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EVALUATION OF THE RESIDENTIAL SATISFACTION VIA A FACTORIAL ANALYSIS OF THE RESIDENTIA ENVIRONMENT (SOCIAL HOUSING). THE CASE OF THE CITY OF BOUSSAÂDA, ALGERIA

Abstract: The improvement of the quality of life within the residential environment is the ultimate objective of sustainable development, in which its environmental, economic and social dimensions are constantly identified and updated. To this end, the development of a reference framework for the actors of the housing sector can formulate new policy trends related to the planning and design of the residential environment. Post-occupancy evaluation is an appropriate method for assessing and evaluating the impact of housing policies on residents' behaviour. Then, the results of these policies are tested by measuring residential satisfaction and by determining the factors that affect it. To achieve this objective, the technique of a head-of-household interview form was used. We relied on eighteen well-known potential variables in studies related to housing satisfaction, focusing on the social dimension. A sample consisting of two social housing clusters in the city of Boussaâda, comprising 121 households was randomly selected. Finally, the data were statistically processed using a factor analysis which is the principal components method, through which four factors containing fourteen variables that control residential satisfaction were extracted.

Key words: residential satisfaction, post-occupancy evaluation, factor analysis, residential environment, social dimension, City of Boussaâda

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Introduction

The residential environment is considered as one of the most important components of the urban system, if not the most influential subsystem at all. The way to approach it requires a judicious treatment of social and physical components. The existence of correlations between these two components makes this environment a complex and delicate subject. Well-known the physical aspect is perceived as a logical outcome of the projection of the social component on the space, as underlined by Henri Lefebvre (Paquot, 2009), of course, as far as the economic conjunctures allow it. In reality, the current practices go against this axiom; it is the economic conjunctures which determine the physical aspect the living environment by an implicit complicity between the project manager and the project owner. Thus, they decide the future of the way of life for the category in question according to its capacity of solvency.

The present article analyses the repercussions of the above-mentioned practices that produce a rigid living environment - signalling the lack of flexibility required within the design process- generating negative behaviours of the residents towards the produced residential environment and translating a feeling of refusal and dissatisfaction.

The traditional Cartesian approach has become incompatible with the changing and dynamic requirements of both the complexity of the universe and the ramifications of its components (the urban and residential environment). Albert Einstein says: "If we do not change our way of thinking, we will not be able to solve the problems we create through our current ways of thinking". This new way of thinking is the systemic approach (Donnadieu et al., 2003).

Improving the quality of life in the residential environment is the ultimate goal of sustainable development. Thus, addressing the quality of life requires the establishment of measurable and assessable indicators (Dehimi & Hadjab, 2019). In other words, to evaluate the satisfaction of occupants through their behaviours towards the built environment via preconceived indicators, three levels are retained: the housing, the environment that contains it, and finally the expenses and costs of housing.

Therefore, we use the post-occupational evaluation method to measure the residential satisfaction via factor analysis as a continuation of the systemic approach. This is because the improvement of housing quality is chimerical with a simple intervention on the physical component. In this respect, a global approach is necessary for the planning and the design of the residential environment. Eventually this approach can, first, determine the indicators controlling the residential satisfaction, and second, promote and improve the quality of life within the residential environment.

The city of Boussaâda (province of M'sila), of the Algerian highlands, is designated as the "gateway to the desert" as being the closest oasis to the Algerian coast. A booming city, which is manifested by the increase in demand for housing, is reflected in housing programs with different types dominated by collective housing with similar plans, without considering the social structure.

The situation requires that it is best to evaluate the existing models of collective housing - albeit few - before proceeding to the adoption and generalization of this new model in the city. Residential mobility - the change in the place of residence of a household (Insee, 2017) and the changes in the interior space of the dwelling that extend to the altera-

tion of the urban facade of the residential environment – is seen as a phenomenon worth studying and analysing. Eventually, the latter may be due to residents' dissatisfaction with their environment made available to them. We assume that an assessment of this environment can lead us to determine the factors responsible for residential dissatisfaction which helps us develop reliable indicators for future residential environment designs.

