbah has an organic urban order. It developed gradually through a step-by-step generative process ruled by the interaction between the geometry of the built form, the site, and the residents' needs and culture (Benhamouch, 2003). The overall form shows repetition, translation and rotation of cubic units forming the dwellings, which flank the edges of the streets, hence drawing curvilinear boundary lines. Their gleaming white appearance gives an overall consistency in aesthetics, colour, tone and brightness to the city (Figure 1). All the urban facades are unadorned, deprived of ornamentation and covered with white lime, which contrasts with the brown wooden beams, and the heavily decorated doors. Dominance of the bright white colour, gives this city its famous nickname *The White City* (Gerber, 1993).

The streets are tortuous and interconnected (Figure 2); some are large and open, and some are as narrow as corridors while others are vaulted like cellars (Figure 6). As one moves upward to the Haute Kasbah, the streets become narrower and stepped to fit with the steep topography, and they cut through the urban fabric to improve the communication between the city's districts, called *houma* (Faidi, 2015, p. 11).

Figure 1. Dominance of the colour white.
(Source: Authors)

THE KASBAH OF ALGIERS

Placed on the world heritage list in 1992, the Kasbah of Algiers is a unique kind of medina and an outstanding example of a historic Maghreb city of the 16th century. Built on the ruins of the ancient Phoenician city of *Ikosim*, the Kasbah sits on a huge crescent bay on the Mediterranean, surrounded by abrupt slopes, with a maze of narrow winding alleys and

The Houses of the Kasbah

The Kasbah's houses belong to a Mediterranean architecture characterized by an exteriorization looking toward the sea, and introversion through its courtyards (Karabag and Fellahi, 2017). A typical Kasbah house is a well-proportioned and highly introverted three-story structure with a courtyard surrounded by rooms and an entrance space called a *sqifa*,

which is a space located directly after the entrance door, where male guests are received to prevent them from entering the interior spaces of the house, for reasons of privacy (Figure 3). The courtyard is the main source of daylight and fresh air in the house (Karabag and Fellahi, 2017).

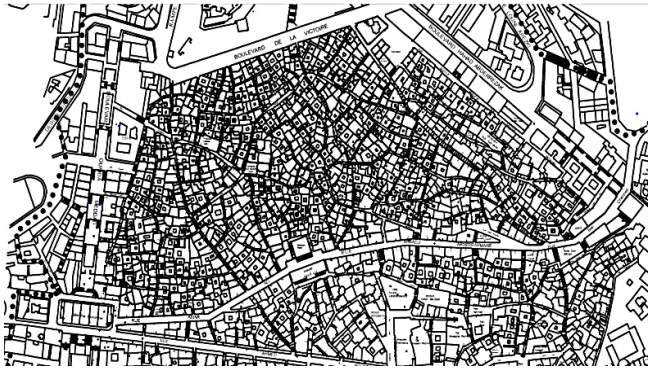

Figure 2. Plan of the Kasbah illustrating the meandering maze of streets. (Source: Authors)

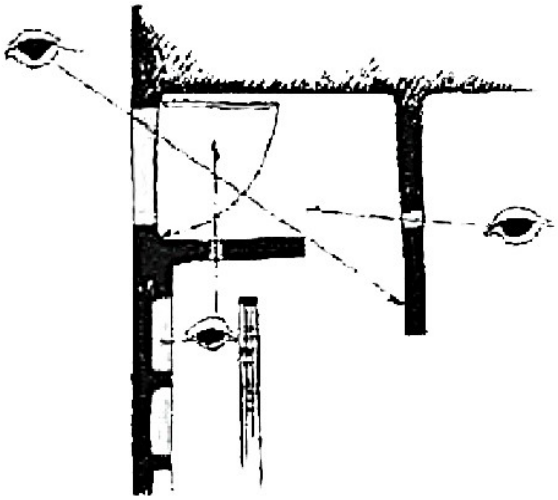

Figure 3. Principle of Sqifa (Source: Hadjiri, 1993)

The indoor space of the Kasbah's houses is totally the opposite of the outdoor space of the Kasbah. It is richly ornamented and coloured, the walls are covered with faience, and the wood used for the doors and the stairs is richly sculpted with floral and geometric motifs (Figure 4).

The Kasbah's houses are built following the site topography and some strict regulations established by the local government and by Islam; one of these rules instructs that every house should face the sea and have a roof terrace (Hadjri, 1993, p. 68). The terrace occupies the upper floor of the house. And it is open to the terraces of the neighbouring houses so that women can communicate easily. Each terrace, especially those on the top of the hill, offers a panoramic view over the whole city and over the Mediterranean Sea (Figure 5).

