Measure User Emotions in Relation to Spaces

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Abstract

All architectural spaces address a user, who reacts according to the architectural product, towards built spaces and their environment. The environment is modified through the designing process and the environment triggers our emotions hence it is a bidirectional relationship. The impact of spaces is significant on the users feeling and behavior. Multiple factors impact our emotional response towards space. In the aspiration to design the built environment, architects are continuously trying to create spaces that adhere to the users positively. Architects are designing functional spaces that are user-oriented but don't consider the user's emotion. Emotion is a qualitative parameter and it varies from user to user to the different set up of spaces. In spite of these differences, the process of emotion being evoked is universal. With the increasing demand for habitable spaces, users need multi-functional spaces that bridge the psychological perception of the user to space. The inclusivity of spaces and emotional response of users have been sparsely researched before. This research bridges the psychological perception of the user to space.

The research measures the qualitative parameter of the emotion of users to different spaces. Various parameters of emotions to space are quantified with the help of expertise score weightage matrix method. Different sets of space modules are created, and the user response is recorded considering the identified parameters of research. There are various tangible and intangible parameters of a space that triggers emotions of a user; thus, every user response is different in the same setup space as per their psychological perception. Hence, this research will propose a different set of user responses to different set up of spaces. The inclusivity of spaces and emotional response of users have been sparsely researched before. The scope of the research is limited to institutional spaces- Open and closed spaces. This research bridges the psychological perception of the user to space. With the help of this research, architects can design multi-functional spaces measuring the emotional response of the users. This will indeed evolve a newer perspective of space in architecture.

Key words: *Space; emotion; user; emotional response; functional space; psychological perception*

1.Introduction

Architecture design which once moved us was involved with spiritual satisfaction and wonder. It touched us with a sense of beauty, intimacy, and memory and offered us an emotional platform to which we can better understand the human collective to which we all belong. In this modern era, designer-oriented spaces are being transferred to user-oriented spaces that consider the user's emotions as well as the functions of the space, producing a multi-sensory space (Cho & Kim, 2017).

Emotion is a qualitative parameter and it varies from user to user to the different sets of spaces. In spite of these differences, the process of emotion being evoked is universal. Although user emotion and their response towards space are critical, the amount of research done on user emotion and their responses are very little in the architectural domain. More research is focused on the perception of architecture by the user and their psychological response towards space; however, this research focuses on quantifying the qualitative parameter of the user's emotion to different spaces. This paper takes the past approaches of measuring emotions a step further by developing a new method of quantifying user emotions called score weightage matrix method. Parameters of space are identified and are ranked with the help of experts. Different sets of institutional space modules are created and the user response is recorded considering the identified parameters of the space.

2. Literature Review

The parameters that defines the emotion and the emotional response were analyzed through the study of different research papers and the following parameters were derived. Each of these parameters help us to understand the user's emotional response towards a space.

