CONFIRMATORY FACTOR ANALYSIS OF PHYSICAL ENVIRONMENT FOR MENTAL FATIGUE RESTORATION

[1]POOREE SAKOT, [2]YANIN RUGWONGWAN

[1]Student in Arch D., King Mongkut's Institute of Technology Ladkrabang, Thailand.
[2]Asst. Prof. Dr. in King Mongkut's Institute of Technology Ladkrabang, Thailand.
E-mail :[1]59602076@kmitl.ac.th, [2]yanin.ru@kmitl.ac.th

Abstract - This research aimed to analyses the confirmatory factors of physical environment for mental fatigue restoration. The sample size was 400 medical students at pre-clinical level whose data were collected through questionnaires.Multi-stage sampling technique was implemented in the collected with the Item Objective Congruence *(*IOC*)* of 0.70. The reliability was evaluated with the Cronbach's alpha coefficient of 0.98 by analyzing the confirmatory component data. The results revealed five notable components*:* 1*)* Nature, 2*)* Color, 3*)* Lighting, 4*)* Music, and 5*)* Finishing.The second order confirmation element analysis results included the relative Chi- square*/*DF=2.823, the Root Mean Square Error of Approximation *(*RMSEA*)* of .091, the Root Mean Square Residual *(*RMR*)* of .010, the Comparative Fit Index *(*CFI*)* of .991, the Tucker Lewis Index *(*TLI*)* of .981.This component analysis allowed for quality measurement of physical environment as reflected by the Composite Reliability *(*CR*)* of .943 and, the Average Variance Extracted *(*AVE*)* of .769.

Keywords - Confirmatory Factor Analysis, Physical Environment, Mental Fatigue, Restoration

I. INTRODUCTION

A healing environment that promote the renewal of adaptive resources, called restorative environments, have attracted attention in diverse disciplines.This idea is not new. Florence Nightingale wrote already in the nineteenth century about the positive effects of daylight and ventilation on patients' health. Both theoretically and practically, work with restorative environments can complement work guided by a stress perspective on adaptation that focuses on demands from the environment and ways of minimizing and mitigating them.The physical environment can be definedas all tangible physical entities in and around organizations [1].

A healing environment is considered a holistic entity wherein different componentsall play a synergistic role [2].Therefore, healing environment from a holistic point of view considers these tangible physical entities of the physical environment as related having an intertwined effect on its users. In definitions of healing environment from this holistic perspective, the focus is not only on physical aspects, but also on social and psychological aspects.Psychological aspects that are influenced by environmental stimuli are of a cognitive or emotional nature, for example the presence of plants in a patient roomthat give the patient a morehomely feeling which results in less anxiety [3].

II. LITERATURE REVIEWS

A. Psychophysiological Stress Recovery Theory

The psychophysiological stress recovery theory [4] – [5] is concerned primarily with environments as people see or view them. It focuses on the affective response to particular stimulus patterns and contents in the visual stimulus array. The theory assumes that some visual characteristics support stress reduction and that this has an innate basis. Stress is one manifestation of the operation of an evolved affective system that directs approach and avoidance behavior.

Restoration will be facilitated if the visual stimulus array has moderate depth, moderate complexity, provides a focal point, and contains particular environmental contents.Following a stressful transaction with stimuli that are perceived as threatening to well-being, a person viewing such a pleasant scene will feel positive affects replacing the negative ones, affirming that well-being is being fostered instead of threatened. The person will concomitantly experience decline in physiological activation to a more moderate level. An innate tendency to respond this way in appropriate situations would hold survival value by enabling faster recovery from acute stress and so providing protection against chronic stress and ensuring the ability to adapt to changing circumstances in the long term.

Empirical support for this theory has been discerned in the results of experiments in laboratory and field settings by Ulrich, Ulrich et al., and others (e.g., Hartig, Evans, Jamner, Davis, &Gärling; Parsons, Tassinary, Ulrich, Hebl, & Grossman-Alexander)[5] - [8]. Importantly, very similar theoretical notions that seem to have been developed without awareness of Ulrich's work have also received experimental affirmation. Specifically, Fredrickson and Levensontested an "undoing hypothesis" that invokes essentially the same affective mechanism for stress recovery described in 1983 by Ulrich; positive affect evoked by some environmental stimuli blocks negative affect and thoughts and enable more rapid, complete psychophysiological stress recovery [9].

B. Attention Restoration Theory*(ART)*

ART suggests the ability to concentrate may be restored by exposure to natural environments.The ART states that exposure to nature might lead to better cognitive abilities, mainly because nature can help replenish a specific limited cognitive resource, directed attention.

