A Study of the Associations between the Environmental Variables and Comforting of Children in the Interior Spatial Environment of Pediatric Hospitals from a Behavioral Context

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***Abstract*—** Children are exceptionally sensitive to the environment and suffer from changes in the environment, which certainly adds to their stress and fear in the hospitals due to which they become restless, impatient, irritated and tired. But, nevertheless a designed environment can contribute to the comforting of children. The design may be based on the behavioural responses of children towards the aspects of Interior spatial environment since literature reveals that several factors of the environment have an effect on children's physical activity and behaviour. This paper convenes on the behavioural responses of children towards the environmental variables such as light, sound, air and water, which are a part of the Interior spatial environment, to find associations between the variables and comforting of children for deriving a behavioural justification for the design of comforting interior spatial environments in the paediatric hospitals.

***Keywords*—** Behavior, Children, Comforting, Environment, Interior.

I. Introduction

CHILDREN are affected by variations in the environment since they are sensitive. A hospital environment, which makes children captive, without a choice to leave or change certainly creates stress and fear due to which they become insecure, anxious, threatened and unprotected [1]. Reference [2] stated that the above symptoms may not necessarily be due to their illness, but, could be caused by misappropriations between the hospital environment and the physical, social and psychological needs of the patients.

In hospitals, children confront with many difficulties and special needs such as *comforting* needs, which may be either physical, psycho spiritual, social or environmental [3]. The scope of this study lies with the environmental comforting needs of children in the pediatric hospitals. In this context, Comforting is more scientifically conceptualized and defined as creating a pleasant state of physiological, psychological and physical harmony between the human being and environment [4].These views make it apparent that healthcare environments not only address the purely medical needs of patients, but also the 'non-medical' needs that have an effect on their well-being, which can be achieved by designing supportive, comforting and welcoming spatial environments in healthcare settings [2].

Reference [5] stated, that the importance of designed spatial environments which include good furniture, light, ventilation etc. in the children's hospitals might be noted by the change of behaviour and attitudes it can create in children, which implies the significance of the behavioural study.

Thus, this paper concentrates on the behavioural study of children undertaken in the interior spatial environments of the paediatric hospitals in Hyderabad and Secunderabad, India to find associations between the environmental variables (*light, sound, water and air*) and comforting of children to derive a behavioural justification for the design of comforting spatial environments in paediatric hospitals.

II. Literature Review

The literature reviewed from various disciplines due to its interdisciplinary and multidisciplinary nature elaborates on the following aspects:

(i) Interior spatial environment and behavior of children

(ii) Environmental variables for behavioral analysis from children's perspective (iii) Comforting and children's actions

A. Interior Spatial Environment and Behavior of Children

Interior Spatial environment refers to the complete space for human activity, which includes spatial elements, their characteristics , interior spaces and all environmental variables that relate to human sensory systems such as sight, touch, sound, taste and odor [6].

Behavior is the result of a complex interaction between such an environment and the physiological (related to body's biological mechanisms) and psychological (related to cultural background, motives, experiences, basic needs) condition of human beings [7].

The direct interaction of the environment has an effect on building of children's mental representations of space and objects in the environment [8]. This implies that the spatial environment has an effect on human behavior and people are

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continually manipulating their spatial surroundings in an attempt to make life physically, physiologically and psychologically more comfortable [7].

The design of the spatial environment cannot determine behavior, but it could only modify or control or provide possibilities of choice, thus explaining the relationship as a possible association [9]

B. Environmental Variables for Behavioral analysis from Children's Perspective

Light, sound, air and water are environmental variables considered in this study. The literature regarding these variables is limited to the qualitative aspects, since measurements are not in the scope of this study. The other environmental variables such as odor and temperature are not discussed in this paper since they could not be observed qualitatively.

Light is radiant energy and one of the most important aspect in the interior environment. Quality and type of lighting in the interiors either supports or hampers convenience, comfort and emotions of the users [10]. Sound affects the user depending on its intensity and frequency. Air causes comfort or discomfort to the users depending on its quality. Water, which is an essential element used for various purposes is explored in this study for associations with comforting of children [11]. The actions observed towards the environmental variables in this study, establish probable associations with comforting.