Sno.	TITLE	Name of the Journal	AUTHOR NAME	YEAR	INPUT PARAMETERS	MATERIALS USED	METHODOLOGY	RESULTS
1	SPACE AND HUMAN PERCEPTION - Exploring Our Reaction to Different Geometries of Spaces	20th International Conference of the Association for Computer-Aided Architectural Design Research in Asia CAADRIA	A. SHEMESH	2015	(1) Square symmetrical space (Sq). (2) Round domed space or half a sphere, symmetrical (Ro). (3) Sharp edged space, tilted surfaces (walls, ceiling), unsymmetrical (Sh). (4) Curvy space with rounded smooth surfaces (with no corners), unsymmetrical (Cu).	Two groups of 21 people per group participated in the experiment. Experts, non experts, 3d glasses, joystick	A two stage methodology was followed. The first stage is focused on quantification and analysis of a descriptive response. The next stage focused on collecting data over physiological response and brain response	Both groups of experts and non-experts preferred asymmetric spaces over symmetric, with one main difference: group E showed a tendency to prefer space Sharp edged while group NE showed a tendency to prefer space Curvy group NE felt more pleasant in spaces that are more familiar to them. They showed great interest toward the Cu.Most participants in group E showed smaller differentiation between categories (Sq space is an exception). Space Ro tented to seem more interesting and pretty to them.
2	Measurement of User Emotion and Experience in Interaction with Space	Journal of Asian Architecture and Building Engineering	Myung Eun Cho	2017	National Science Museum , Yoon Dong Ju Literature Museum , DDP Museum	Three university students, aged 20 and over, were recruited for the field survey. Participants were interior architecture students with similar education backgrounds and experiences	The field survey was conducted at exhibition halls that are considered to be appropriate for emotion evaluation. Based on the proposed framework, the questionnaire was developed.	Of the morphological factors, volume and style affected user's emotions the most, and of the sensory factors, color was the most affective.Of the perceptual factors, social integration, immersive experience, and context-awareness was most effective.
3	Introducing emotions in the architectural design process	1st International Conference on Higher Education Advances, HEAd'15	F. Juan-Vidal	2015	the six semantic concepts obtained (tranquility - wellbeing; innovation - futuristic; happiness - warmth, nostalgia - romanticism, functionality and monumentality - luxury)	3D images or Architectural Renders	A field study was carried out on a sample of 217 subjects (104 architects and 113 nonarchitects) who were asked to express their opinions on 48 renders of architectural spaces.	•the perception of the architectural render can be expressed through 6 independent concepts or semantic axes,which explains 55% of the variance in the sampled perception. These axes or factors are, by order of explained variance: tranquility – well-being; innovation – futuristic; happiness – warmth; nostalgia – romanticism; functionality and monumentality – luxury. •for both groups, the success of a render is associated with the emotions of innovation – futuristic and tranquility – well-being.
4	Investigating the Emotional Responses of Individuals to Urban Green Space Using Twitter Data:A Critical Comparison of Three Different Methods ofSentiment Analysis	Urban Planning 2018,Volume3,Issue1	HelenRoberts, Bernd Resch	2018			For case study 60 urbangreen spaces located in Brimingham. Manual annotation of tweets were done based on the presence of emotive words or emoticons. The method relies on a graph based semi-supervised learning algorithm. manual, fully automated and semi-supervised learning methods of sentiment analysis on the same corpus of tweets. For the automated method, an Affective Norms for English Words (ANEW) resource was used as the basis for emotion annotation.	Variation existed in the numbers of tweets assigned to into the 'positive', 'neutral' and 'negative' categories by each of the methods for all three methods, the majority of tweets were placed into the 'neutral'category,categorisationoftweetsinto'positive' and'negative'categories showed to be more variable between the three methods. All three methods were found to assign variable yet similar numbers of tweets into the positive, neutral and negativecategories,withthemajorityoftweetsbeingannotated as neutral, followed by smaller numbers of positive and negative tweets respectively. Manualannotationhaspreviouslybeencitedasproviding the most reliable method of sentiment analysis
5	Visual Perception of Public Open Spaces in Niksic	ASIA Pacific International Conference on Environment-Behaviour Studies	Svetlana Perovica	2012	Niksic City and its parts:- The central square, The central city street, Walking street - the promenade , The circular flow square, The Central Park, The monastery complex, The hospital complex, markets, graveyards, Indoor housing block, A semi housing block, An open housing block	150 Respondants of age groups from 15 to 70 years	Gestalt psychology , which emphasizes the importance of the perception of the totality. The research methods, designed and applied in studies of visual perception, such as mental map , experimental method, method of visualization , computer models , observational method, method of semantic differential , surveys and interviews method and others.	Twelve analyzed public open spaces of Niksic by users and experts, suggests that poly functional, dynamic, associative, homogeneous, inclusive, accessible, authentic spaces with an emphasis on natural elements, achieve desired visual effect on users. Spaces that do not have clearly defined visual identity in the structure of the city were negatively evaluated, as well as one which is monofunctional, program indefinite and with low content of vegetation. there is some overlap when perception of space is concerned; however they differ depending on the expertise and the specific needs and the aspirations of the respondents.

Figure 1 Literature review table

2.1. Basic Models of Emotion

A basic model of emotion has been selected. This model describes the conditions which evoke the emotions with the use of three underlining key variables: stimulus, concern and appraisal.

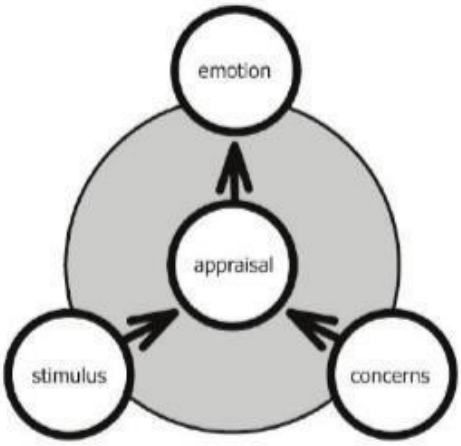


Figure 2 Basic model of emotion

2.1.1 Appraisal

According to appraisal researchers, all emotions are preceded and evoked by an appraisal (Smith & Lazarus, 1990). An appraisal is a method of automatic evaluation of an impulse for one's well-being. Other than the product itself, the personal significance of a product causes emotions because appraisals mediate between products and emotions, different individuals who appraise the same product in different ways will feel different emotions (Smith & Lazarus, 1990).