Literature review

Residential satisfaction

Residential satisfaction theories are based on an assessment of the 'perceived' gap between the 'realistic' achieved residential environment and what the occupants want or desire to have their actual needs and aspirations satisfied (Salleh, 2008; Jiboy, 2012)

Thus, the evaluation of residential satisfaction cannot be considered solely as an issue related to the delivery of the building in its final form, but rather as a life cycle issue that must be considered from the first planning and design stage of the residential environment until the end of its service.

Residential satisfaction is used for four purposes: first, the most used indicator is the concept of quality of life. Second, the indicator explaining the reasons for residential mobility. Third, an indicator to measure the degree of success of the project. And finally, it is used as a tool to assess the residents' perception of the improvements required based on their current residential environment (Kendall & Teicher, 2000).

Research on residential satisfaction is also classified into two distinct categories: the first concerns studies on residential satisfaction as a criterion for assessing residential quality (Amerio & Aragones, 1997). This category is characterized by the use of residential satisfaction as a dependent variable, whereas the second category of studies focuses on residential mobility. From this point of view, residential satisfaction is considered as an indicator of behaviour and is therefore treated as an independent variable. Thus, residential satisfaction is studied as a basic criterion for describing the quality of life of residents in a given residential environment, and as a motivating factor for residential mobility (Amerio & Aragones, 1997).

Amerigo presents an integrated model of residential satisfaction which aims to study the dynamic interaction between the individual and his or her residential environment, as well as to analyse the different cognitive, emotional or behavioural processes that run through this interaction. This model was built on three levels of study: the objective characteristics of the residential environment which, once evaluated by the individuals, become subjective and lead to a certain degree of satisfaction. Then, the subjective characteristics affected by personal characteristics (social, demographic of the individual or the study group), in addition to the "residential quality model" as a normative element adopted by the individual to compare his concrete residential environment with the ideal one.

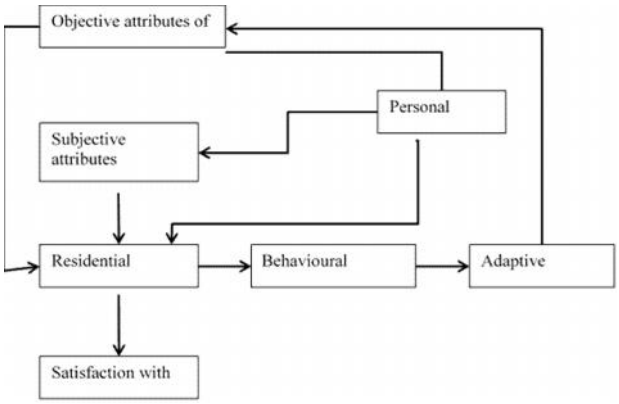

Fig. 1. Systemic model of residential satisfaction (Amerio & Aragonés, 1997).

The result of the evaluation, according to Amerio's model, is represented in (Figure 1) which leads to housing satisfaction as a positive emotional state that the individual affirms towards his/her residential environment and that drives him/her to a specific behaviour that directs him/her towards maintaining or improving the compatibility with the residential environment.

Indicators of Residential Satisfaction

Lawrence published a study in which he adopted eighteen possible variables controlling the residential satisfaction: density (housing and room occupancy rates), safety, symbolic image, public facilities and services, site characteristics, neighbourhood relationship, dominant social class, economic status, physical condition of the dwelling and its surroundings, preservation of privacy, comparison between previous residential environment and future aspirations and ambitions (Lawrence, 1987).

Post- occupancy Evaluation Method

Post-occupancy Evaluation Model is defined as a systematic assessment of opinions about buildings in use from the perspective of its occupants. It is the evaluation in which we resort to measure the correspondence of buildings to the needs of the occupants and identify ways to improve the design, performance and suitability of buildings.

