

# Comparative Study of Complexity in Streetscape Composition

Ahmed Mansouri, and Naoji Matsumoto

**Abstract**—This research is a comparative study of complexity, as a multidimensional concept, in the context of streetscape composition in Algeria and Japan. 80 streetscapes visual arrays have been collected and then presented to 20 participants, with different cultural backgrounds, in order to be categorized and classified according to their degrees of complexity. Three analysis methods have been used in this research: cluster analysis, ranking method and Hayashi Quantification method (Method III). The results showed that complexity, disorder, irregularity and disorganization are often conflicting concepts in the urban context. Algerian daytime streetscapes seem to be balanced, ordered and regular, and Japanese daytime streetscapes seem to be unbalanced, regular and vivid. Variety, richness and irregularity with some aspects of order and organization seem to characterize Algerian night streetscapes. Japanese night streetscapes seem to be more related to balance, regularity, order and organization with some aspects of confusion and ambiguity. Complexity characterized mainly Algerian avenues with green infrastructure. Therefore, for Japanese participants, Japanese traditional night streetscapes were complex. And for foreigners, Algerian and Japanese avenues nightscapes were the most complex visual arrays.

**Keywords**—Streetscape, Nightscape, Complexity, Visual Array, Affordance, Cluster Analysis, Hayashi Quantification Method.

## I. INTRODUCTION

COMPLEXITY, as a concept, covers the major aspects of our urban life. When a human being walks in a street or contemplates urban scenery, he often feels an increasing complexity from the smallest urban detail to the whole urban scene. The most frequent question is usually related to the origin of this complexity. This has been the subject of series of researches dealing from the physical aspects of the urban environment to its social dimension. This research tries to deal with another aspect of complexity, which is the evaluation of the degree of complexity in different streetscapes issued from two different physical environments (Algeria and Japan), according to multi-cultural groups of individuals.

Ahmed Mansouri is a doctoral student in Matsumoto Laboratory, Department of Architecture, Urban Engineering & Civil Engineering, Faculty of Social Engineering, Nagoya Institute of Technology, Showa-Ku Gokiso-Cho, Nagoya-Shi 466-8555, Japan (phone: +81-52-735-5510; fax: +81-52-735-5569; e-mail: a71mansouri@hotmail.com).

Naoji Matsumoto is a Professor within the Department of Architecture, Urban Engineering & Civil Engineering, Faculty of Social Engineering, Nagoya Institute of Technology, Showa-Ku Gokiso-Cho, Nagoya-Shi 466-8555, Japan (phone: +81-52-735-5510; fax: +81-52-735-5569; e-mail: matsumoto.naoji@nitech.ac.jp).

## II. CONCEPTUAL BACKGROUND

As an urban space, a street can be defined as a more or less narrow, linear space lined by buildings, found in settlements and used for circulation and other activities (Rapoport, 1996). Street sidewalks exist to permit local interactions and create a more complex order. Within science, complexity is a watchword for a new way of thinking about the collective behavior of many interactive units. In the urban context, complexity exists within two fundamental forms. First, the systematic complexity that makes the city a self-organizing system. This sort of complexity describes more the urban system rather than its experiential reception by the city dwellers. The second type of complexity has a conventional sense of sensory overload where the city extremely stretches the human nervous system, revealing new kinds of reflexes. In Environmental psychology, complexity represents the involvement component, which means: How much there is to see in a visual array (two dimensional composition)? A definition mainly related to the concept of Affordance that refers to what a perceived scene has to offer as far as the perceiver is concerned (Kaplan, 1988).

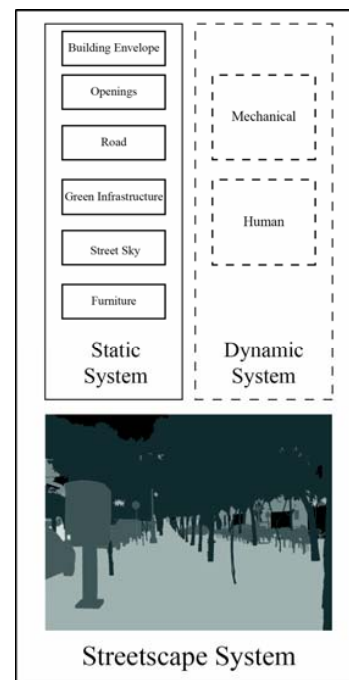


Fig. 1 The Streetscape System

In this research, a streetscape composition is considered as a visual array within which a dynamic system and a static one, both composed of smaller sub-systems, exist in a continuous interaction “Fig. 1”. The static system includes the buildings envelope, the street sky, the openings, the road, the urban furniture and the green infrastructure. The dynamic system includes the mechanical system (Vehicles) and the Human system (people, creatures).