2.1.2 *Concern*

Every emotion hides a concern that is, a more or less stable preference for certain states of worlds (Frijda, 1986). The point of reference in an appraisal process is regarded as a concern. Thus, the significance of a stimulus for our wellbeing is determined by an appraised concern match or mismatch: stimuli that match our concerns are appraised as beneficial, and those that mismatch our concerns as harmful. The same principle applies to architecture: a building evokes an emotion in the user only if it is appraised as relevant to a person's concern (Frijda, 1986).

2.1.3 Stimulus

Any perceived change has the potential to evoke an emotion. This can be some event, e.g. someone saying something to us or encountering something in space (Frijda, 1986). Other than actual events hypothetical events also have the potential to evoke emotions.

2.2. Emotional Response

People respond emotionally to stimuli or situations in various ways, not just one fixed way; thus, there is no one standard method for the measurement of emotions. (Cho & Kim, 2017). Before one can measure emotions, one must be able to characterize emotions and distinguish them from other states and unfortunately, this is a problem that currently belongs to those yet unsolved (Desmet, 2003). At

present, the psychologist's most favored solutions are to say that emotions are best treated as a multifaceted phenomenon consisting of several components (Izard, 1977) (Lazarus, 1980). These components are - behavioral reactions (e.g. running or seeking contact), expressive reactions, physiological reactions, and subjective feelings (Desmet, 2003). These multi-componential responses of emotions act as a tool for the measurement of user emotion and also helps to consider their applicability in designing spaces.

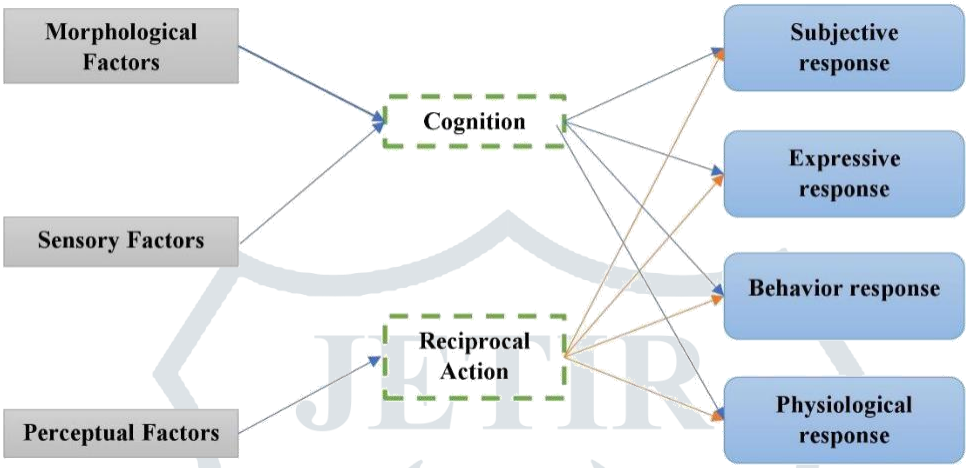


Figure 3 The Conceptual Framework of Measurement of Emotion in a Space

2.2.1. Behavioral Reaction

Emotions initiate behavior in the form of action tendencies such as approach, inaction, avoidance and attack (Arnold, 1960). Fear makes one want to run; love makes one want to approach (Frijda, 1986). Emotional states can be linked to action dispositions (Frijda, 1986).

2.2.2. Expressive Reaction

Expressive reaction for example, smiling is the facial, vocal and postural expression that accompanies the emotion (Cho & Kim, 2017). Each emotion is associated with a particular pattern of expression for example, anger is accompanied by a fixed stare, contracted eyebrows, compressed lips, brisk movements, and usually a raised voice almost shouting (Ekman, 1994)(Darwin, Murray, & Street, 1872).

2.2.3. Physiological Reaction

The physiological reaction induces changes in the body which goes through as a response to an emotional event and these changes include increase/decrease of heartbeat and breathing rates, body temperature and pupil dilation, among others (Beuzekom, 2006). It is the change in automatic nervous system which accompanies emotions.

2.2.4. Subjective Reaction

Each emotion involves a specific feeling which is a basic, irreducible kind of material element (Titchener E. , 1908). Refers to the fact that the individual is aware of the emotional episode and can describe it through the use of a rich emotional lexicon to easily communicate his response to certain stimuli for example, feeling happy or feeling inspired (Beuzekom, 2006).

3. Methodology

To verify the framework proposed for the measure of user emotion in an institutional space, some parameters were developed.

3.1. Emotion

An emotion is a complex psychological state that involves four main types of emotional responses: a Subjective Response, a Physiological Response, a Behavioral Response and an Expressive Response. (Ekman, 1994)

Six basic human emotions that are universal throughout human cultures are considered for recording the response towards any space i.e. Happy, Sad, Anger, Disgust, Surprise, and Fear. (Ekman, 1994)

3.2. Space Parameters

Space parameters were developed are the general parameters of any space which stimulates the user's emotion.

