The Impact of Transparency on Fostering Sustainable Behavior in Educational Buildings - Buildings of Mosul University as a case study

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ABSTRACT

Sustainability is no longer unchartered territory for research scholars. Its significance has increased with the growing effects of the alarming consumption of natural resources; after we saw rapidly natural treasures drain in the modern age. It has been theorized that the built environment plays a significant role in the life of users, and the architects can consider several factors of the human-environment relationship in the development of interior space. Transparency of space was one of the main considerations targeted in order to create a sustainable built environment. This paper tries to draw the effect of transparency on the behavioral actions and their relationship with the built environment, through its impact on dynamic termed "personal space" area, which plays a major role in regulating individual behavior, and interactions with the rest of the individuals in the environment. The study assumes that the high degree of transparency supports sustainable behavior among individuals .The paper tested that hypothesis into the lecture halls at university to highlight its validity and to use the results as a design indicators for design of such spaces

Keywords: Sustainability, Personal Space, Transparency, Sustainable Behavior.

1. INTRODUCTION

Sustainability is not a new or innovative term, it is one of the most important issues in the past two decades. The process of creating a sustainable environment is a legitimate goal and a noble target for many research centers as a result of the great consequences of individuals' behavior towards the surrounding environment. Achieving that goal does not pass without the practical employment of sustainability, making it relevant to the individual. The process of transforming sustainability into a daily behavior requires knowledge of the factors that can affect the individual in his or her adoption of sustainable behavior or aggressive behavior. These factors, namely environmental factors, are considered as physical factors that can be dealt with objectively. Among these factors is the Transparency of the space, so this research paper aims to investigate its impact on the behavior of individuals and enhance the cognitive aspects about the nature and degree of this effect.

2. THE CORRELATION BETWEEN HUMAN BEHAVIOR AND BUILT ENVIRONMENT.

The interaction between the environment and human behavior is intertwined within certain mechanisms. Behavioral theories have pointed to the nervous and sensory organs as intermediaries

between the two parties, as well it is not possible to study the influence of one side on the other without passing through these mediators. Series of studies aimed at reducing risks which have resulted from the behavior of individuals, and directed these activities towards environmental support. These studies have developed into what is known as ecological psychology. Furthermore, the researches have examined how each of them can influence the other to form a recently defined field of what is known as the Environmental Psychology (Gifford&etl,2011,p445).

2.1. ENVIRONMENTAL PSYCHOLOGY

The studies of environmental psychology mainly focused on the physical and spatial impacts of the environment, as it constitutes a large part of individuals`s various activities on the personal and social level, also tried to activate supportive mechanisms towards the environment, and dealt with the effect on the environment and behavior on each other [5].

These studies have evolved through three main interrelated approaches, the first one examines the basic psychological processes that occur when an individual is interacting with the environment, such as sensitivity, perception and personal experience. While the second approach examines the mediators used by individuals in their daily activities, the overall considerations and spatial aspects of these mediators and their impact on the behavior regulation. This is known as "managing social space".

Personal Space is one of the most important behavioral mediators, which plays a major role in regulating and directing the behavior of the individual, as well as being an important anchor in the process of enhancing the sense of Territoriality and Crowding. While the third approach examines the importance of psychological science in making positive impact on the environment, its role in climate change and solving the environmental problems caused by the behavior of individuals by encouraging them to adopt sustainable behavioral activities [8].

3. SUSTAINABLE BEHAVIOR

Sustainable behavior is defined as a set of vital activities that have the potential to contribute to both the physical and social environments in which an individual lives and to reduce aggressive behavior towards them [5], furthermore, it is considered as a deliberate behavior that represents a set of effective actions that respond to the social and individual requirements of protecting the environment and promoting the individual and the community prosperity [12].

Sustainable behavior activities don't aim only at human and immediate aspects, but beyond that narrow circle to go further towards preserving the safety of future plant, animal and human species [11], so it is a comprehensive behavioral system that conserves energy, reduces the continuous depletion of natural resources, and minimizes damage and aggression to the components of the environment [16].