Many contrasts are at play in the Kasbah, alternating between openness and closure, light and shadow, and

Figure 4. : A Kasbah house interior (Dar Mustapha Pacha) (Source: Authors)

Figure 5. View from the terrace (Source: Authors)

Figure 6. Play of contrasts (Source: Authors)

different dimensions and heights. On the urban level, the most prominent examples of these contrasts can be seen in the dynamic change between large and open streets that suddenly or gradually become narrow and closed, and in the subtle play of light and darkness in them, when light is

slightly filtered either by the entrances in the covered lanes, or the cantilevered corbels of houses extended over the street (Figure 6). At the house level, the strongest contrasts are encountered everywhere and characterized by the dynamic shift between different contrasts from one space to another, such as in the transition from the closed dark entrance room to the open and lit up courtyard, and from the dark closed staircase to the open terrace flooded with sunlight.

NEUROSCIENCE AND THE BUILT ENVIRONMENT

Rosenblum (2013, p. 69) emphasizes that our brain derives infinite meanings from the surrounding environment by merging diverse forms of our sensory perception. Over the last two decades, a growing body of research has been investigating the neural underpinnings of the relationship between the built environment and humans. Neuro-aesthetics investigates one's response to aesthetics; neuro-architecture investigates the impact of design features on one's perception of architecture, while cognitive-neuroscience studies the neural substrates of mental processes and psychology.

A literature review, grouping empirical and theoretical papers in the fields of neuroaesthetics, neuroarchitecture and cognitive neuroscience, unveiled six categories of identifiable spatial properties (morphological and atmospheric) affecting man cognitively and psychologically. These categories concerned, essentially, research about beauty and aesthetic judgment, approach avoidance decision making, spatial navigation and wayfinding, perception and emotions.

Curvilinear and sculptural forms

A great deal of psychological research and neuroimaging studies outline strong human preferences and sensitivities to curves in the built environment, especially in contrast to sharp or linear edges and contours (Paul and Christopher, 2009; Vartarian *et al*., 2013; Banaei *et al*., 2017). Curvilinear forms are perceived as aesthetically appealing and providing richer stimulation to neurons representing 3D surface shapes in the brain of the beholder (Balachandar, 2012). The perception of curves taps into the reward/punishment system in the brain, and activates the anterior cingulate cortex (ACC), which is a region strongly responsive to the reward properties and emotional salience of objects (Vartarian *et al.*, 2013).

Magnitude and vastness

Perceived vastness generates the emotion of awe. Schopenhauer defines it as a powerful emotional experience involving both the feeling of being powerfully overwhelmed, humbled, or dislocated and the sense of being exalted, elevated, or elated (Vandenabeele, 2015). This emotion relates to physical size and other categories involving magnitude (Eberhard, 2009; Gallagher *et al*., 2015). For instance, when looking at an open sky, or an open natural landscape, the spatial memory will evoke an embodied sense of space that helps to create, within the size parameter, the sense of awe (Navarretea *et al*., 2017).

The experience of awe arises from a feeling of sublimity, which is a powerful aesthetic feeling that is different from beauty. The experience of the sublime involves different neural mechanisms than that of beauty. It activates the inferior temporal cortex, the frontal gyrus and the posterior hippocampus, as well as the basal ganglia and most importantly, the cerebellum, which is associated with spatial cognition and the experience of extended space (Ishizu and Zeki, 2014). In contrast, the experience of beauty involves the medial orbito-frontal cortex (mOFC) and the anterior cingulate cortex (ACC) (Yeh *et al*., 2015). The mOFC is activated in pleasant aesthetic experience related to visual beauty. The ACC is involved in regulating both emotional and cognitive processing; it also correlates with preference ratings (Lindal and Hartig, 2013).

Colours

Our psychological responses to colour are subconscious; however, our conscious responses to a specific colour are mainly related to the symbolism behind it (Brucker, 2013), and the recognition of specifically coloured objects does not add any cognitive operation to the recognition task (Bramão, 2010). Hence, responses to a specific colour are related to the beholder, and they initiate emotional responses aroused by feelings of the fulfilment and satisfaction of expectations, which are predisposed ideas or mental images related to one's beliefs, imagination, culture or knowledge. The emotional engagement in the perception of a specific colour involves both the amygdala, which facilitates attention through emotional integration (Phelps, 2006), and the right precuneus, related to consciousness, visuo-spatial imagery tasks and the subjective wellbeing that results from the experience of satisfaction. Moreover, colour harmony has a strong positive correlation with colour preference since it is reflected by the aesthetic value represented in the mOFC, which is related to aesthetic and visual beauty (Ikeda *et al*., 2015).