Light: - Light is measured in lux. It varies from space to space and helps to initiate the activities and reciprocates the human resources with respect to the emotions.

Area: - Area is the 2-dimensional amount of space that an object occupies. Area is measured in square units such as square centimeters, square feet, square inches, etc.

Temperature: - The temperature of a space tells about the thermal comfort. Thermal comfort is the condition of mind that expresses satisfaction with the thermal environment and is assessed by subjective evaluation

Color: - Colors are a powerful communication tool and can be used to signal action, influence mood and even influence physiological reactions (Motto Cosmos, n.d.)

Ventilation: - Better indoor/outdoor air quality for better function of a space.

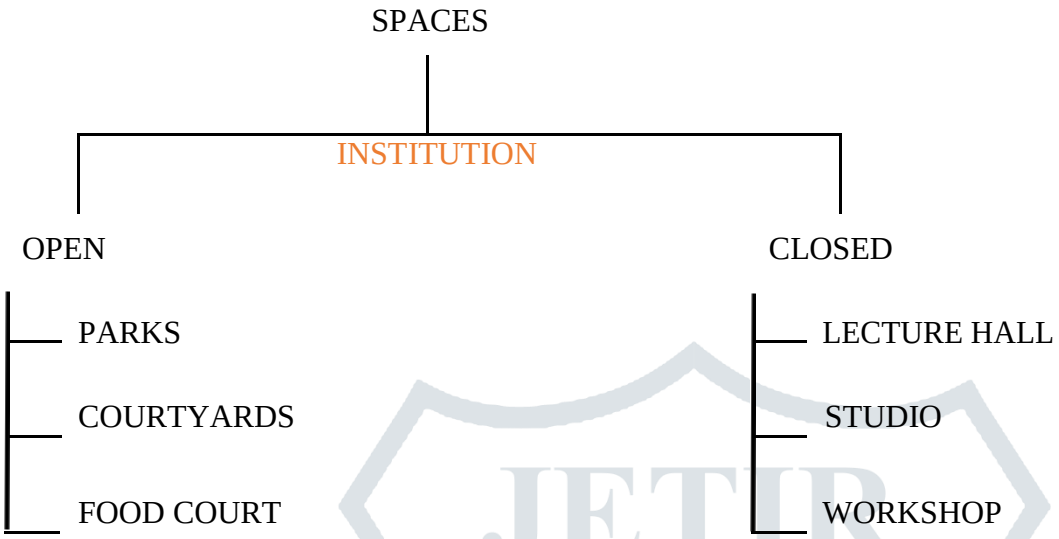
Volume: - Defines the volume of space with respect to the activity/event performed in that space.

Sense of Belongingness: - Belongingness means the comfort level of a space.

Sense of Security: - Person feel secure in a defined space.

3.2.1. Spaces

In this research Institutional spaces are taken into consideration. These include Open and Closed spaces around the campus.



The strategy of the research is to firstly prioritize the user emotions with respect to space and then define their response based on the personal interviews done with the users. A method for the measure of human emotions in any space was developed. Two scales were constructed for measuring the emotional response types in space: one for the weightage of the spaces and the other for the ranking of the space parameters. The method is called Score Weightage Matrix Method. The ranking of the space parameters required the expertise in the related field to indicate their responses to the parameters by ranking them from a scale of 10 according to their preference. The parameters being: Light, Area, Temperature, Color, Ventilation, Volume, Sense of Belongingness and Sense of Comfort as shown in Fig.4. Space weightage also required the users to rate the spaces according to their preference using a scale of 10 and the spaces Open Spaces: Food Court, Sunken

Park, Fashion Block Courtyard and Closed Spaces: Studio, Lecture Rooms, Workshops as shown in Fig.5.

3.1.1. Space Modules

Six different space module sets are created to measure the user's emotion of space. Before creating space modules, the parameters of space developed were floated to the experts of the related field for their ranking out of 10 via google forms and emails. The expertise ranking would help to quantify the emotions stimulated by experiencing the space.

20 university students, aged 18 and over male/female, were selected in unbiased way for the experiment. Participants were architecture students with similar background and experiences. At first stage they were required to give weightage to the spaces mentioned above out of 10 according to their preferences. At last sets of six different spaces were created considering the ranking of space

parameters by the experts with regards to the user emotional response. The second stage was personal interaction, for the recording the user response considering the identified parameters of space and given circumstances/situations. Based on the proposed framework, situations and questionnaires were prepared for different spaces and the users were supposed to respond to the given spaces by highlighting the parameters of space. The detailed table with results is included in the next section.

4. Results

User's emotional response in different spaces were recorded and then measured using the Score Weightage Matrix method and the results are as follows.