III. THE RESEARCH PROBLEM AND STRATEGY

The aim of this research is to explore the degree of complexity that a streetscape composition can express, as well as the evaluation of this complexity according to different individuals with different cultural backgrounds. The strategy behind this study was structured throughout three phases. First, the visual arrays collection. Second, the experiment during which the participants were asked to rank and to organize the selected samples. Finally, the data analysis using Cluster analysis, ranking method and Hayashi Quantification Method (Method III).

A. Data Collection

The Data collection process was based on the principle of taking two visual arrays of the same streetscape, one in daytime and another one at nighttime “Fig. 2”.

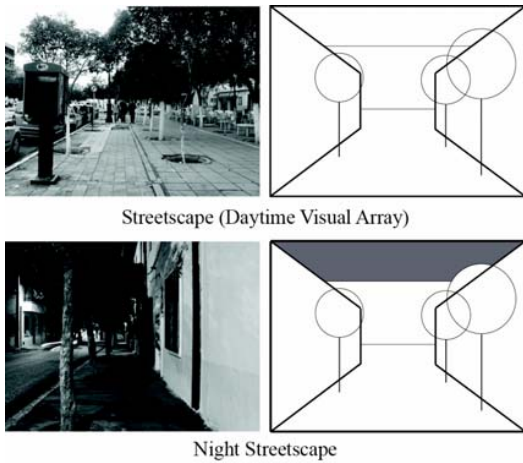


Fig. 2 The Data Collection Method

A total number of 176 visual arrays have been taken in different sites in Algeria and Japan. Then, 80 random samples were selected (see Table I), with an equal number of 40 visual arrays (20 daytime and 20 nighttime samples) from each country “Fig.3” & “Fig.4”.

TABLE I  
THE SELECTED DATA

Country	City	Period	Collected Data	Selected Data
Japan	Kyoto	10-2008	24	20
	Tokyo	10-2008	62	20
Algeria	Al-Kantara	12-2008	58	20
	Batna	12-2008	32	20
	Total		176	80

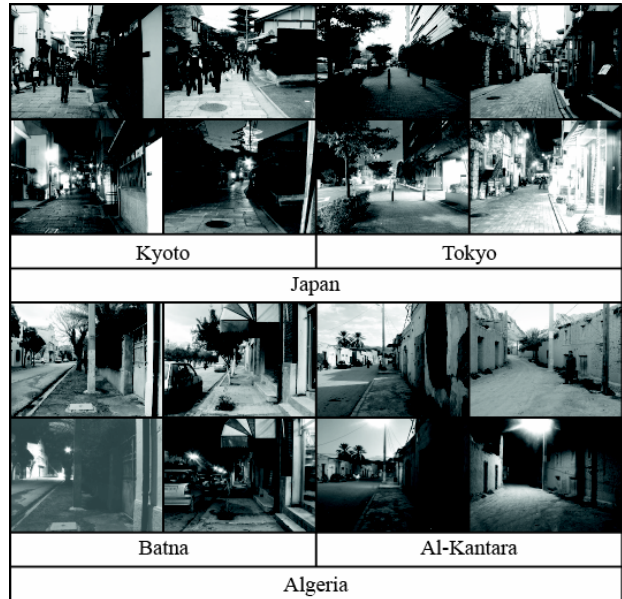


Fig. 3 Selected Streetscapes

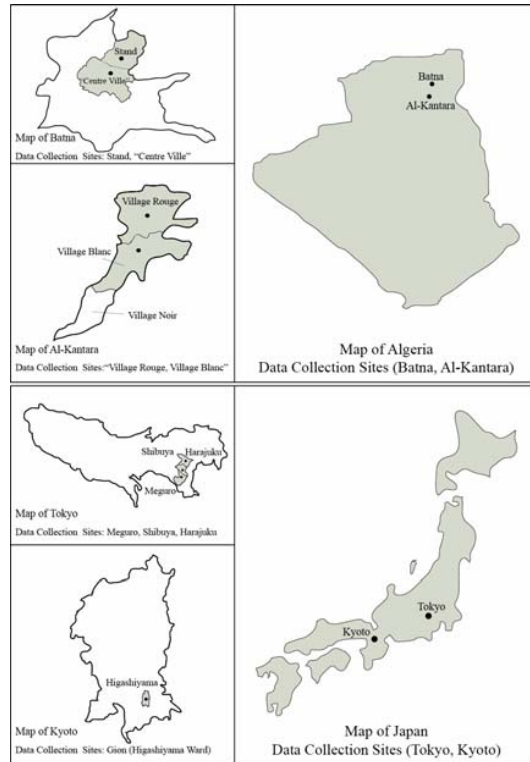


Fig. 4 The Data Collection Sites

B. The Experiment

In order to conduct the experiment, 20 students from Nagoya Institute of Technology agreed to participate in this research (see Table II). The strategy was to have two groups of participants, the first group is composed of 10 Japanese students and the second one is composed of 10 foreign students with different cultural backgrounds (Algeria, Kenya,

Brazil, Egypt, Chile, Libya and Morocco). The participants were asked first to categorize the samples into different groups, according to their physical characteristics (functional and morphological), and then to rank them, according to a five-point scale, from the simplest visual array to the most complex one “Fig. 5”.