Previous theories and studies that examined sustainable behavior have pointed to the importance of emotional aspects in encouraging individuals to adopt sustainable behavior. Strengthening emotional attachment and a sense of belonging enhances the individual's desire to avoid aggressive

behaviors and focus on sustainable activities, as personal space plays a key role in organizing and behavioral space management [4][7].

4. TRANSPARENCY AND PERSONAL SPACE

Transparency is the state or quality of being transparent, is a two-fold process. As a material condition, transparent qualities include submitting the passage of light and that which is easily seen through. As a result, transparency is described as an "intellectual imperative- our inherent demand for that which should be easily detected, perfectly evident, and free of dissimulation [15]. The tangible qualities of a transparent material, such as glass, can affect on personal space by producing welcomed compositional ambiguity within a place, and calling for a continuation of interpretation to objects beyond its division. While solid forms stop the movement of the eye for focusing on the object itself. This layering of planes, gives the interpreter the sense of more than optical transparency, but also a broader spatial order [15].

The degree of transparency is affecting on the size of personal space by allowing the individuals to remain in contact with the exterior world, in addition, also inspiring on his sense of safety within the space by increasing his feeling of secure and diminishing the aura of hazard and anxiety, and these two factors have a significant impacts on the size of personal space by decreasing its dimensions [2][11].

5. RESEARCH PROBLEM

The increasing damage to the built environment components as a result of unsustainable behavior due to the negligence of designers to the concept of personal space as a mediator affects on the individuals behavior and severely affected by Transparency, and the scarcity of comprehensive and specific local studies of the effect of Transparency degree on user behavior through the influence on personal space.

The paper will attempt to address this problem within the context of educational buildings due to the importance of its vital function for elite members of society. The fact that the university is not an investment institution and it is difficult to carry out maintenance and continuous expenditure resulting from the consequences of user behavior. Sustainable behavior therefore plays a vital role in the sustainability of the university spaces.

6. CASE STUDY
6.1. LIMITATIONS

The research hypothesis will be tested within a group of theoretical classes (both regular and auditorium) that belong to different colleges from Mosul University, one class from each collage. The site has been chosen because of its vitality and importance, considering that the university is a phase of great importance in the individual life, in addition to being an environment of relatively homogeneous groups social, mental and psychological, with backgrounds that represent the spectrum of society and include students from both females and males, so it is logical to neutralize many factors related to the impact on the size of the individuals personal space, in addition to those spaces perform one function, which enables researchers to obtain acceptable credibility, and ensure that the research effectively addresses the relationship between the variables involved.

6.2.PROCEDURAL PHASES

6.2.1. Measuring the degree of transparency (O) in specified spaces by the researcher, by calculating the percentage of the area of openings (windows and doors) relative to the total area of space walls, and calculated according to the following equation:
O=AO/AW
O= the degree of Transparency, AO: The area of openings, AW=Total Walls Area.

Based on the fact that behavioral outputs occur as a combination result of overlapping and complex processes (which are difficult to melt in one crucible), the indicators of personal space are a set of interrelated and associated factors.

Since the degree of transparency is one of the factors influencing the formation of personal space (but not the only factor) as previously stated, the research has sought to deal with this variable as a quantum of information acquired from space that sets an indicator of the personal space of individuals in that space. Thus, it was necessary to reliance on the value of an index that could be used to quantify the state of the transparency variable as an informational value indicating the nature of the individual's personal space.

So the research relied on the information theory suggested by "C. Shannon", which is used to quantify the information coming from a particular source and relate it to the amount of surprise the receiver feels when receiving the information. When the amount of information is increased by the source, the number of options that the recipient can compare and choose between them also will increase and in parallel the suspicion will be increasing, thus reducing the likelihood of one of these options, then the value of Entropy (Entropy E) will rise. While increasing the limits imposed on the freedom of choice in the future will decrease his suspicion and as a result will drop the value of entropy [14].