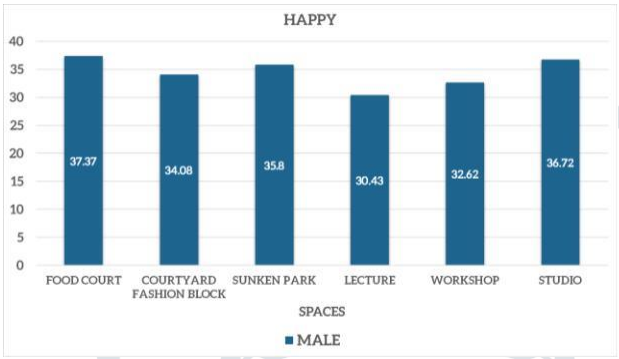


Figure 4. Measure of happiness for different spaces for males

Figure 4. shows the level of happiness for the different spaces for males. Amongst open spaces, males are most happy in Food Court followed by Sunken Park and the level of happiness is least in Courtyard Fashion Block. Amongst closed spaces, the level of happiness is maximum in Studios followed by Workshops and least in Lecture Halls. Lecture Hall is the space in which the happiness level is the lowest among all other spaces.

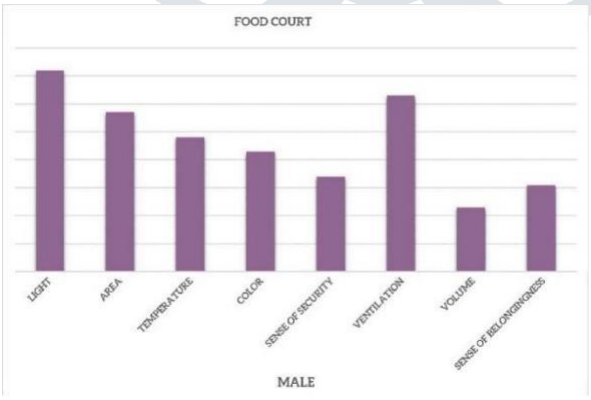


Figure 5. Parameters preferred for food court by males when happy

Figure 5. shows the parameters that affect the happiness levels for males in Food Court. The abundance of Light is the most significant factor contributing to happiness followed by proper Ventilation. Volume and Sense of Belongingness were the least important parameters which contributes towards male's happiness.

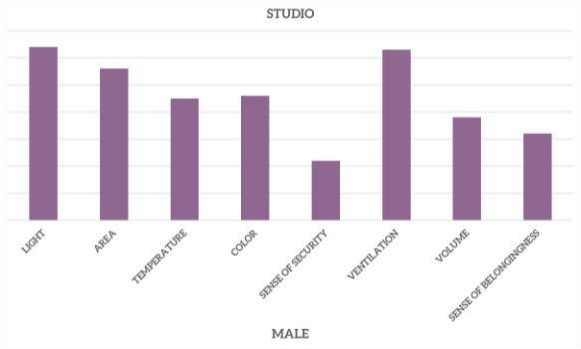


Figure 6. Parameters preferred for Studio by males when happy

Figure 6. shows the parameters that affect the happiness levels for males in Studio. Proper Lighting conditions and Ventilation contributes the most towards male's happiness followed by and proper area suitable for studio activities. Sense of Security does not add much to the level of happiness for males.

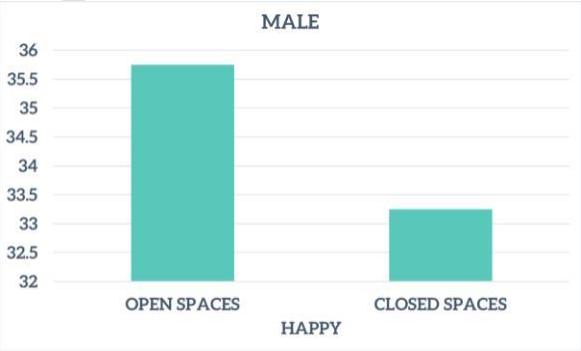


Figure 7. Preference of Open and Closed spaces for males when Happy

Figure 7. shows that the level of happiness for males is more in Open Spaces as compared to Closed Spaces.

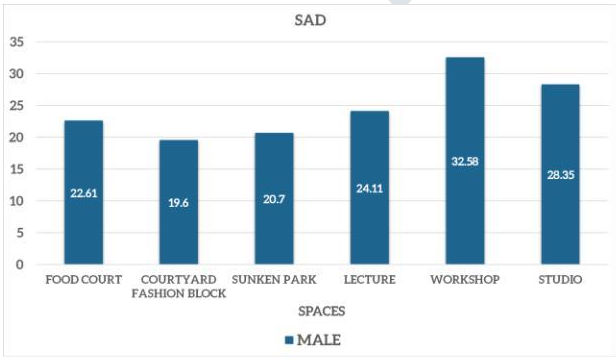


Figure 8. Measure of sadness for different spaces for males

Figure 8. shows the level of sadness for the different spaces for males. Amongst closed spaces, the level of sadness is experienced maximum in Workshops and among open spaces in Food Court.