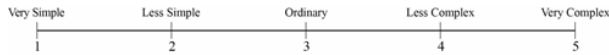


Fig. 5 Complexity ranking scale

#### IV. DATA ANALYSIS AND RESULTS

In order to classify and evaluate the selected streetscapes, three different analysis methods have been applied. First, Cluster Analysis (Ward method) in order to identify the physical and functional typology of the different visual arrays “Fig. 6”. Second, Ranking Method that aims to rank the samples according to their degrees of complexity “Fig. 7”. And finally, Hayashi Quantification Method (Method III), which aims to categorize the samples according to a lexicon related to the concept of complexity “Fig. 8” & “Fig. 9”.

##### A. Cluster Analysis

In order to configure a similarity matrix that can serve as a basis for Cluster analysis, the participants were asked to organize the different daytime and nighttime streetscapes into different groups according to their physical and functional characteristics. The application of Cluster Analysis (Ward Method), helped in identifying the following groups of streetscapes and night streetscapes, “Fig. 6”:

##### *Algerian Daytime Streetscapes:*

GrD.1(Alg): Traditional streetscapes.

GrD.2(Alg): Avenues with green infrastructure.

GrD.3(Alg): Quiet, Residential streetscapes.

##### *Japanese Daytime Streetscapes:*

GrD.A(jp): Avenues, Commercial Streetscapes.

GrD.B(jp): Quiet streetscapes with green infrastructure.

GrD.C(jp): Traditional streetscapes.

##### *Algerian Night Streetscapes:*

GrN.1(Alg): Quiet, wide, traditional night streetscapes.

GrN.2(Alg): Dark, narrow, quiet, traditional night streetscapes.

GrN.3(Alg): Residential, quiet, wide, modern night streetscapes.

GrN.4(Alg): Well-lit Avenues.

##### *Japanese Night Streetscapes:*

GrN.A(jp): Traditional. a bit dark, night streetscapes.

GrN.B(jp): Wide, a bit dark, modern night streetscapes.

GrN.C(jp): Well-lit Avenues.

##### B. Ranking Method

In the second phase of the experiment, the participants were asked to rank the streetscapes from the simplest visual array to the most complex one according to a five-point scale “Fig. 5”. In the daytime streetscapes category, both Japanese and foreign participants ranked the Japanese quiet streetscapes with green infrastructure and Algerian traditional streetscapes

as the simplest visual arrays. The Japanese traditional streetscapes, Algerian Avenues with green infrastructure and some Algerian residential streetscapes were ranked as the most complex visual arrays by Japanese participants.

The “complex visual arrays” category for foreign participants included mainly Japanese and Algerian Avenues, some Japanese traditional streetscapes, as well as some Algerian residential streetscapes. In the night streetscapes category, the participants classified the Algerian traditional night streetscapes as the simplest visual arrays, and Avenues nightscapes (both Japanese and Algerian samples) as the most complex. Therefore, the simplest visual arrays were traditional Japanese night streetscapes for the Japanese participants, and modern Japanese night streetscapes for the foreign participants “Fig. 7”.

##### C. Hayashi Quantification Method (Method III)

Hayashi Quantification Method (Method III) is an analysis method formally equivalent to Correspondence Analysis (Greenacre, 1984) and closely related to Scalogram Analysis (Guttman, 1950). In this study, this method was applied in order to cluster the different visual arrays according to a lexicon related to the concept of complexity “Fig. 8” & “Fig. 9”. In the Algerian daytime streetscapes category, the application of Hayashi Quantification Method (Method III) could show that order characterized traditional streetscapes. The residential streetscapes and avenues seem to be attractive; therefore, richness was more related to Avenues. In the Japanese daytime streetscapes category, disorder was the aspect of traditional streetscapes and Avenues were characterized by balance and attractiveness. Complexity, heterogeneity, irregularity, unbalance and disorganization were more related to the Japanese streetscapes with green infrastructure. In the Algerian nighttime streetscapes category, traditional night streetscapes as well as Avenues were irregular and disorganized. Therefore, wide traditional night streetscapes had some aspects of order and the narrow traditional night streetscapes were joyless and uninteresting. Balance was an aspect of Avenues nightscapes and wide residential night streetscapes had some aspects of organization, regularity and variation. In the Japanese night streetscapes category, balance, disorder and irregularity characterized traditional nightscapes. Well-lit avenues were varied but unambiguous and wide modern night streetscapes had some aspects of disorder, balance and attractiveness (see Table III). In a more general scale, Algerian daytime streetscapes were balanced, ordered, regular and organized with some aspects of simplicity and homogeneity. Japanese daytime streetscapes were vivid, attractive and beautiful with some aspects of unbalance and regularity. Nevertheless, Dualities between order and disorder, organization and disorganization characterized some Japanese streetscapes. Algerian night streetscapes seemed to be ambiguous, unbalanced and ordered with some aspects of confusion and repulsion. Attractiveness, order, organization and regularity characterized Japanese night streetscapes with some aspects of confusion, repulsion and inelegance (see Table IV, Table V).