Embodiment and empathy for order and proportions

One of the main tasks of architecture is the creation of empathy (Mallgrave, 2013, 2015) and instilling the emotional potential in the physical environment to create sensibilities in humans, by the invocation of its *atmospheres,* which are a state of resonance between man and the built space (Pallasmaa, 2014).

At the neural level, the discovery of *canonical neurons* and *mirror neurons* holds implications for the experience of architecture. These neurons are essential to learning through observation and emulation. Hence, people can feel empathy for space by establishing an embodied simulation (Freedberg and Gallese, 2007), mapping the sensory representation of some architectural properties as form, proportions, rhythm, materials, light, temperature, and sounds onto the perceiver's brain. Freedberg and Gallese (2007) assert that proportions, as with many other spatial and architectural properties, can influence the aesthetic experience and appreciation of the built environment, through an empathic embodied simulation.

Embodiment responses to architectonic stimuli evoke in the observer distinct multisensory sensations linked to emotions and feelings, such as familiarity, intimacy, fear and safety. This mirrored mapping process links perception,

action, memory and emotion by implicating the same neural structure involved in the unconscious modelling of our body in space (Stamatopoulou, 2018), so the experience of the built environment provides a richer and more complex constellation of active responses.

Openness and enclosure

Openness and enclosure are related to aesthetic judgment, permeability, approach/avoidance decisions, empathy and visual motion. Open and large spaces are judged more beautiful, pleasant, and inviting to enter than closed spaces. The aesthetic preference for openness is coupled with activation in the parietal and frontal structures located in the dorsal stream, which support visuo-spatial attention. Openness activates structures underlying perceived visual motion (Vartarian *et al*., 2015). Navarretea and Witherspoon (2017) emphasize that smaller spaces speed up perceived time, while larger ones slow it down.

Closed spaces elicit exit decisions and activate the anterior midcingulate cortex (aMCC), a region with direct projections from the amygdala, which is involved in evaluating the significance of affective visual stimuli (Ikeda *et al*., 2015).

Light

When light is used strategically in the built environment, it can enhance mental understanding and trigger a nerve response that increases sensory perceptions and wellbeing. Light affects different functions of the brain and regulates one's emotions and behaviours (Havelka, 2018). The light that falls on the retina is transmitted to the hypothalamus, an endocrine gland that controls circadian rhythms. This later regulates mental alertness and other aspects of wellbeing (Navarretea *et al*., 2017), and when it is disrupted, it causes various mood swings. The circadian rhythm relies on blue light found in the outdoor environment (especially from the sky), in order to achieve optimum physiological and psychological performance (Navarretea *et al*., 2017).

Spatial navigation

Spatial navigation is one of the most important functions for exploring and interacting with the environment. It is a multimodal function (involves different sensing modalities), which helps create a mental image of the encounters in visual cortical areas during perception (Lacey and Sathian, 2015). The quality of free exploration creates experiences that are less influenced by the paths taken, and it enhances the sense of place within a space (Sternberg, 2006). A sense of place is generated by spatial navigation, through empathy and the formation of memories about the functionality and aesthetics of a space.

The brain's navigation system involves place cells and grid cells, from the hippocampus and parahippocampal regions, activated by movement and location tasks. The hippocampus and the parahippocampal areas act as cognitive maps to create mental representation of the environment in the brain (Moffat, 2016). They are recognized as the key sites for consolidating long-term memories for storage (Stephenson, 2019). Neuroimaging studies show that the entorhinal cortex, the subiculum, and the dentate gyrus are also involved in spatial navigation (Jain *et al*., 2017). The brain's navigation system contains receptors that bind with the pleasure felt when we visually and physically seek and discover (Biederman and Vessel, 2006).

LE CORBUSIER'S EXPERIENCE OF THE KASBAH OF ALGIERS

Methodology

This paper develops a qualitative methodology for studying the impact of the built environment on one's architectural experience, by combining thematic content analysis and knowledge from cognitive neuroscience. Using this methodology, the writings of Le Corbusier about his experience of the Kasbah are analyzed in order to identify and discuss the spatial properties of the Kasbah that shaped his experience of the city.