Earlier studies of researchers indicate that the environmental variables affect children behavior in the interior environments [11]. Light maybe natural or artificial. The brightness, contrast, intensity, glares and color of the light affects users in the interiors. Lighting enhances users' perception of shape, form and surface texture by creating shadows, brightness variations on the objects and patterns of light and shade which create visual interest in the spatial environment [12]. Lighting affects children behavior and attention span and good interior lighting has positive correlations with children outcomes in pediatric settings and daylight increases physical activity in children [13]. It was noted that changing patterns of brightness and shadow, sparkle and reflection capture and redirect occupant's attention, thus helping in relieving, stress and mental fatigue. These imply that day lighting has several direct physiological and psychological effects on young and old patients [14].

Sound is the sensation by the ear and it is necessary to preserve the desired sounds and reduce or eliminate sounds that interfere with the activities of the users in interior environments [12]. Humans or equipment in the interiors may generate sound and its degree of loudness makes it desirable or undesirable. Music was designated as a form of sound which is soothing to the ear and enhances comfort and play activity, indicating positive distraction and changes in mood. It was found that patients could rest better in hospital environments with varied patterns of auditory input (Music, T.V) than with quiet ambience. Previous studies indicate music to reduce stress and promote healthy development in children [15].

Humans experience water in multi-sensory ways [6]. Reference [11] suggests that incorporating views of nature promote measurable restoration to acutely stressed patients. Playing with water is a soothing activity for children and they enjoy by touching and playing in it and the multi-sensory qualities of water makes substantial contribution to children's development. The aesthetic views of water are associated with restorative influences in the interior environments and water in any form is a wonderful play material [16].

C. Comforting and Children's actions

Comforting is scientifically defined above but may also be exclaimed as soothing, relaxing, cheerful, uplifting, getting rid of anxiety, emotional escape and setting the mood.

The understanding of user-environment relationship requires study of the actions of users, in favor of their own comfort conditions. It was assessed that development, comforting and well-being in children could be through the feedback of their actions in the milieu or also as the outcome of design features, measured by actions [17] Thus, comforting is denoted by the actions of children towards the variables in this study.

Literature from child psychology reveals several strategies that children use to regulate distress in mildly stressful situations, which range from passive, reactive, active, and proactive to reorienting [18]. Based on studies from Child Psychology, Categories were formed for classifying the various actions of children for analysis. The categories were *active engagement, passive exploration, symbolic self-soothing, and physical comforting; focus on desired objects and distraction* [18]

Active engagement is denoted when a child is engaged in a sustained action or behavior and all types of physical activities and thrill seeking actions indicate active engagement [19]. *Passive exploration* is addressed as an action which is initiated rather than self-directed. Children explore the environment passively, more by touch that engage the senses, stretch the imagination and take advantage of their natural curiosity and innate abilities [18]. *Symbolic self-soothing* strategy is considered to be goal-directed, which requires symbolic or representational thought to achieve comforting [18]. *Physical comforting* is defined as bodily-directed behaviors and includes all other actions encompassing to become a source of comfort & wellbeing [18]. *Distraction* or redirection of attention occurs when the child's focus of attention is orienting from something in use to an alternative object [18]. It is also known as a positive distractor i.e. moving attention away from the source of negative arousal to more neutral, nonsocial stimuli [20]. *Focus on desired objects* is described as focusing on a desired object in a delay situation [18]. It also refers to children going repeatedly towards a single object or space.

Thus, this study explores the behavioral associations of comforting with the environmental variables in the pediatric hospitals, by applying the above strategies to observe and categorize the actions of children.

III. Research Methodology

The study is concerned in exploring the associations between the environmental variables and comforting of children in the pediatric hospital environments. This investigation is based on a naturalistic inquiry which identifies the variables from the data and forms theories and patterns to define the behavior of the children [21]. Reference [21] has described multiple case study and grounded theory methods, which were most suitable to find associations.

The present study is limited to the twin cities, Hyderabad & Secunderabad, of Andhra pradesh in India, which are rising to new heights in the pediatric health care and medical technology. Observation technique was employed to study the associations between the environmental variables and comforting in environments of pediatric hospital settings.

Individual children were observed by the *Non-participant unobtrusive behavioral tracking* technique. This strategy involves a systematic following and recording of movements and actions of the respondents and noting their responses in the settings, to translate them into patterns of behavior [22]. In this technique the data is collected in the form of tracking maps, notes and photographs. This method was found to be non-biased, representative, credible and reliable for observing children in the physical settings.