TABLE II  
NUMBER OF PARTICIPANTS

Participants	Japan	Algeria	Morocco	Syria	Kenya	Libya	Brazil	Egypt	Chile	Total
Group A	10									10
Group B		1	1	2	2	1	1	1	1	10

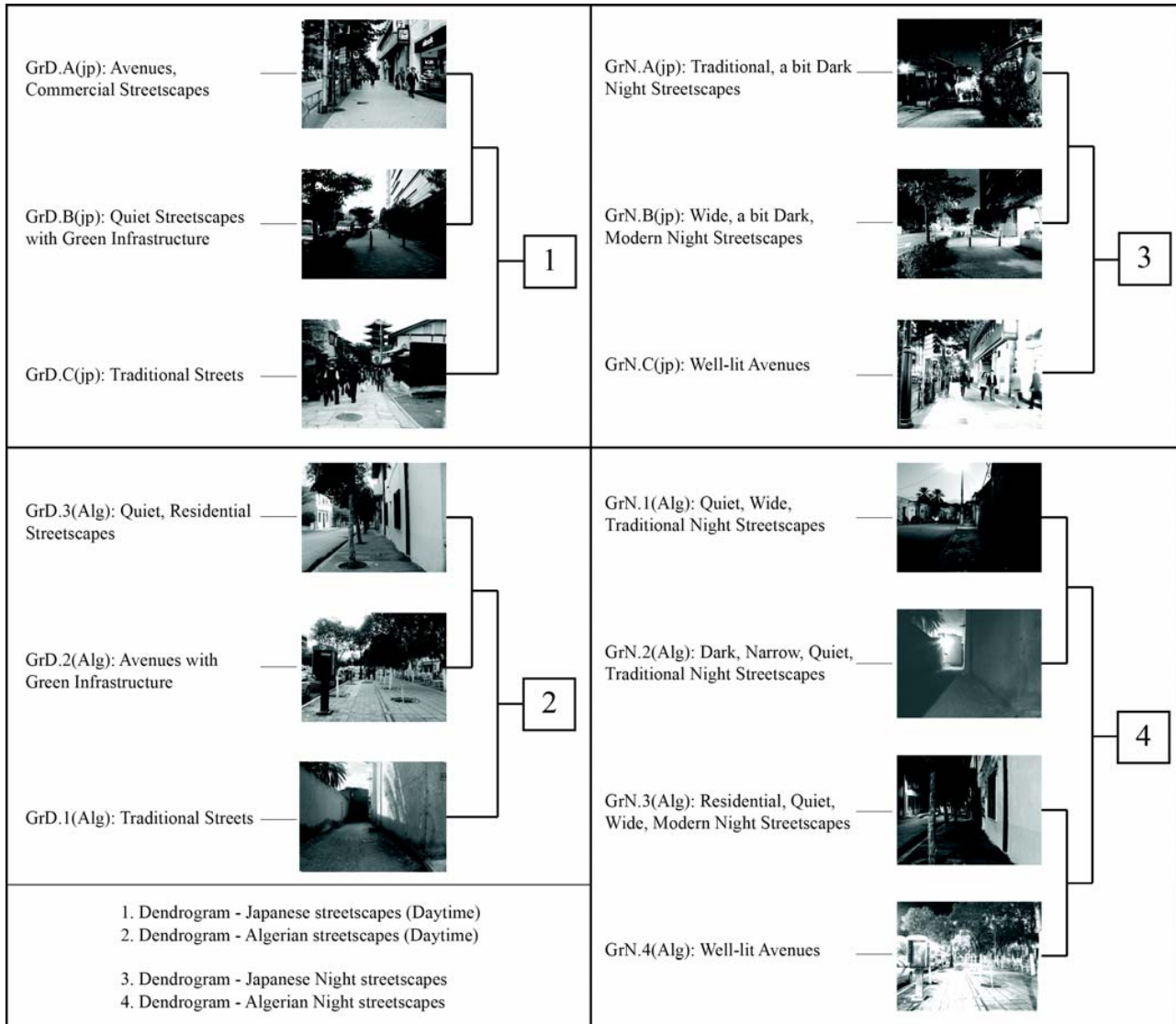


Fig. 6 Streetscapes Categorization using Cluster Analysis (Ward Method)