Content analysis, which has already been applied in many architectural and urban studies (Dagenais, 2007; Joanne, 2003), makes it possible to objectively analyze certain aspects of architecture related to spatial perception and representation, through an objective approximation of people's holistic sensory/emotional experience of a space. An architecture literature review based on neuroscience is used as a theoretical background for this analysis and for a discussion of the results about how the built environment of the Kasbah was perceived and experienced by Le Corbusier.

The content analysis

Content analysis is a six-step method (Bardin, 1977): 1) constitution of the study's corpus; 2) definition of the recording units; 3) analysis and coding of the units; 4) categorization; 5) calculation of the occurrences (facultative step); and 6) discussion of the results. The process of analysis consists of working and re-working the data that reveal any connections to the study questions. Once meaning units are coded, it is easier to identify the patterns in the codes and organize them in categories. The whole study ends with a discussion of the results and establishment of links between them and the questions and aims of the study.

Data collection

A *content analysis* was conducted on Le Corbusier's writings about the Kasbah. The writings were collected from different sources, including but not limited to: books – *poesie sur Alger*; postcards; and articles – *L'Architecture vivante* (1932), *La ville radieuse* (1933), and *Le folklore est l'expression fleurie des traditions* (1941).

Data analysis

The analysis was conducted by 4 different scholars, including the authors. Each, individually, read the corpus over 10 times and highlighted all the revealing passages in it. The analysis then proceeded by extracting words and phrases that reveal information about Le Corbusier's experience of the Kasbah, and organizing them into recording units, each expressing a response by Le Corbusier towards the built environment of the Kasbah. The recording units were coded. The codes, then, were grouped, analyzed and assigned to content categories established in the light of the literature review on neuroscience for architecture. Finally, the categories identified from the 4 analyses were discussed and organized into themes based on the questions, the aims

and the theoretical background of this study.

Erlingsson and Brysiewicz (2017) emphasize that using many scholars to conduct an analysis together is actually a key element in qualitative analysis when striving to ensure trustworthiness and objectivity. Collaborating with others during analysis makes it easier to see variations in the data, thereby enhancing the quality and the rigor of the results.

Results

The results of the data analysis are presented in Table 2, while Table 1 gives an overview on how the analysis proceeded.

Table 3 reorganizes the previous results (Table 2) based on the relationship between spaces (outdoor/indoor), their properties and the frequency of the theme effects.

The most frequent themes display strong emotional responses to the Kasbah's built environment. The effects of harmony (7 times), empathy (7 times) and contrast (5 times), respectively, are the most influential in Le Corbusier's experience of the Kasbah. They are followed by the effect of vastness and magnitude (4 times), the effect of spatial navigation (3 times), the effect of colours (2 times), and the effect of contours (1 time).

Acting together like a hierarchical complex system to shape Le Corbusier's experience of the Kasbah, each theme relates to others, reinforces them and gets reinforced by them at the same time. Hence, all the spatial properties are part of the city as a whole, and exist as complex networks of physical and atmospheric elements. For example, the emotional outcomes of bliss, calm and intimacy are related to the extended view towards the sea and the contrasts played dynamically

Table 1: Content analysis of some recording units collected from Le Corbusier's writings about the Kasbah

Recording units	Space	Codes	Categories	Themes
Dominant horizontal... here each house lends its roof to touch the clouds, Azure or stars… (Gerber, 1993, p. 209)	The house	Extended view towards the horizon	Dominance via openness	The effect of magnitude and vastness
It is in consonance with nature because from the terrace of each dwelling …one sees the sea. (Le Corbusier, 1941, p. 30)	The house	Open view on the sea	Consonance via openness	
Arab architecture is the most mathematical. (Gerber, 1994, p. 370)	The house	Fascinating mathematical dimensions	Proportions and dimensions	The effect of harmony and proportions
An Arab house is measured in accordance with the pace of the steps and the height of the shoulders. The courtyard and the rooms are dimensioned based on the measure of the step, and the heights are estimated according to the height of the head and the shoulders: columns with the height of the shoulders and passages within the level of the head. (Gerber, 1994, p. 370)	The house	Architecture and human scale	Proportions and dimensions	
Principles of the Moorish dwelling: contrast of various heights… (Le Corbusier, 1933, p. 247)	The house	Contrast of heights	Contrast in the geometric shape	The effect of contrasts
…and the so prodigiously architectural contrasts of low and high spaces (Le Corbusier, 1932, p. 7	The house	Contrast of heights	Contrast in the geometric shape	