The settings in the twin cities were sampled using the *Proportionate stratified systematic sampling* [23] method for deriving at a representative sample. Based on this method 16 settings were selected from a sampling frame of 30 hospitals since one of them had two units. A sample size of 15% of the children or the population in each setting was decided to obtain representativeness, based on the recommendations that the minimum sample size must be 5% of the population [23]. The minimum tracking time for each individual was decided as half an hour and maximum time as half an hour based on the view that it could be chosen arbitrarily [24]. This was further tested and confirmed in the pilot study. Thus, behavioral tracking was done for 154 children across 16 settings.

IV. Data Analysis And Results

The data was analyzed inductively using the grounded theory method in which the data was systematically collected and empirically analyzed.

The tracking maps and track notes were sorted and coded based on the respondents for the convenience of analysis. The data of the environmental variables was separated and classified into categories developed while the actions were classified into categories developed from psychology. Categories could be identified only for light and sound while they could not be identified for air and water, although they were also observed qualitatively.

Then a data set was prepared in Excel format. Associations between the different categories of light and sound with comforting were found by the frequency of the children observed, while associations were also found by the count for air and water but further tests were not done since they did not have any categories. However, the count for light and sound and their categories were converted to percentages and cross-tabulated for detecting associations and to check the significance and strength of the associations [25]. The significance of the associations was tested by Pearson's chi-square test [26]. Then the strength of the associations was computed for the significant associations using *Cramer's V test* [25].

The following table shows the summary of the statistical results in terms of significance and strength of associations between comforting and the environmental variables (light and sound) in the pediatric hospitals.

TABLE I
SUMMARY OF THE STATISTICAL RESULTS OF THE DATA

Environment variables	Chi square	Significance	Cramer's V	Strength
Light	(x^2(DF=12)=62.8 P(0.000)<0.05)	Significant	0.642	Strong
Sound	(x^2(DF=12=27,5 P(0.007)<0.05)	Significant	0.509	Strong

Note: (i) Water and air are not included in the table since they have no categories.(ii) Associations are significant when $p < 0.05$ (iii)Association is strong when V is greater than 0.5, moderate when V is between 0.3 to 0.5 and weak when V is below 0.3

Table I shows that light and sound have significant associations and both the environmental variables light and sound have a strong association whereas light has a stronger association compared to sound.

V. Discussions, Interpretations And Inferences

The statistical and significant associations are discussed for light and sound under the categories identified in the study. The associations are inferred and interpreted descriptively and illustrated with representative photographs.

A. Associations between Light and Comforting of children

Based on the observations with comforting light was categorized as natural, artificial and the shadows of reflections of light. The count of the children observed for the above categories with comforting was used to compare them statistically and discussed for interpreting their associations.

Natural light was found to be contributing to the comforting by focus on desired object, which explains that the children were running towards the direction or in search of natural light, owing to its brightness and warmth. Also, the bright sunlight seemed contributing to the comforting by distraction.

The artificial light contributes to the comforting by passive exploration due to the brightness and different forms (shape, size & design) of fixtures. Further, the brightness contributes to the comforting by symbolic self-soothing, enhancing the psychological feeling, especially in dark spaces.

Streaks and beams of sunlight and reflections due to both artificial & natural light were found contributing to the comforting by passive exploration. Children were fascinated with the reflections and streaks of sunlight of various shapes

on the floors, walls and other objects and hence stood exploring them visually. In addition, shadows & reflections were found contributing to the comforting by active engagement encouraging children to jump & play with the patterns of light reflections on the floor.

The following photographs illustrate the above discussion

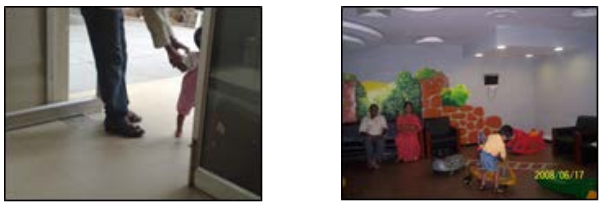

Fig.1 Views showing comforting by natural and artificial light

Fig 2 Views of comforting by reflections of natural & artificial light

It can be noted that brightness, warmth and the different shapes and patterns formed due to shadows and reflections of natural and artificial light are important factors contributing to the comforting of children.

However, it was also observed that children were disturbed and uncomfortable due to the glare of the harsh sunlight and direct intense artificial light.

B. Associations between Sound and Comforting of children

Based on the observations with comforting, sound was categorized as human initiated sound, equipment sound and TV/music/recorded sound. The count of the children observed for the categories with comforting was used to compare them statistically and discussed for interpreting their associations.