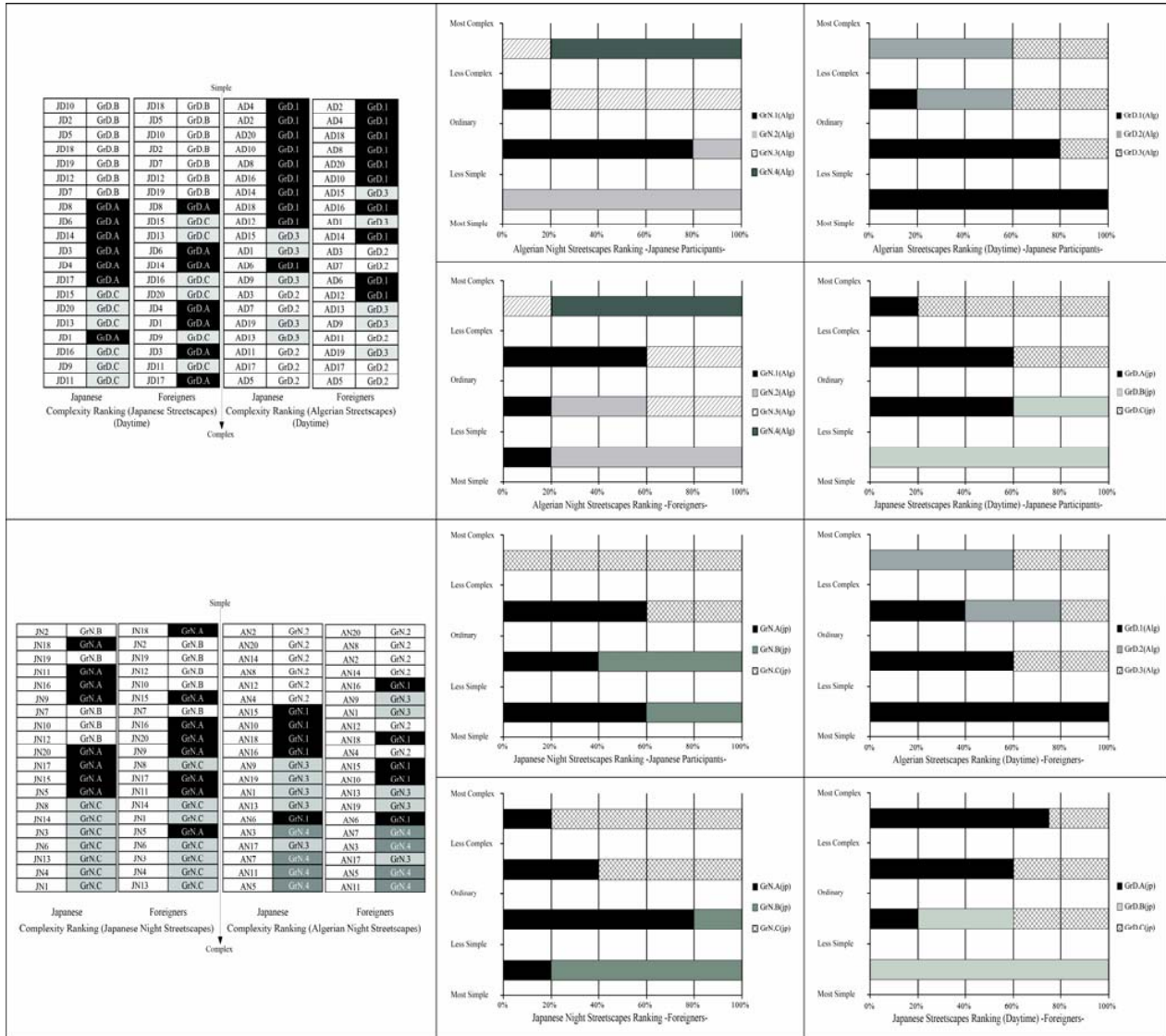


Fig. 7 Ranking Method

TABLE III  
HAYASHI QUANTIFICATION METHOD (METHOD III) – CATEGORY AND SAMPLE SCORE –

Category	Group	Characteristics
Algerian Streetscapes -Daytime-	GrD.1(Alg): Traditional Streetscapes	(Balanced, ordered, organized), (Confusing, depressing, repulsive), (Banal, poor, uninteresting)
	GrD.2(Alg): Avenues with green infrastructure	(Vivid, active, rich), (Attractive, beautiful, interesting)
	GrD.3(Alg): Quiet, Residential Streetscapes	(Calming, inviting, opened), (Attractive, beautiful, interesting)
Japanese Streetscapes -Daytime-	GrD.A(jp): Commercial streetscapes, Avenue	(Attractive, balanced, expressive)
	GrD.B(jp): Quiet streets with green Infrastructure	(Irregular, unbalanced, disorganized), (Complex, beautiful, heterogeneous)
	GrD.C(jp): Traditional streetscapes	(Irregular, unbalanced, disorganized), (Vivid, disorganized, interesting)
Algerian Night Streetscapes	GrN.1(Alg): Quiet, wide, traditional night streetscapes	(Inviting, soft, ordered, familiar), (Foggy, heterogeneous, disorganized, irregular)
	GrN.2(Alg): Dark, narrow, quiet, traditional night streetscapes	(Foggy, heterogeneous, disorganized, irregular), (Uninteresting, joyless, inelegant, unpleasant), (Inexpressive, unbalanced, complex, unaesthetic)
	GrN.3(Alg): Residential, modern, quiet, wide night streetscapes	(Organized, regular, active, unambiguous), (Vivid, varied, attractive, beautiful)
	GrN.4(Alg): Well-lit Avenues	(Vivid, varied, attractive, beautiful), (Joyous, aesthetic, balanced, elegant), (Foggy, heterogeneous, disorganized, irregular)