There is a very slight difference between the level of sadness amongst open spaces. Some parameters in each of these spaces resulting in the trigger of sadness level for males.

Figure 9. Parameters preferred for workshop by males when sad

Figure 9. shows the parameters that affect the level of sadness for males in Workshops. Poor Ventilation in the workshop is the parameter that contributes most to the sadness level. Improper lighting conditions, poor Colors & Sense of Security are the parameters that contribute significantly towards the level of sadness. Volume is the least important parameter which contributes towards male's sadness.

Figure 10. Preference of Open and Closed spaces for Males when Sad

Figure 10. shows that the level of sadness for males is more in Closed Spaces as compared to Open Spaces.

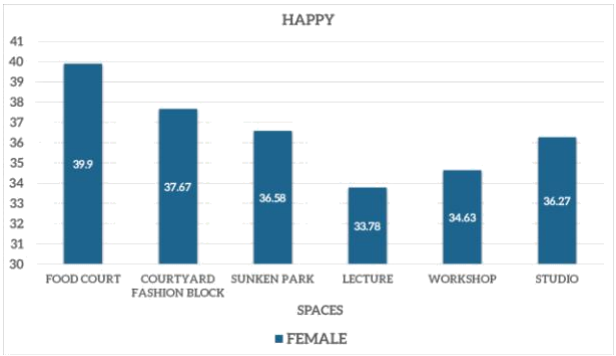


Figure 11. Measure of happiness for different spaces for females

Figure 11. shows the level of happiness for the different spaces for females. Amongst open spaces, the level of happiness is highest in Food Court followed by Courtyard Fashion Block and is least in Sunken Park. Amongst closed spaces, happiness level is maximum in Studios followed by Workshop and least in Lecture Halls. Lecture Hall is the space in which the happiness level is the lowest among all other spaces.

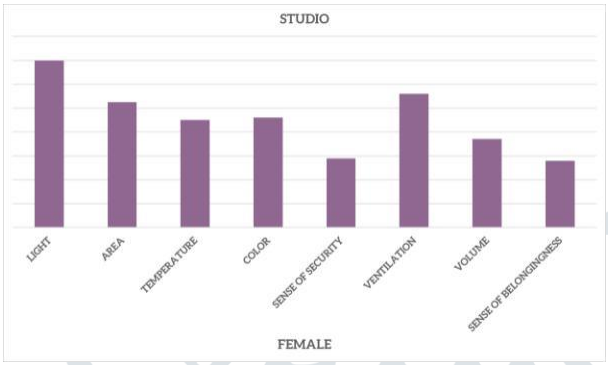


Figure 12. Parameters preferred for studio by females when happy

Figure 12. shows the parameters that affect the happiness levels for females in Studio. The abundance of light contributes maximum towards the happiness level for females. Proper Ventilation and Area sufficient for the activities to be performed are also significant parameters contributing to the levels of happiness. There is a very slight difference among the other parameters which shows that all the parameters for Studio are significant to achieve satisfactory levels of happiness.

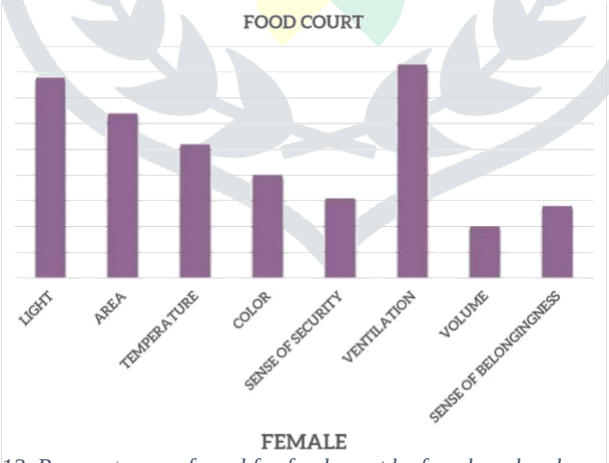


Figure 13. Parameters preferred for food court by females when happy

Figure 13. shows the parameters that affect the happiness levels for females in Food Court. Proper Ventilation contributes the most towards female's happiness followed by an abundance of Light (natural/artificial) and Area sufficient for the activities to be performed. Volume, Sense of Security and Sense of Belongingness are the least contributing parameters.