An evaluation is the extent to which a designed setting meets and supports the explicit and implicit human needs and values of those for whom a building is designed (Friedmann, et al., 1978).

White defines post-occupancy evaluation as "[...] a set of procedures and tools used to learn how well design ideas have worked in real buildings." And he sees it as a new component in the building delivery system (Preiser et al., 2015).

The approach has its origins, as Zimring points out, in the reactions and criticisms made against the current architectural practice, based on aesthetic criteria, usually carried out under the aegis of an architect as the only expert who uses methods based mainly on his intuition and artistic taste (Bechtel & Churchman, 2003). In contrast, the social design research approach uses program or occupant needs as the criteria for evaluating the building, bases its conclusions on user impressions, and employs survey and interview methods (Gifford, 1987).

Post-occupancy evaluation is the process of evaluating buildings in a systematic and rigorous manner after the construction phase and occupancy for a period. It focuses on the occupants and their needs, and thus provides insight into the consequences of previous design decisions and the resulting building performance (Preiser, 1994). Post-occupancy evaluation aims to systematically and rigorously compare actual building performance with explicitly stated performance criteria; the differences between the two constitute the evaluation. As such, evaluation can provide feedback to clients and designers on the impact of the physical environment on people's behaviour.

Feedback emerges as the most practical and effective tool for post-occupancy evaluation of buildings. In addition, post-occupancy evaluation becomes the formal process that reviews the results of the design process.

Moreover, post-occupancy evaluation is, in fact, only a tool and a process for measuring residential satisfaction, which is an inherent part of studies of occupant behaviour towards the residential environment, and which manifests itself through two main outcomes:

- The first is embodied in the state of satisfaction - even if it is relative, for satisfaction is a dynamic process, i.e. unstable, influenced by the time factor - and therefore the concordance between the physical and social environment, which is the situation or condition responsible for the planning and design of the residential environment, aspired.
- The second is summarized in the state of dissatisfaction that the inhabitant must adopt voluntarily or involuntarily to one of the three options; to be content and adapt to the unavoidable situation or to resort to adapt his physical environment according to his needs and aspirations, then, the most extreme option is the refusal of the residential environment and the search for another alternative, of course in measures of solvency.

The practices of the modernist movement in the planning and design of the residential environment do not distinguish between the objective component of this environment (public taste, communal life) and the individual subjective component. This practice is the source of all the ills of the residential environment. Habraken, the founder and theorist of the open building concept, recognizes in his book Supports: Alternative to Mass Housing, that housing design has two has two parts that are coordinated: the first relates to the community role or collective life (objective requirements), the second relates to the individual (subjective requirements). When the individual is excluded, the result is repetition and rigidity. When there is no control, there is room for individual practices; the eventual result is chaos and conflict. It is therefore necessary to opt for a balanced control that requires the involvement of all actors in the design process (Habraken, 1999).

Factor Analysis

Factor analysis is a descriptive statistical method whose purpose is to facilitate the interpretation of a data set by synthesizing it. Factor analysis consists of grouping correlated variables to construct a smaller number of independent factors. These factors are linear combinations of the initial variables. Thus, a complex database composed of a large number of variables is “transformed” into a small number of independent dimensions, which are easier to interpret (Éva et al., 2021).

Each factor has a function that relates it to some or all of the variables via an analysis of the correlation matrix between these variables. In other words, factor analysis is the extraction of the set of factors associated with the original variables, provided that they explain the largest percentage of the variance of the original variables. In addition, it is interested in the relationships that exist between sets of variables of the same status, i.e., between which there is no established hierarchy, as in the case of predictive and causal methods. Their purpose is to group in the same structured set - indifferently called "axis", "factor", "component" or "dimension" (Caumont & Ivanaj, 2017). The relationship between the original variables is given according to the following equations (Equation 1):

$$F_1 = \alpha_{1.1}X_1 + \alpha_{1.2}X_2 + \ldots + \alpha_{1.nXn}$$

$$F_2 = \alpha_{2.1}X_1 + \alpha_{2.2}X_2 + \ldots + \alpha_{2.nXn}$$

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$$F_m = \alpha_{m.1}X_1 + \alpha_{m.2}X_2 + \ldots + \alpha_{m.nXn} \quad (1).$$

A factor analysis is qualified as exploratory when it is used to identify possible links between all the variables studied. It is actually a family of methods, the most widely used of which is principal component analysis (PCA). It considers the factors as indices formed by the variables (Éva et al., 2021).