Japanese Night Streetscapes	GrN.A(jp): Traditional, a bit dark night streetscapes	(Closed, strange, restrictive, old fashioned), (Ambiguous, foggy, light, irregular), (Vivid, attractive, balanced, beautiful, disordered)
	GrN.B(jp): Wide, a bit dark, modern night streetscapes	(Ordered, joyless, unaesthetic, unbalanced), (Vivid, attractive, balanced, beautiful, disordered)
	GrN.C(jp): Well-lit Avenues	(Joyous, varied, clear, unambiguous)

TABLE IV  
HAYASHI QUANTIFICATION METHOD (METHOD III) – CATEGORY AND SAMPLE SCORE –  
- DAYTIME AND NIGHTTIME STREETSCAPES -

Category	Country	Characteristics
Daytime	Algeria	(Homogeneous, ordered, simple), (Organized, regular), (Banal, uninteresting, poor), (Inexpressive, unaesthetic)
	Japan	(Organized, ordered, regular), (vivid, attractive, beautiful), (Unbalanced, disordered, disorganized)
Nightscape	Algeria	(Interesting, beautiful, expressive, meaningful), (Attractive, ordered, organized, regular), (Ambiguous, unbalanced, disorganized, irregular), (Joyless, confusing, repulsive, inelegant)
	Japan	(Attractive, ordered, organized, regular)

TABLE V  
HAYASHI QUANTIFICATION METHOD (METHOD III) – CATEGORY AND SAMPLE SCORE –  
- ALGERIAN AND JAPANESE STREETSCAPES AND NIGHT STREETSCAPES-

Category	Country	Characteristics
Algeria	Daytime	(Balanced, ordered, organized, regular) – (Vivid, attractive, beautiful, expressive)
	Nightscape	(Calming, passive, unaesthetic, irregular) – (Vivid, attractive, beautiful, expressive) – (Varied, exciting, active, rich)
Japan	Daytime	(Disordered, disorganized, irregular, complex) – (Attractive, balanced, beautiful, organized, irregular)
	Nightscape	(Ambiguous, soft, foggy, ordered) – (Attractive, balanced, beautiful, organized, regular)