In other words, when the amount of information about a particular event increases from a set of events, the probability of occurrence of the event decreases. The entropy equation consists of the sum of the probability of any event occurring in the logarithm. The entropy is measured by the bit, as in the following equation:

$$E = [h1 \log(h1) + h2 \log(h2) + \ldots \ldots hn \log(hn)]$$

E =Entropy of Space.
$h_{1=}$ the probability of personal space being affected for the first indicator (Transparency "O")
$h_2 \ldots h_n=$ The size of personal space may be affected for any number of indicators.
The base logarithm 2 is used in the entropy equation.
Entropy here represents the amount of information given by the transparency degree on the impact of the size of individuals` personal space in the specified area, which will be processed and consolidated according to table (1):

$$E = [O`1 \, log(O`1)]$$

Table (1) data of degree of Transparency for the theoretical halls

No.	Space	O	Percentage (O)	Decimal Value(O`)	E $O`1 \, log(O`1)$
1	Agriculture	0.27	100	1	0
2	Programming	0.076	28.1	0.28	-0.5146
3	Water Resources	0.08	29.6	0.29	-0.5198
4	Civil	0.077	28.5	0.28	-0.5161
5	Mechanic	0.072	26.66	0.26	-0.5084
6	Chemistry	0.084	31.11	0.31	-0.5240
7	Quran Science	0.11	40.7	0.40	-0.5278
8	Computers	0.11	40.7	0.40	-0.5278
9	Geographic	0.21	77.77	0.77	-0.2820
10	Arts	0.14	51.8	0.51	-0.4915
11	Communications	0.12	44.44	0.44	-0.5199
12	Dentistry(A)	0.06	29	0.29	-0.5179
13	Medicine(A)	0.13	46	0.46	-0.5153
14	Mechanic(A)	0.042	15.5	0.155	-0.4161
15	Chemistry(A)	0.05	27	0.27	-0.510
16	Civil(A)	0.15	53	0.53	-0.4854
17	Water Resources(A)	0.14	51.8	0.518	-0.4915

6.2.2. Measure the indicators of the individual`s sustainable behavior in those spaces, and based on the standards of the global organization (LEED) in determining these behaviors, as follows (See table (2)):

- **Sustaining the natural resources by relying on natural lighting (Y1):** this indicator is calculated by knowing the number of hours used by space users for industrial lighting during the day [10].
- **Maintaining the individual`s health and sustaining the internal environment quality by abstaining from smoking (Y2)**: because of the negative impact of smoking behavior, abstaining from this behavior and promoting it is an activity that supports sustainability. This indicator is calculated by calculating the average amount of cigarettes wake in the internal space during a certain period of time (full school day) [16].
- **Sustaining the quality of the internal environment by maintaining the cleanliness of space (Y3):** Refraining from throwing wastes outside their specified places represents a behavioral activity which supporting the environment. This index is determined by calculating the frequency of cleaning times that take place in space during a certain period of time (one week) [16].
- **Sustainability of natural resources through moderate consumption of electrical appliances (Y4):** The moderate consumption of electrical devices within space represents a support for resources and a reduction of atmospheric damage. This indicator can be determined by calculating the number of maintenance operations performed on electrical appliances over a one year [10].

Table (2) the data of sustainable behavior for the spaces

Each indicator has been measured by a lot of monitoring procedures and repeated behavior recordings

Y7	Y6		Y5	Y4	Y3	Y2	Y1	Space	No.
	Y6b	Y6a							
1	10	2	4	3	5	2	4	Agriculture	1
0	5	1	2	2	2	3	6	Programming	2
0	2	0	2	2	4	5	3	Water Resources	3
1	4	1	2	1	3	3	4	Civil	4
1	5	1	2	2	3	4	5	Mechanic	5
2	6	1	3	2	4	5	3	Chemistry	6
0	6	1	3	1	4	5	5	Quran Science	7
0	6	1	2	2	4	5	6	Computers	8
1	6	1	3	3	5	4	7	Geographic	9
0	6	0	3	2	3	5	5	Arts	10
1	5	1	2	1	3	4	4	Communications	11
0	6	0	2	1	4	5	4	Dentistry(A)	12
0	3	1	2	2	3	5	5	Medicine(A)	13
1	4	0	2	2	5	5	6	Mechanic(A)	14
1	3	0	2	1	4	6	5	Chemistry(A)	15
1	5	1	3	2	3	4	4	Civil(A)	16
0	4	1	3	2	4	5	3	Water Resources(A)	17

The header spans: "Sustainable Behavior Indicators" covers Y7 through Y1 columns; "Space" and "No." are separate columns.