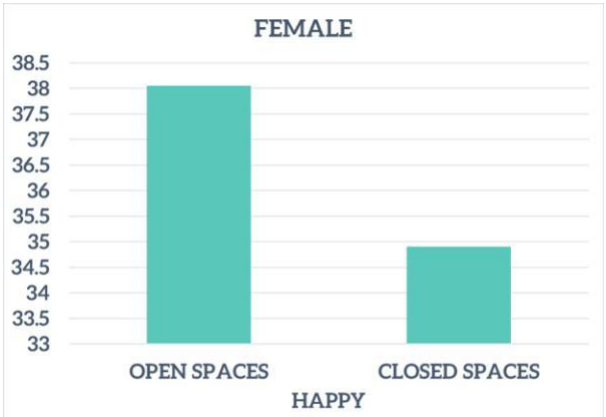


Figure 14. Preference of Open and Closed Space for Females when Happy

Figure 14. shows that the level of happiness for females is more in Open Spaces as compared to Closed Spaces.

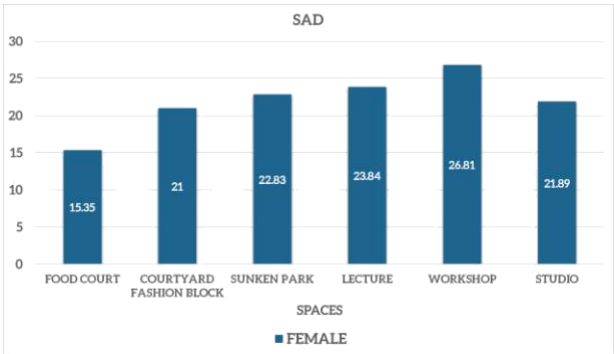


Figure 15. Measure of sadness for different spaces for females

Figure 15. shows the level of sadness for the different spaces for females. Amongst closed spaces, the level of sadness is experienced maximum in Workshops and among open spaces in Sunken Park. Food Court is the space in which sadness level is the lowest among all other spaces.

Figure 16. Parameters preferred for workshop by females when sad

Figure 16. shows the parameters that affect the level of sadness for females in Workshops. Poor Ventilation in the workshop is the parameter that contributes the most towards the sadness level. Improper Lighting conditions, insufficient Area and poor thermal comfort also add to the sadness level.

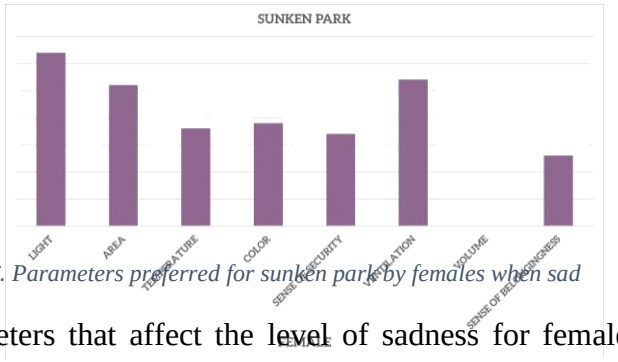


Figure 17. Parameters preferred for sunken park by females when sad

Figure 17. shows the parameters that affect the level of sadness for females in Sunken Park. Improper Lighting conditions (all time of the days) mostly at night, contributes the most towards the sadness level. Poor Ventilation, especially during the summer season and less Area for the activities to be performed, are also significant factors. There is a slight difference between Thermal Comfort, Sense of Security and Sense of Belongingness but anyways contributing to the cause. Volume does not contribute anything in this case.

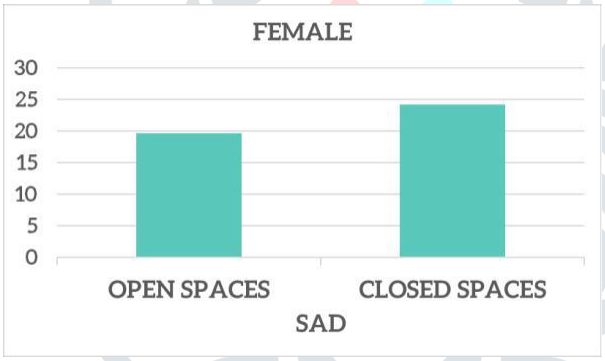


Figure 18. Preference of Open and Closed Space for Females when Sad

Figure 18. shows that the level of sadness for females is more in Closed Spaces as compared to Open Spaces with a very slight difference between both.

5. Conclusion and Discussion

In the aspiration to design the built environment, architects are continuously trying to create spaces that adhere to the users positively. The motive behind creating such spaces is that these must awake in the user favorable emotions that promote the activity for that space. The proposal is to provide future architects with an experimental modal to be incorporated into the design of the architectural space. This research will allow the designing of multi-functional spaces that are more inclined towards achieving user needs at an emotional level for a better life quality for the inhabitants. This will indeed evolve a newer perspective of space in architecture.