DISCUSSION

The content analysis (Table 2) unveils seven themes representing the impact of the spatial properties that shaped le Corbusier's experience of the Kasbah. Some are related to the physical features of the built environment, and some are related to the atmospheric ambiances of the Kasbah. The themes are: the effect of contours; the effect of vastness and magnitude; the effect of colours; the effect of proportions and harmony, the effect of empathy; the effect of contrast; and the effect of spatial navigation.

through smooth transitions in the space. Here, empathy, magnitude and contrast effects exist by themselves and are aroused by the panoramic view, the contrasts and the spatial organization, but they become more intense when interacting with each other, hence strengthening the formation of memories and the architectural experience of the Kasbah.

According to the content analysis in Table 3, indoor space displayed a frequency of 16 repetitions for 6/7 effects listed in Table 2, while outdoor space displayed a frequency of 9 repetitions for 5/7 theme effects. This suggests that the

indoor built environment (the architecture) left a greater impact on Le Corbusier's experience of the Kasbah than the outdoor space.

Within the indoor space, the terrace and courtyard had the greatest impact on Le Corbusier's architectural experience of the Kasbah. *Terrace* is recorded 5 times within 2 theme effects, those of magnitude and vastness and empathy, while *courtyard* is recorded 3 times within 1 theme effect, that of empathy via positive emotions and beauty judgment.

Composed of a maze of narrow winding alleys, sometimes

Table 2. Content analysis results

Recording units	Space	Codes	Categories	Themes
A1	The city	Magnificent, compact and curved forms	Curvilinear contours	**The effect of curvilinear contours**
Total	**1**			
E1	The house	Extended view towards the horizon	Dominance via openness	**The effect of magnitude and vastness**
C1	The house	Open view of the sea	Consonance via openness	
C2	The house	Giant terrace staircase open to the sea	Dominance via size and openness	
G1	The house	Extended view towards the horizon	Dominance via openness	
Total	**4**			
C3	The city	Glittering white walls	Dominance of the colour white	**The effect of colour**
C4	The house	Mixture and harmonious contrast of colours	Harmony of colours	
Total	**2**			
C5	The city	Fascinating mathematical dimensions and proportions	Proportions and dimensions	**The effect of harmony and proportions**
F3	The house	Fascinating mathematical dimensions	Proportions and dimensions	
F4	The house	Architecture and human scale	Proportions and dimensions	
A2	The city	Fascinating mathematical dimensions and proportions	Proportions and dimensions	
A3	The house	Fascinating mathematical proportions and human architecture	Proportions and dimensions	
D1	The city	Imminent harmonious wholeness	Symphonic Harmony	
C6	The city	Imminent harmonious wholeness	Symphonic Harmony	
Total	**7**			
A4	The house	Embodied feeling of calm, intimacy, bliss, comfort and hospitality	Empathy via positive emotions	**The effect of empathy**
F1	The house	Embodied feeling of calm, intimacy, bliss, comfort and hospitality	Empathy via positive emotions	
E2	The house	Embodied feeling of calm, intimacy, bliss, comfort and hospitality	Empathy via positive emotions	
G2	The house	Attachment, happiness and the joy of living	Empathy via attachment	
C7	The house	Surprise, awe and beauty	Empathy via beauty and awe	
F2	The house	Tenderness and sensitivity to human needs	Human architecture	
C8	The city	Tenderness and sensitivity to human needs	Human architecture	
Total	**7**			
A5	The house	Contrast of heights	Contrast in the geometric shape	**The effect of contrasts**
B1	The house	Contrast of heights	Contrast in the geometric shape	
B2	The house	Contrast of ambiences light/ shadow	Contrast of ambiences	
E3	The city	Contrast of indoor/outdoor ambiences	Contrast of ambiences	
A6	The house	Contrast of indoor/outdoor ambiences	Contrast of ambiences	
Total	**5**			
E5	The house	Flexible transition and fascinating spatial discovery	Spatial Promenade	**The effect of spatial navigation**
E4	The house	appreciated spatial discovery though walking	Architecture of walking	
F5	The house	appreciated spatial discovery though walking	Architecture of walking	
Total	**3**			

vaulted like cellars, and bordered by densely packed high blank-walled houses, the spatial configuration of the outdoor space as a maze of enclosed space and a bare minimum of openness, generates the feeling of being in an indoor space, since it generates empathetic feelings of intimacy, protection and calm like those usually felt in indoor spaces. The same reasoning goes for indoor space that feels like outdoor space; its exteriorized spatial configuration through the courtyard and the terrace, and its open panoramic views towards the sky and the sea, generate an empathetic feeling of freedom and being connected to the world, as usually felt in outdoor spaces.