It was found that some parents were talking and initiating sound by hitting surfaces and objects for comforting. This was found to be comforting by distraction. Children were observed to be thumping surfaces or playing with objects to generate sounds comfortable to them. Hence, this type of initiated sound was also found to be comforting by active engagement. It may be inferred that all types of sound contribute to the comforting by distraction and the initiated sound by active engagement, encouraging children to play & enjoy.

The sounds from mechanical, electronic and electrical gadgets were found contributing extensively to the comforting by distraction. The sound or the soothing music and the recorded voices from the lifts were found contributing to the comforting by distraction and symbolic self-soothing (enjoying & feeling relaxed).

The following photographs illustrate the above discussions

Fig 3 Views showing comforting by sound (initiated & music)

Thus, it may be inferred that Music contributes to the comforting by symbolic self-soothing (quiet & peace).

It may be noted that the different levels of audibility & quality of sounds are the important factors contributing to the comforting. It was also observed that the prolonged crying of small children and equipment noise was uncomfortable to the other children. They expressed fear and discomfort to the screeching noise and sound of the objects falling accidentally.

C. Associations between Air, Water and Comforting

Air was also observed qualitatively but could not identify any categories. The tracking method for air recorded the actions of children with comforting and associations were discussed on the frequency of actions.

During *tracking*, the actions (children purposely stood & sat under the fans to enjoy the breeze, fanned themselves with objects for breeze, drew curtains & opened windows for fresh air, went to open spaces to get fresh air etc.) with comforting were recorded.

The graph below shows comforting of children by Air

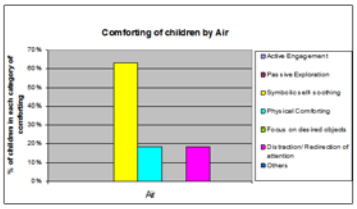

Fig 4: Graph showing associations between air and comforting

The frequency of this data is graphically represented to show the percentage of children in each comforting type with air. The discussions and findings indicate that there is an association between air and comforting of children.

D.Associations between Water and Comforting of Children

Water was also observed qualitatively but could not identify any categories. The tracking method recorded the actions with comforting and associations were discussed based on the frequency of the actions.

During the observation by tracking, the actions, with comforting by water (in any form) were recorded. It was seen that the sight of water in any form (coolers, taps, bottles and patches of water) contributes extensively to the active engagement of children, encouraging them to jump & play on the surfaces with patches of water. Children were found turning the taps to collect water in containers or hands to engage themselves by pouring, rubbing with hands, cloth etc.

Water was found to be contributing to the comforting by passive exploration (watching others playing with water or involved with water for short durations, since the elders prevented them) and distraction in few cases. Water contributed to the comforting of children by creating a focus on the desired object (child repeatedly went to the water).

Thus, we may infer that the sight of water in any form encourages children to play actively & passively, thus comforting them by active engagement, passive exploration and distraction.

The photographs below illustrate and support the discussions, findings and interpretations indicating the association between water and comforting of children.

Fig6: Views showing comforting by water

The findings with respect to the comforting by environmental variables (light, sound, air and water) reveal their multi-sensory qualities which may be helpful in designing for the psychological comforting of children.

VI. Conclusions

This investigation puts forth the findings of environmental variables, which emerge from the empirical evidence to recommend the design of the Interior Spatial environments in the pediatric hospitals. The study has also made significant contribution to the theoretical body of knowledge by strengthening certain old theories and formulating new grounded theories which may be open for verification, corroboration and further exploration. Methodologically, the study recommends systematic unobtrusive observations of children to study their behavior and get an insight into their needs, attitudes and preferences to provide innovative designs for pediatric environments.

It may be suggested to further strengthen the above findings using quantitative methods, since the environmental variables were observed only qualitatively. The study can also be replicated in different cities for generalization of the findings.

The other related disciplines of this research can further explore the psychosocial comforting needs of children in the pediatric hospitals and associate them with the physical design. This investigation suggests in-depth behavioral research of the interior environments from children's perspective in pediatric hospitals to associate the interior characteristics with comforting physical designs which may complement the clinical care in today's context.

References

[1] Malkin, Jain (1991). Creating excellence in Healthcare Design. Journal of Health Care Interior Design: Proceedings from the National Symposium on Health Care Interior Design, Vol 3, pp: 27-41.