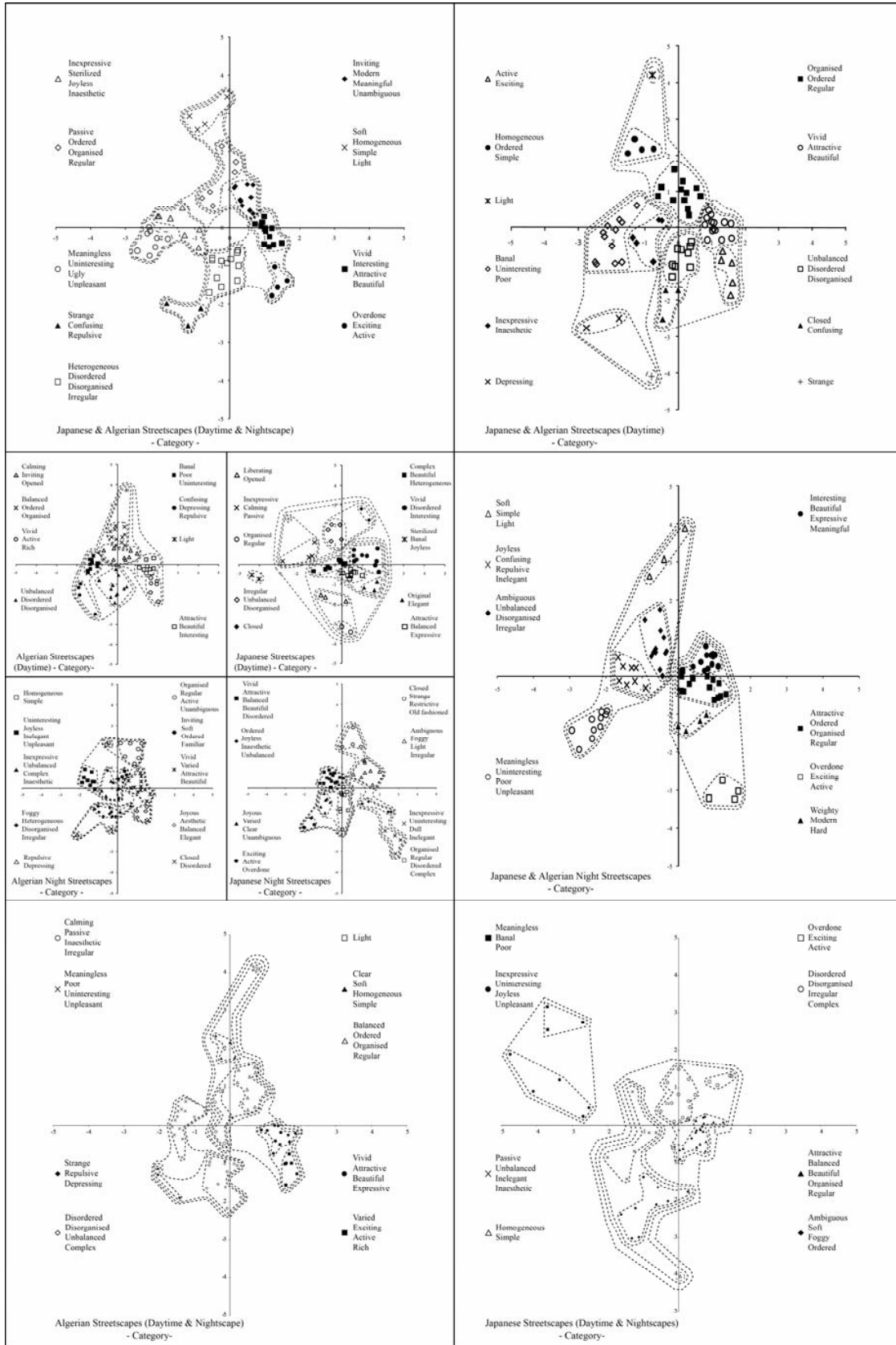


Fig. 8 Hayashi Quantification Method (Method III) - Category –

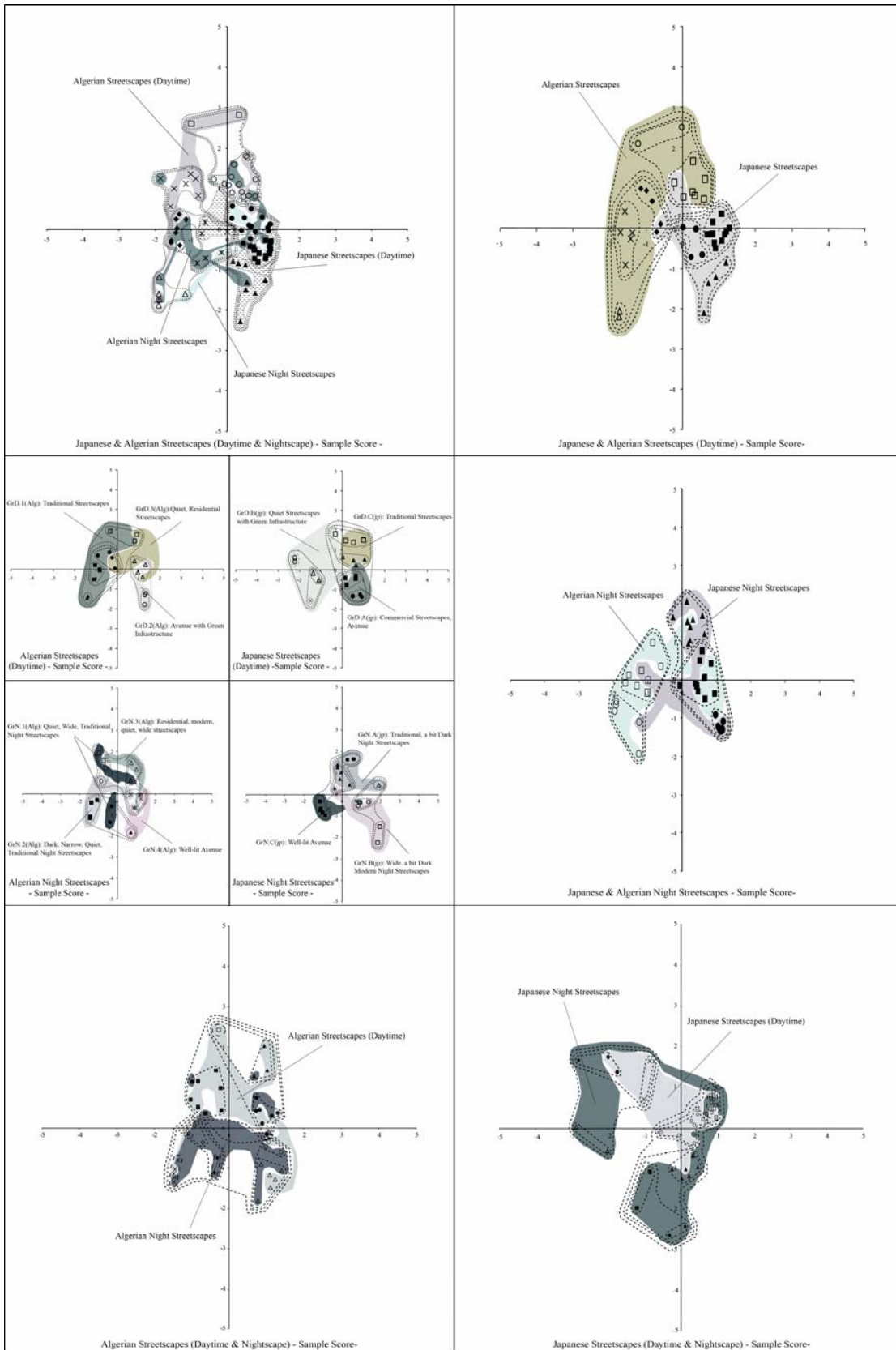


Fig. 9 Hayashi Quantification Method (Method III) - Sample Score –



## V. DISCUSSION

Complexity is a multidimensional concept. Throughout this study, many results could show that some concepts related to complexity, such as disorder, irregularity and disorganization are often conflicting and contradictory. In many cases, Order was related to disorganization and complexity was related to regularity and organization. Therefore, this study could notice that concepts, such as: variety, richness and irregularity with some aspects of order and organization seem to be the major aspects of Algerian night streetscapes. Japanese night streetscapes seem to be attractive, balanced, regular, ordered and organized with some aspects of confusion and ambiguity. In the other hand, concepts like: Balance, order, regularity and homogeneity seem to characterize Algerian daytime streetscapes. Unbalance, regularity, vividness and attractiveness seem to be the major characteristics of Japanese daytime streetscapes.

In the daytime category, simplicity was related to the Japanese traditional streetscapes and the quiet streetscapes with green infrastructure. Complexity was more related to the Algerian avenues with green infrastructure.

In the nighttime category, Simplicity seems to be more related to the Japanese traditional night streetscapes. Therefore, for foreign participants, simplicity was also related to the Japanese modern night streetscapes. Concerning complexity, the Japanese participants ranked the Japanese traditional night streetscapes as complex, but for foreign participants, complexity was more related to Algerian and Japanese avenues nightscapes.

Future researches will aim to explore the geometric background and concepts behind this complexity in streetscapes composition.