Le Corbusier's experience of the Kasbah is led by a number of factors such as his background as an architect in progression, his knowledge and expectations related to his previous *voyage de l'orient* and his predisposed ideas about the Muslim word and exotic cities. For instance, the psychological factor of Le Corbusier's expectations for a *white city* strengthened the aesthetic impact of the white colour of the walls in positively shaping his experience of the Kasbah.

Insights on Le Corbusier's Experience of the Kasbah of Algiers

The harmony and the synergy between the site (topography, nature and climate), the life style (religion and culture), the proportions and the desire for spatial quality and adaptation to the human scale are what shaped the architectural experience of Le Corbusier in the Kasbah of Algiers (Le Corbusier, 1941). Acting as a complex system of hierarchal and ordered elements that contribute to the formation and the harmony of wholeness, these elements are a small part of the numerous secrets behind the impactful architecture of the Kasbah. These elements, argues Gerber (1994), served as lessons for Le Corbusier to develop his second architectural language, especially with regard to proportions (human scale), spatial navigation (promenade and discovery) and empathy (humanization of architecture). "*L'architecture arabe nous donne un enseignement précieux [...] Je préfère l'enseignement de l'architecture arabe.*[2] " (Le Corbusier, 1928-34, p. 24).

The effect of curvilinear contours

The great amount of curvature present in the Kasbah (especially in the outdoor space) was greatly appealing and fascinating to Le Corbusier. The resulting pleasure and the beauty judgment of the curvilinear forms and contours of the Kasbah are underpinned by the reward and positive emotions of joy and pleasantness. Using the words *magnificent body*, *supple-hipped* and *full-breasted*, Le Corbusier compared the Kasbah's forms and contours to the plasticity and the curves of women's bodies (Le Corbusier, 1933, p. 260). These forms may have influenced Le Corbusier's emotional response towards the Kasbah by

Table 3: Indoor and outdoor experience

Spaces	Spatial properties/ elements		Theme effects	Frequency of effects
Outdoor environment (the city)	Forms and contours		The effect of curvilinear contours	1
	White walls		The effect of colour	1
	Human dimensions and Proportions		The effect of harmony and proportions	3
	Harmony of ratios			2
	Human sensitive architecture		The effect of empathy	1
	Contrasts		The effect of contrasts	1
			5 effects / 7 effects	**Total 9**
Indoor environment (the house)	Terrace	Open panoramic view on the sea and the sky	The effect of magnitude and vastness	3
		Size		1
	Harmony of colours		The effect of colour	1
	Human dimensions and proportions		The effect of harmony and proportions	2
	Terrace	Blissful, comfortable, calm and intimate atmosphere	The effect of empathy	2
	Courtyard	Beauty		1
	Human sensitive architecture			1
	Contrasts of heights		The effect of contrasts	2
	Contrasts of ambiences			1
	Spatial transition as a discovery		The effect of spatial navigation	1
	Architecture of walking and discovery			2
			6 effects / 7 effects	**Total 16**

activating the brain's circuit of aesthetic processing and stimulating a reward response within the anterior cingulate cortex through both emotional engagement and embodied imagination that relates the curves of the built environment to the curves of women's bodies.

The effect of magnitude and vastness

The synergy between the panoramic view from the terraces towards the horizon (connecting the blue of the sky with the blue of the sea) and the illusionary view of the gigantesque white stairs (formed by the gradation and imbrication of the terraces following the topography of the site) (Corbusier, 1941, p. 31) increases the perceived vastness and gives rise to a strong and memorable spatial experience of the sublime.

Le Corbusier did not actually used the word *awe* in his writings, however certain aspects of awe, as defined earlier, are still recognizable. In his description of the Kasbah, he highlighted the consonance between nature and the terraces that offer a dominant view open to the sky and the sea. Le Corbusier overwhelmingly described these terraces that drove him to the light as magic, dominant and touching the clouds, azure or stars (Gerber, 1993, p. 209). The vastness and grandeur offered by this view are behind this feeling of awe and the experience of the sublime, intimacy and bliss (Gerber, 1993, p. 266).