[2] Fiona De Vos (2002). HEALING ENVIRONMENTS II: A historical overview of the interaction between healthcare environments and patients. http://www.swiz.nl/healing_environments2.doc. Accessed on October 24, 2007, 6:51:18 PM.

[3] Katharine Kolcaba and Marguerite A. DiMarco. (2005). Comfort Theory and Its Application to Pediatric Nursing. Journal of Pediatric Nursing. Vol 31 (3) pp: 187-194. Janneti publications Inc

[4]. Slater, K. (1986). The assessment of comfort. Journal of the Textile Institute, 77, 157-171.

[5] Eriksen Aase (2000). Participatory Planning and Design of a New Children's Hospital. (IADH) International Design for Academy and Health.http://www.designandhealth.com/uploaded/documents/Publications/Papers/Aase-Eriksen-WCDH2000.pdf Accessed on October 19, 2009, 1:01:07 PM.

[6] Heerwagen Judith. (2006). Psychosocial value of space. National Institute of Building Sciences http://www.wbdg.org/design/psychspace_value.php

[7] Laurie Michael (1986). An Introduction to Landscape Architecture. New Jersey: Prentice-Hall, Inc.

[8] Spencer. C. P. & Mark Blades. (2006). Children and their environments: learning, using and designing spaces. Cambridge University Press.

[9] Rapoport, A. (1977). Human Aspects of Urban Form: Towards a Man-Environment Approach to Urban Form and Design. Oxford: Pergamon Press Ltd.

[10] Pile, John.F. (1988).Interior Design. Harry. N. Abrams, Inc. New York.

[11] Ulrich.S.Roger. (2000).Effects of Healthcare Environmental Design on Medical Outcomes.International Academy for Design and Health. pp: 49-59

[12] Ching. D.K. & Binggeli. (2005). Interior Design Illustrated. Second edition. John Wiley & Sons, Inc. New Jersey.

[13] Catherine Docherty, Andrew Kendrick, Paul Sloan, Jennifer Lerpiniere (2006). Designing with Care. Interior Design and Residential Child Care. Final Report by Farm 7 Scottish institute for Residential Child Care.

[14] Mahbub Rashid & Craig Zimring (2008). A Review of the Empirical Literature on the Relationships Between Indoor Environment and Stress in Health Care and Office Settings: Problems and Prospects of Sharing Evidence. Environment and Behavior. Vol 40. No.2. pp: 151-190.

[15] Barrera, M. E., Rykov, M. H. and Doyle, S. L. (2002), The effects of interactive music therapy on hospitalized children with cancer: a pilot study. Psycho-Oncology, 11: 379–388

[16]. Cooper Marcus, C. and Barnes, M. (1999) Healing Gardens: Therapeutic Benefits and Design Recommendations. New York: Wiley.

[17] Zeisel, John. (2006). Inquiry by Design. Environment/Behavior/ Neuroscience in Architecture, Interiors, Landscape and Planning. Revised edition. New York: W.W. Norton & Company.

[18] Tamis-LeMonda , Lawrence Balter, Catherine S. (Eds) (2006). Child Psychology: A Handbook of Contemporary Issues, New York: Psychology press, Taylor & Francis group.

[19] Holder, M. D., Coleman, B., & Sehn, Z. L. (2009). The contribution of active and passive leisure to children's well-being. Journal of Health Psychology, 14(3), 378-386.

[20] Balter, L. (Ed.). (1999). Child psychology: A handbook of contemporary issues. Psychology Press.

[21] Creswell. J. W. (1994). Research Design: Qualitative & Quantitative Approaches. Thousand Oaks: Sage publications.

[22] Sanoff Henry, (1991). Visual Research Methods in Design. New York: Van Nostrand Reinhold

[23] Nachmias. C.F. & Nachmias. D. (1996). Research methods in the Social Sciences. Fifth edition. Great Britain: St. Martin's Press Inc.

[24] Hill, Michael.(1984). Stalking the Urban Pedestrian: A comparison of Questionnaire and Tracking Methodologies for Behavioral Mapping in Large-Scale Environments. Environment and Behavior. Vol. 16 No. 5 pp: 539-550.

[25] De Vaus. D.A. (2003). Surveys in Social Research. Jaipur: Rawar publications.

[26] Dwivedi.R.S. (1997). Research Methods in Behavioral Sciences. Macmillan India Ltd.

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