## ACKNOWLEDGMENT

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**Ahmed Mansouri** was born in Batna (Algeria) in 1971. He received his bachelor degree in Architectural Planning and Design from the National Institute of Architecture of Biskra (Algeria) in 1993. He received a Master degree in Architectural Design from the Department of Architecture, Faculty of Science and Engineering, University of Biskra (Algeria) in 2001, and a Master of Engineering from the Graduate School of Social Engineering, Nagoya Institute of Technology (Japan) in 2005. He is a Doctoral Student and a member of Matsumoto Laboratory, Department of Architecture, Urban Engineering and Civil Engineering, Graduate School of Social

Engineering, Nagoya Institute of Technology (Japan).

Ahmed Mansouri is a regular member of the Architectural Institute of Japan. His research interests are related to complexity, Emergence and Fractal geometry in the urban environment.



**Naoji Matsumoto** was born in Saitama (Japan) in 1950. He obtained his Doctor degree of Engineering from Tokyo Institute of Technology in 1979. He was an Assistant Professor at Tama Art University from Nov. 1979 to Sep. 1981, Tokyo Institute of Technology from Oct. 1981 to March 1982, Shinshyu University from April 1982 to April 1989 and Nagoya Institute of Technology from May 1989 until May 1993. He was a Professor at Nagoya Institute of Technology from May 1993 to March 2003. He is a Professor of Nagare College, Human Space field, Graduate School of Socio Engineering, Nagoya Institute of

Technology since April 2003.

Prof. Dr. Eng. Naoji Matsumoto is a member of the Architectural Institute of Japan, City Planning Institute of Japan, The Association of Urban Housing Sciences and the IAPS. His research interests are related to townscape and landscape design, the visual effects of the Architectural space and its surroundings and the development of visual simulation systems.