Moreover, built environments that offer panoramic views of natural elements are judged to be aesthetically attractive (Galindo and Hidalgo, 2005). Nature scenes have the ability to bring emotional and cognitive restoration (Jacobsen and Beudt, 2017; Havelka, 2018). In the Kasbah, the diversity and the great exposure to nature scenes increase its aesthetic appeal and positive architectural experience. Hence, the perceived vastness and magnitude, together with the restorative impact of nature, may have played an important role in shaping Le Corbusier's experience of the Kasbah.

The effect of colour

The dominance of the colour white in the Kasbah captivated Le Corbusier's attention and admiration as a result of a strong emotional engagement and appositive subjective wellbeing, which are related to his feelings of fulfilment and satisfaction upon encountering a spatial reality that was close to his expectations, aspirations and imaginations in relation to the exotic Muslim white city in general and the Kasbah in particular (Le Corbusier, 1941, p. 31).

The emotional engagement with the dominant white colour was a key factor in developing a sense of place in Le Corbusier's mind. In this case, the involvement of the circuit of aesthetic processing and the amygdala in the perception and evaluation of the colour white as a spatial quality is expected. Moreover, the harmony between the white of the walls and the blue of both the sky and the sea intensifies the aesthetic value of the Kasbah represented in Le Corbusier's mind, amplifying his emotional and aesthetic response towards this city.

The effect of empathy

A sense of place is generated by the spatial configurations and the atmospheric ambiances (spatial distribution, forms, proportions, nature, calm, freshness) of the Kasbah, which lead to the arousal of some embodied architectonic sensations (intimacy, bliss, containment, happiness and attachment) through an empathic projection caused by a strong emotional engagement towards the built environment encountered. These experiences became part of Le Corbusier's memories, which he took as architectural and urban planning lessons.

The dimensions in each space in the Kasbah are conceived according to the proportions of the human body, such as the height of the eyes in a sitting or standing position, the rhythm of one's steps, the length of the arms… etc. (Fig 7) (Karabag and Fellahi, 2017, Ravereau, 2007). Jean De Maisonseul, who was Le Corbusier's guide in the Kasbah, speculated that the idea of the *Modulor* was born in Algiers; he reported that Le Corbusier admirably described the Kasbah as a harmonious symphony (Le Corbusier, 1941, p. 30) and a mathematical city, where everything is calculated and measured according to the proportions of the human body (Gerber, 1994, p. 370). The perception of the mathematical dimensions in the architecture of the Kasbah and the observation of people being in this space triggered an embodied simulation of harmony in Le Corbusier's mind, ensured by canonical neurons and mirror neurons, leading to a beauty judgment regarding the richness of the stimulus and the poetic (mathematical) synergy between the human body proportions and the built space.

The effect of contrasts

In his texts, Le Corbusier pointed out different contrasts of sizes, heights, light and shadow, openness and closure, ornamented and unornamented, wideness and narrowness, etc. that contributed to the beauty and the comfort of the Kasbah's architecture (Le Corbusier, 1932, p. 7; Le Corbusier, 1933, p. 247). In fact, the subtle play of the contrasts between these elements, in both the indoor and outdoor spaces of the Kasbah, amplifies its aesthetic and sensory experience through a continuous switch of ambiances, causing continuous emotional regulations and shifts in the neural activities in the brain.

Since the play of light and volumes are decisive parameters in his works (Morel Journel, 2015), his sensibility towards the interaction and contrasts between the hardness of matter, the dimensions and heights of volumes and the lightness of light in the Kasbah is a crucial factor with regard to the architectural experience it offers. The alternation between light and shadows (darkness) through the meandering form of the alleys of varying widths, the salient cantilevered corbels of the houses covering parts of the streets, the transition from the entrance (dark) to the courtyard (immersed in daylight) to the rooms (dark), etc., create constantly changing ambience patterns of air, light and shadows during the day. These contrasts in the light settings intensify the self-regulating circadian rhythm, thus enhancing Le Corbusier's emotional response and beauty judgment about the Kasbah, and his empathetic sense of place.