- **Destruction of built environment components through the cracking of furniture and public property (Y5):** This behavior is one of the aggressive behavior patterns, and can be measured by calculating the total number of pieces of furniture that were replaced during a certain time (one year) (Akhorshedeh,2009,p29).
- **Destruction of built environment components through graffiti (Y6):** This indicator can be determined by the following procedures:

First: Calculate the number of maintenance carried out on space during a specified time period (five years) (Y6a).

Second: Documenting the frequency of such behavior through pilot study (Y6b).

- **Violation of the built environment security through physical and verbal violence by users (Y7):** This indicator can be calculated by documenting repeated occurrences of such behavior documented by the relevant faculty.
  - **6.2.3.** Determine the correlation between the data extracted from the first phase and the data determined from the second phase. In this paragraph, the statistical analysis between the variable (personal space index) and each of sustainable behavior indicators will be performed using the correlation model. Table 3.

7. RESULTS

7.1. The results showed a strong relationship between the <u>personal space index</u> and a set of documented behaviors represented by variables (Y4,Y5,Y6b), while there was a weak relationship with a set of documented behaviors represented by variables (Y1 ,Y7), and normal relationship with these variables (Y2,Y3,Y6a).

7.2. The results showed a positive relationship between the <u>personal space index</u> and the variables (Y1,Y3,Y4,Y5,Y6a,Y6b,Y7), while there was a negative relationship with (Y2), as shown in the forms below:

Table (3) the correlation between (E) and the indicators of Sustainable Behavior

Correlation	Y1	Y2	Y3	Y4	Y5	Y6a	Y6b	Y7
E	0.124186	-0.597	0.58065	0.6777	0.674824	0.50253	0.68841	0.259
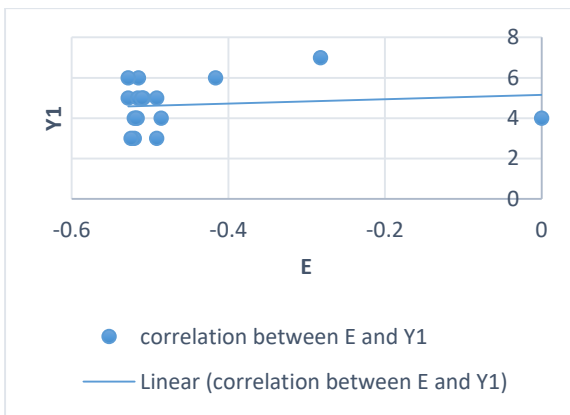
Figure 1. Correlation between E and Y1
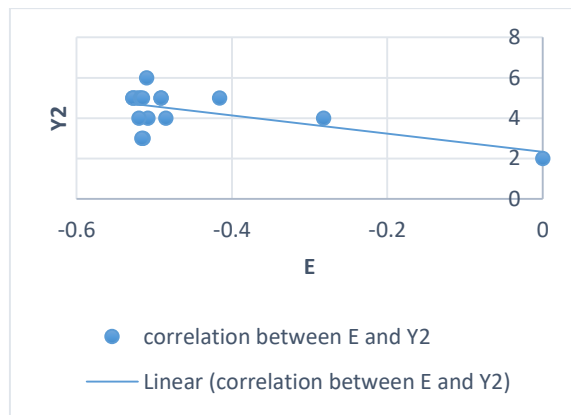
Figure 2. Correlation between E and Y2
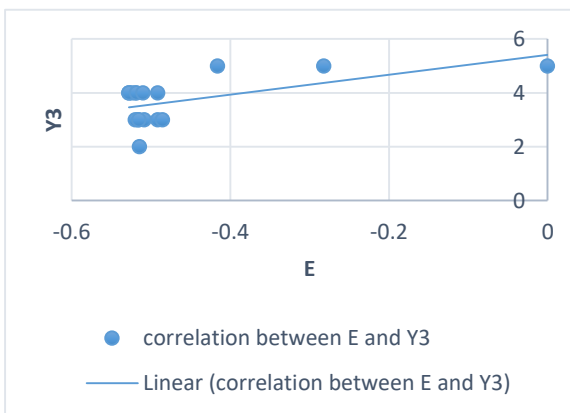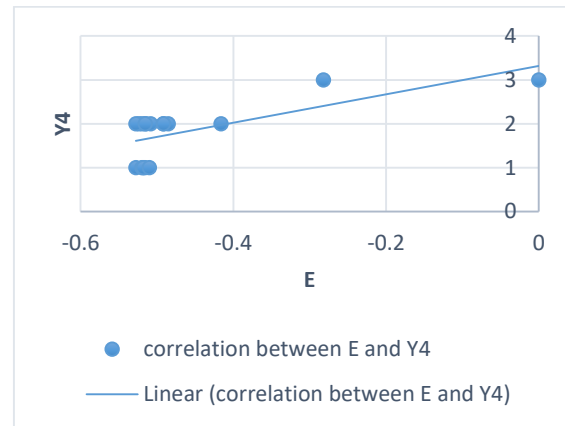