Principal Component Analysis

Principal Component Analysis is applied to a data table containing continuous variables. In particular, it consists of:

- Exploring the links between the selected variables of a phenomenon in relation to a prior hypothesis;
- Transforming the variables into ordered factors (the principal components) according to their respective contribution to the total variance of a phenomenon;
- Simplifying or reorganizing the data by keeping only the factors that cover the major part of the variance (Hair et al., 1998).

Conditions for the Implementation of a Factor Analysis

In reality, there are two types of conditions: conditions before the analysis and conditions during the factor analysis (Morenikeji, et al., 2017). They are tested by the SPSS statistical program, the most important of which are summarized in the following points:

1) Anti-analysis conditions:

    a. The sample must be random and its size sufficient, with a calculated KMO value that must be greater than 0.50;
    b. The data must be quantitative (cardinal or ordinal);
    c. The normal distribution of the variables expressed in the program with significance α greater than or equal to 0.05.

2) The conditions during the analysis include:

   a. The determinant: to measure the autocorrelation problem, its value must not be less than 0.0001. If its value is lower, we look for variables whose correlation is greater than 80%, and we remove one of the two variables.
   b. The question of partial correlations that measures the adequacy of each variable in the factor analysis method, the diameter of each variable in the table Anti-image Correlation must be greater than 50%, otherwise the variable will be deleted.

Materials and Methods

Data and Sampling

The research methodology adopted is based mainly on the process of post-occupancy evaluation in order to measure the degree of compatibility of the residential environment of social collective housing - according to the thinking of the organizations that produced it- and the requirements, perceptions and aspirations of its users in terms of performance in order to correct the deficiencies found. This type of study is based mainly on fieldwork, through which a questionnaire was administered to heads of households in two social collective housing complexes in the city of Boussaâda (province of M'sila, Algeria), the 110-housing group and the 96-housing group. Regarding the sample, we targeted all the families of the two apartment complexes, due to the limited number of housing units. Practically, we were able to retrieve only 121 forms out of a possible 206 due to the families' reluctance to cooperate (we consider them acceptable enough to complete the study) The results of the research focus on the understanding, awareness and importance of the qualitative aspect through the logical responses of residents towards their residential environment - where the quantitative aspect dominates in the design and realization of this environment. The questionnaire includes variables testing residential satisfaction, inspired by the work of Lawrence.w who determined eighteen variables acting on residential satisfaction (Lawrence, 1987).

Measurement

The hypothesis adopted is based on the fact that residential satisfaction with the residential environment is the dependent variable, as long as residents' behaviours toward that environment are the independent variables. We will indirectly test the correlations between the dependent variables in order to extract the most important determinants of residential satisfaction.

Statistical Tools

The variables (data) testing residential satisfaction were approached using factor analysis (Principal Component Analysis) - which analyses the correlation between variables- to test the hypotheses. Statistical software (SPSS) is the appropriate tool to analyse and interpret the data.

Results and Discussion

Applying the factor analysis to the data collected from the questionnaire surveys, the results obtained to improve the level of satisfaction, shows that among the 45 variables included in the questionnaire, only 27 were retained in the first stage of processing (we eliminated the variables whose correlation between two variables is > 80% when the determinant of the correlation matrix is < .0001) illustrated in the Correlation Matrix table. In the second step, when testing the adequacy of each variable - as a condition for performing the factor analysis- we remove the variables whose partial correlation coefficient is less than 50% shown in the Anti-image Correlation Matrices table.

The factor analysis was performed with Eigen values = 1 to improve the reliability of the factors.