In this research, the review of multidisciplinary literature is done which talks about the user's emotional response and the various methodologies of measurement of emotion/emotional response were studied. Based on the study of measurement of emotion, a new method (scales) is developed for the measurement of the user's emotional response carrying forward the approach of the past. To verify the proposed method, space parameters are identified and ranked with the help of expertise, different sets of institutional space modules are created, and the user response is recorded based on personal interviews. The results showed that the user's response to all space module sets was different. User's responded emotionally to how each space was designed for the purpose it was built. The results also showed the parameters which triggered the emotional response towards that space and how these parameters lead to the formation of a response. Further, the result proves that users experience different emotional stimuli in regard to the different sets of space modules.

Consequently, the result of this research also proves the potential of the proposed method for measuring the user's emotions and their emotional response. The proposed research method offers a better understanding of environmental stimuli, user's emotion, with respect to situation in interaction with any space and the process by which it is obtained.

The strength of the research is the emphasis on the inclusivity of spaces and the emotional response of users which have been sparsely researched before. The research also measures the qualitative parameter of the emotion of users of different spaces which is a new perspective in emotion research, rather than concentrating only on the architectural components of a space. This research bridges the psychological perception of the user to space. This research is focused not only on the emotional expression of space but also on what factors the emotion of the users depends. This research would contribute to the development of the emotional aspects of architecture in the near future.

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7. Appendix

Appendix I

Space modules are created for the six different spaces and the user response was recorded based on the personal interview questions.

USER	EMOTIONS		PARAMETERS OF SPACE_SUNKEN PARK (2.2)																TOTAL RATING	TOTAL RANKING FOR WORKSHOP
			LIGHT (1.6)		AREA (1.4)		TEMPERATURE (1.5)		COLOR (1.2)		ENSE OF SECURITY (0.8		VENTILATION (1.8)		VOLUME (1)		NSE OF BELONGINGNESS (			
STUDENTS			SCORE (5	RATING	SCORE (5	RATING	SCORE (5	RATING	SCORE (5	RATING	SCORE (5	RATING	SCORE (5	RATING	SCORE (5	RATING	SCORE (5	RATING		
MALE	HAPPPY	SUBJECTIVE																		
	SAD																			
	ANGRY																			
	SURPRISE																			
	FEAR																			
	DISGUST																			
FEMALE	HAPPPY																			
	SAD																			
	ANGRY																			
	SURPRISE																			
	FEAR																			
	DISGUST																			
MALE	HAPPPY	BEHAVIOURAL																		
	SAD																			
	ANGRY																			
	SURPRISE																			
	FEAR																			
	DISGUST																			
FEMALE	HAPPPY																			
	SAD																			
	ANGRY																			
	SURPRISE																			
	FEAR																			
	DISGUST																			
MALE	HAPPPY	PHYSIOLOGICAL																		
	SAD																			
	ANGRY																			
	SURPRISE																			
	FEAR																			
	DISGUST																			
FEMALE	HAPPPY																			
	SAD																			
	ANGRY																			
	SURPRISE																			
	FEAR																			
	DISGUST																			
MALE	HAPPPY	EXPRESSIVE																		
	SAD																			
	ANGRY																			
	SURPRISE																			
	FEAR																			
	DISGUST																			
FEMALE	HAPPPY																			
	SAD																			
	ANGRY																			
	SURPRISE																			
	FEAR																			
	DISGUST																			

Appendix II

Space ranking parameters required the expertise to indicate their responses from a scale of 10 according to their preference.

FOR FACULTIES			
S.NO	PARAMETERS OF SPACE	DESCRIPTION	SCORE (10)
A	LIGHT	Light is measured in LUX. It varies from space to space and helps to initiate the activites and reciprocates the human resources w.r.t the emotions.	
B	AREA	Area is 2 dimensional amount of space that an object occupies. Area is measured in square units such as square centimteres, square feet, square inches, etc.	
C	TEMPERATURE	The temperature of a space tells about the thermal comfort. Thermal comfort is the condition of mind that expresses satisfaction with the thermal environment and is assessed by subjective evaluation.	
D	COLOR	Colors are a powerful communication tool and can be used to signal action, influence mood and even influence physiological reactions.	
E	VENTILATION	Better indoor/outdoor air quality for better function of a space	
F	HEIGHT	Defines the volume of a space w.r.t the activity/event performed in that space	
G	SENSE OF BELONGINGNESS	Belongingness means the comfort level of a space	
H	SENSE OF SECURITY	Person feel secure in a defined space	
NOTE:- To be rated according to the preferences. Rating to be done in a way that the total of parameters should be 10. (A+B+C+D+E+F+G+H=10)			