Figure 3. Correlation between E and Y3

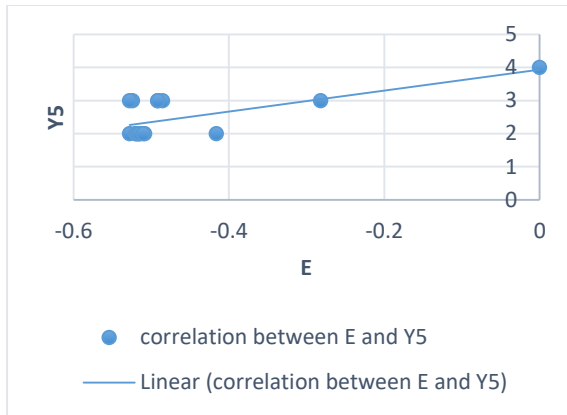Figure 4. Correlation between E and Y4

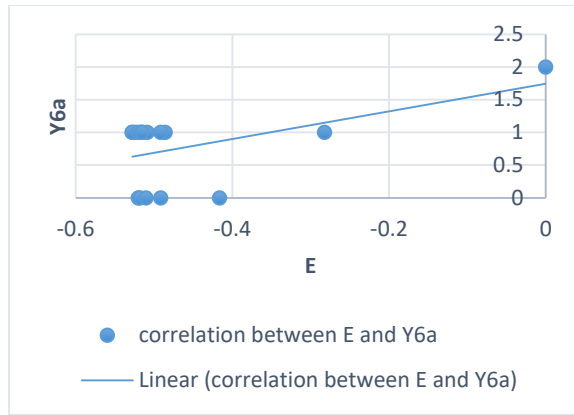Figure 5. Correlation between E and Y5
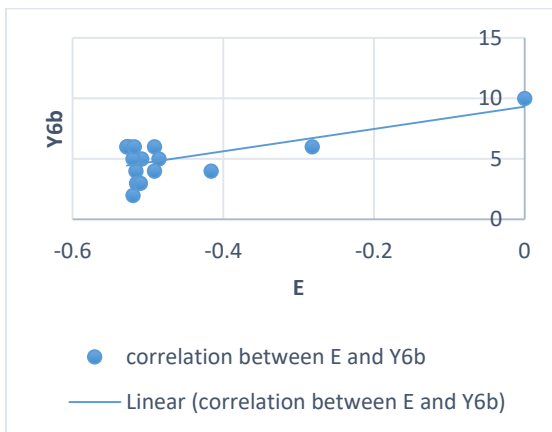

Figure 6. Correlation between E and Y6
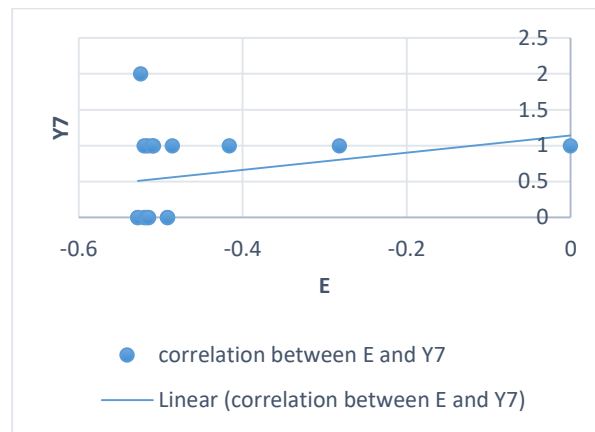

Figure 7. Correlation between E and Y7

Figure 8. Correlation between E and Y8

8. CONCLUSIONS

1. The study supported the importance of personal space and its essential role in controlling the individuals` behavior and supporting sustainable activities, and it is influenced by a range of environmental factors, including transparency degree, and revealed its significant association with a certain set of sustainable behaviors that were documented. The paper also suggested that the effect on personal space size varies according to the transparency degree within the built environment.