Outputs

The determinant has a value of 0.17 and is greater than 0.0001 (after removing the variables whose correlation matrix is greater than 80%). Therefore, there is no problem of autocorrelation of the variables. KMO and Bartlett's Test: the KMO value = 0.639, greater than 0.50, which means that the sample size is sufficient to perform the factorial analysis. Bartlett's Test of Sphericity: its value is 0.000, less than 0.05, which indicates the existence of a statistically significant relationship between the variables, and therefore a factor analysis can be performed.

Component Rotation: The last step consists of eliminating the variables belonging to the factors containing less than 03 variables after the rotation of the component matrix (Rotated Component Matrix). As a result, the final result is to adopt 4 factors containing 14 variables (Rotated Component Matrix, Table 1). The four extracted factors, whose “Eigen Value" is greater than 1, explain 58.423% of the total variance.

Table 1: Rotated Component Matrix

		Component			
		1	2	3	4
Q1	housing occupancy rate	.917			
Q2	individuals in the dwelling	.914			
Q3	insufficient living space	.620			
Q4	family income		.768		
Q5	financial situation		.731		.378
Q6	the cultural level		.686		
Q7	the function of the head of the family		.641		.523
Q8	Are there any changes?			.776	
Q9	the evaluation of the organization of the interior space			.707	
Q10	mode of participation within the association			.583	
Q11	legal status	.415			-.560
Q12	Are you planning to leave the neighbourhood?			.371	.554
Q13	previous housing type			.435	-.546
Q14	acoustic nuisance				-.540

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. Rotation converged in 5 iterations. Note: Result of the processing of the questionnaires with SPSS

The conclusions of this study show that the elements (variables) influencing residential satisfaction are grouped into four factors, ranked in descending order (Table 2), where the factor related to density comes first with a percentage of 17.23% followed by the factor related to the socio-economic situation (15.38%) and in third place the factor inherent in the satisfaction with the design of the interior spaces of the dwelling (13.41%) and finally the factor related to the intimacy of private life with (12.39%).

Table 02: The four factors extracted

N° of Comp	Variables	Possible title of the component
1	Q1, Q2, Q3	Residential density
2	Q4 , Q5, Q6, Q7	the financial and social situation
3	Q8, Q9, Q10	Satisfaction with the int. design of the home and the neighb.
4	Q11, Q12, Q13, Q14	The intimacy of private life

Note: Result of the processing of the questionnaires with SPSS

Interpretation of Results

The statistical treatment of the data leads to the results presented above (four factors comprising 14 variables) that affect 58.42% on the variance, and therefore the improvement of the residential satisfaction levels goes through the control of these 04 factors and the variables that contain them. The first factor related to density - overcrowding - indicates that achieving the ideal density is done by manipulating the housing occupancy rate. In general, 43% of the families have between 3 and 5 members, indicating that they do not suffer from overcrowding. On the contrary, 39.7% suffer from overcrowding because the number of their members is greater than 5. Then, the second variable expressing overcrowding and room occupancy coefficient, where 78.5% corresponds to less than two people per room, but considering that the living room is dedicated to sleep, is considered a problem in itself because it reduces and limits the privacy of people.

The last variable is the issue of surface adequacy; even if the coefficients of occupancy of the house and room are acceptable, the surface indicator is added to accurately express the density. 59.5% of households considered space to be insufficient, which affects satisfaction levels. In addition, the density factor is eminent in measuring satisfaction, and its variables are precarious, as the arrival of an individual reflects the rates and coefficients; and the result may become inverse. If financial conditions permit, the family moves, otherwise it may resort to adopting modifications in an attempt to adapt the built environment to changes dictated by the social environment.