Moreover, the atmospheric contrasts in the Kasbah also left a strong impression on Le Corbusier (Le Corbusier, 1941, p.31; Le Corbusier, 1933, p.230); they are observed in the transition between the indoor and the outdoor space, where the ambiances are so different, shifting from calm and minimalist atmospheres in the outdoor space to colourful, ornamented and dynamic atmospheres in the indoor space

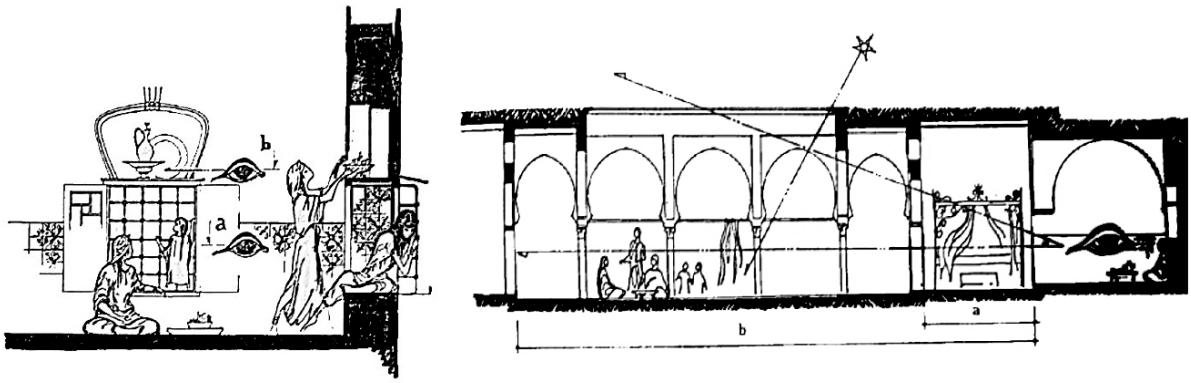

Figure 7. Harmony, human scale and proportions in the houses of the Kasbah (Source: Ravereau, 2003)

(especially the courtyard).

Effect of spatial navigation

The Kasbah stirs rich emotional-sensory experiences, through the stimulation of different perceptual modalities caused by a multitude of harmoniously correlated spatial qualities located along a path of the promenade in indoor or outdoor spaces. The quality of free exploration granted by the Kasbah's complex maze-like street network, the ambulatory navigation in the houses (because of their disposition around a courtyard), and the connectivity between the houses through the terraces, make the pedestrian motion an important parameter for generating a sense of place. The process involved is the formation of long-term emotional-spatial memories by implicating place cells and grid cells in wayfinding, proprioception, and the formation of memory within the hippocampus and the amygdala.

The ambulatory nature of the Kasbah's houses engaged Le Corbusier in a lot of exploratory pedestrian movement (Le Corbusier, 1928-34, p. 24), which, under the influence of the other spatial properties, resulted in a continuous act of cementing and updating memories of striking and visually rich architectural experiences (Le Corbusier, 1928-34, p. 24). It is the order of all the above-mentioned spatial properties along a path which creates a pleasurable experience in the Kasbah through spatial navigation.

Although the above six effect themes do not exhaustively explain or capture the complexity and the diversity of Le Corbusier's architectural experience of the Kasbah of Algiers, they represent a useful starting point for investigating Le Corbusier's responses to the built environment of the Kasbah, based on his discourses and knowledge from cognitive sciences.

CONCLUSION

Inspired by a larger framework for developing a cognitive-phenomenological approach which unites cognitive sciences, architecture and phenomenology in the analysis of an individual's architectural experience, this paper contributes to deepening the knowledge about how architectural experience can be described in neuro-phenomenological terms. It explores how the relationship between humans and architecture can be used to develop an assessment tool to produce knowledge about the impact of the built environment through a text-based analysis of the architectural experience.

The examination of Le Corbusier's experience of the Kasbah of Algiers, based on his writings, shows that this city has the power to generate emotional engagements. These engagements arise from: a high cognitive-affective reaction to the dynamic interaction between the curved contours of its maze of streets; the contrasts and harmony of the colours; the magnitude and vastness generated by its panoramic views; the proportions that follows the human body dimensions in different postures; the contrasts of height and light dimensions and ambiances; and the spatial navigation that favours the act of walking to discover the environment and unveil its mysteries.

The results also show that these properties are part of the city as a whole; they exist as complex networks of physical and atmospheric properties in perpetual interaction. This network experience recruits a number of cerebral activations that involve a variety of mechanisms regulating corporeal, emotional and cognitive responses, under the influence of the previous knowledge, beliefs and aspirations of Le Corbusier.

Analyzing historical architectures like the Kasbah can teach us something that contributes to enhancing the design of contemporary buildings and cities. The exploration of other people's experiences of the built environment of the Kasbah can reveal other properties that did not grasp Le Corbusier's attention, but they are part of the holistic experience of the city. Moreover, with support from phenomenology and neuroscience, as more established experimental frameworks in which architectural experience is studied in the real world and in real time, future studies can expand these results towards a deeper understanding of how the spatial morphology and its properties affect people's perception.

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