2. The study showed a strong relationship between personal space and a set of documented behaviors, namely the moderate consumption of electrical devices and aggressive behavior towards furniture and property and graffiti, indicating that the transparency degree as a determinant of personal space is strongly linked to a number of behaviors, while some behaviors seem to have a weak relationship like an individual's interest in relying on natural lighting and physical and verbal violence behavior. Indeed this does not negate its existence, but the clarity degree of the first set of behavioral activities are dominated.

3. The study showed that personal space has inversely correlation to smoking behavior, due to the fact that the individual may often resort to spaces where he feels more privacy to

practice such behaviors, because privacy is a psychologist strongly influenced by personal space and thus the individual is not afraid to practice such behaviors in those spaces.

4. The study showed that personal space has directly correlation to a range of destructive and aggressive behavior, as a clear manifestation of low interest in the built environment, high degree of tension and a sense of aggression accompanying the increase of personal space.

REFERENCES

[1] Adams, L., Zuckerman,D., **The Effect of Lighting Conditions on Personal Space Requirements**, the journal of general psychology, 118(4), 1991.

[2] Albas, D., Albas, C., **Meaning in Context: The Impact of Eye Contact and Perception of Threat on Proximity**, The Journal of Social Psychology, Volume 129, Issue 4, 1989.

[3] Akhorshedeh. Mohammed Khalaf, The Psychological and Social Factors Related to Violence Among Jordanian Universities' Students and Suggested Solutions, unpublished MSC thesis, University of Amman, Jordan, 2009.

[4] Berenguer, J., **The Effect of Empathy in Pro-environmental Attitudes and Behaviors**, Environment and Behavior Journal, Volume 39 Number 2,2007.

[5] Bonnes,M., Bonaiuto,M., **Environmental Psychology: From Spatial-Physical Environment to Sustainable Development**, Handbook of environmental psychology, john weily&SonsInc, New York,2002.

[6] Corral-Verdugo,V.,&Pinheiro,J., **Aproximaciones al estudio de la conductasustentable**. MedioAmbiente y Comportamiento Humano, 2004.

[7] Cummings, N., **Fostering sustainable behavior through design**, MSC thesis, Department of Art, Architecture & Art History, University of Massachusetts Amherst, 2012.

[8] Gifford, R., **Environmental Psychology Principles and Practice** 4th edition, Optimal Books, 2007.

[9] Gifford, R., Steg, L., Reser,J**., Environmental Psychology**, The IAAP Handbook of Applied Psychology, First Edition, Blackwell Publishing Ltd. Published 2011.

[10] Kirk, J., **Sustainable Environment and Pro-Environmental Behavior**, Master thesis, University of Nebraska – Lincoln, 2010.

[11] Lawson, B., **The Language of Space**, Reed Educational and Professional Publishing Ltd., 2001.

[12] Najera,M., **Sustainability in Higher Education An explorative approach on sustainable behavior in universities**, PHD thesis, Tlaxcala City, Mexico,2010.

[13] Nesbitt, P., & Steven, G., **Personal Space and Stimulus Intensity at a Southern California amusement park**, sociometry, 37, 1974.

[14] Piers. John, **An Introduction to Information Theory**, Dover Publications, New York, 2nd edition, 1980.

[15] Rowe, Colin and Slutzky, Robert. **Transparency: literal and phenomenal**. Perspecta, Yale School of Architecture Vol. 8, 45-54, 1963.

[16] Steg,L., Vlek C., **Encouraging pro-environmental behavior: An integrative review and research agenda**, Journal of Environmental Psychology P(309-317), 2009.