As for the second factor, which is related to the socio-economic status of the family, it includes four complementary variables that contribute 15.38% to the variance of the overall satisfaction with the residential environment. The first variable is inherent to the total income of the family, where 44.6% of families have an income higher than 40 thousand DA, knowing that the guaranteed national minimum wage is 24,000 Algerian dinars, which is equivalent to approximately 153.88 euros. As for the second variable, it concerns the social status of the head of the family (76.9% are active, while 12.4% are retired). This variable completes the first variable. The negative value of this variable shows its negative impact on satisfaction levels. This may be due to the ambition of the families to continuously improve their living environment according to the improvement of their economic conditions. Thirdly, the variable that measures the cultural level of the head of the family (46.3% of whom hold a secondary school level and 41.3% university level) is directly related to the fourth variable composing this factor, which is the profession of the head of

the family (48.3% are salaried employees and 20.8% do liberal professions) and is also related to the second variable, which, in turn, has a negative impact on the satisfaction degrees. All of these variables that make up the factor lead to the identification of a social group with similar characteristics whose living arrangements may be very similar.

The fourth and final factor refers to privacy, represented by four variables, the first variable being the legal nature of the accommodation, since 52.1% are tenants and 46.3% are owners. This may explain the difference in favour of the registered dissatisfaction because the tenant cannot make modifications to a dwelling that does not belong to him. When the second variable translates into the intention to leave the dwelling (This intention changes over time according to socio-economic conditions), 64.5% do not intend to leave while 35.5% intend to leave. The intention to leave may be seen as a pretext for dissatisfaction, while the intention to stay is not necessarily a sign of satisfaction, because a class of residents have circumstances that do not allow them to leave even if they are tenants of the dwelling and not their landlord. As for the third variable, which is the effect of the previous place of residence, 47.9% of families come from a single residential environment. And because of the variance of characteristics between the two environments, we also found that this variable negatively affects residential satisfaction. The last variable of this factor is the soundproofing which is one of the most important components of privacy, since 35.5% of respondents expressed unease with the noise emanating from the outside environment of the home, which negatively affects the degrees of satisfaction.

Conclusion

The large projects announced in the housing sector, due to the growing demand for housing, especially for low-income classes, have led the Algerian authorities to pay more attention to the quantitative aspect in order to address the housing crisis, by achieving minimum levels of life quality, which negatively reflected the residents' behaviour towards their environment produced out of their control.

The assessment of satisfaction levels is inherent in the degree of compatibility between the living environment and the way of life through the behaviours of the residents. This type of research is based on the dissatisfaction recorded during the evaluation operations, whose dissatisfied residents can be divided into three categories; the first category includes residents who are used to adapt their environment according to their lifestyle, the second represents residents who have accepted this environment despite their dissatisfaction, and the last represents residents who have changed their place of residence as soon as conditions permit. These behaviours were claimed and then confirmed as an expression of resident dissatisfaction.

The phenomenon of residential dissatisfaction manifests itself in the deformations of the urban facade of the residential environment. It is logical - before proceeding to the realization of new housing projects - that we assess current residential environments in order to avoid the shortcomings of the past on the one hand and, on the other hand, to synchronize the pace of changes taking place within the social structure of households, in the sense that the built residential environment is, in fact, a projection of a pre-eminent lifestyle.

Post-occupancy evaluation is the fundamental method for measuring satisfaction levels. On the basis of that, a research interview was conducted with heads of household in

the two oldest housing projects (collective social housing) of the city of Boussaâda. The questionnaires were administered to 121 households, followed by the statistical treatment of the questionnaire content via factor analysis (the main component method), four of which were extracted. They are classified according to their contribution to the total variance as follows: The first factor is related to the density or overcrowding of dwellings, followed by the factor related to the socio-economic status of the family, then the factor that deals with satisfaction with the interior design of housing, and then the last factor related to privacy and intimacy. As a result, the subsequent control of the improvement in residential satisfaction levels can be materialized by addressing and manipulating the four aforementioned factors and the variables that comprise them.

Finally, it can be said that this step is insufficient to form the basis for a final conception of housing policies, but rather an important first step in assessing where the results of successive housing policies have failed.

Conflicts of Interest: The authors declare no conflict of interest.

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