ART proposes that individuals benefit from the chance to (1) " be away" from everyday stresses, (2) experience expansive spaces and contexts ("extent"), (3) engage in activities that are "compatible" with our intrinsic motivations, and (4) critically experience stimuli that are "softly fascinating" [10]. This combination of factors encourages "involuntary" or "indirect attention" and enables our "voluntary" or "directed" attention capacities to recover and restore [10]. Relaxing settings (such as places of worship) and activities (such as sleep) may provide restorativeopportunities, but ART argues that nature may be particularly useful because it has an "aesthetic advantage" [11] – [12].

C. Therapeutic Architecture

Therapeutic architecture can be described as the people-centered, evidence-based discipline of the built environment, which aims to identify and support ways of incorporating those spatial elements that interact with people physiologically and psychologically into design. Architecture is an important factor in people's lives when they are well; when they experience ill-health and are less able to cope it becomes even more important. The components of Therapeutic Architecture are nature, color, lighting, music, finishing, etc.

Nature: Nature has always been a key component of healing environments [13], It reduces stress it reduces negative emotions [14], it can enhance positive emotions [14], it can reduce anxiety of patients and family [15], it can improve health outcomes linked to post-operative complications that are coupled to stress such as headaches, it can help dealing with pain, it can lower the use of analgesic medication and it can heighten the pain tolerance [16].

Color: Color is a fundamental factor in environmental design. People often consider our response to color as instinctive and simple, but it involves a very complex interaction between light, eyes, and the brain. The role of color is important not only because it influences aesthetic and technical aspects of human-made environments,but also it affects human beings psychologically, physiologically [17].Several studies have been conducted on the significance of color in healthcare environments by reducing stress, medical errors, depression, length of stay, improving social support of patients, communications in healthcare environment, circadian rhythms, patients sleep, improving satisfaction, andincreasing staff productivity and morale [17] – [18].

Lighting: Adequate lighting is identified as one component that leads to patient satisfaction [16]. Three types of lighting can be distinguished: artificial light, daylight and sunlight. When there is appropriate artificial lighting, less medication errors occur, herein a luminance of 1570 lx shows a significant lower error rate [19].

Bright artificial light isalso effective in improving mood and reducing depression [18]. Artificial lighting can also contribute to an aesthetically pleasing environment; in general, brightindirect lighting is recommended to prevent glare [19]. The presence of daylight reduces pain and the incidence of depression [18]. Ulrich et al. also state that the length of stay of patients suffering from depression can be reduced through morning daylight [18].

Music: Music listening is associated with reduced subjective stress levels and affects physiological markers of stress processed in the central nervous system, then further impacts endocrine, autonomic and immune activity, and leads to the experience of a broad range of emotions [21] – [22].

Finishing: Psychophysiological affective responses toward wood seem to be giving indications of psychological beneficial effects [23].

D. Confirmatory Factor Analysis *(CFA)*

This study utilized SPSS 27 combined by AMOS 23 to derive the CFA with Maximum Likelihood estimation approach. Maximum Likelihood estimation approach was selected since it could derive the parameter estimates in a model using the information in the sets of equations simultaneously [24].

Two sets of measurement model validity were selected to assess the goodness of the CFA: absolute fit measures and incremental fit measures [25].

Absolute fit measures were evaluated by goodness of fit index (GFI), adjusted goodness of fit index (AGFI), and root means square error of approximation (RMSEA) while incremental fit measures were evaluated by normed fit index (NFI), incremental fit index (IFI), Tucker-Lewis index (TLI), and comparative fit index (CFI). Most of the validity measures required the higher the better, similar to the coefficient of determination (R2) in the multiple linear regression. For absolute fit measures, GFI and AGFI more than 0.95 and RMSEA lower than 0.07 indicated that the model was extremely good [25, 26].

For this study, the measurement model validity was selected to assess the goodness of the CFA; CFI, TLI, RMSEA, and RMR.

III. METHODOLOGY

A. Participants

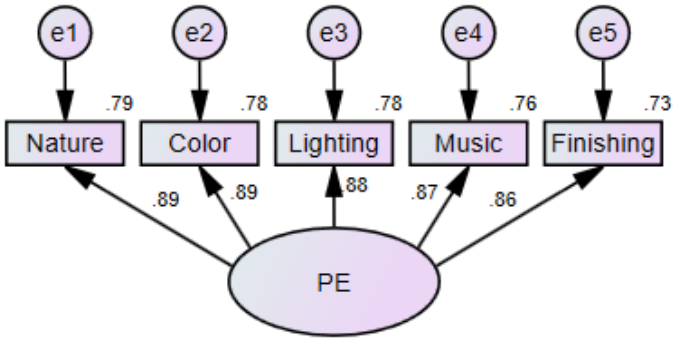
This study involved 400 medical students at pre-clinical level.

B. Data Analyses

Confirmatory Factor Analysis (CFA) was used to find the best factor structure of the scale.

IV. FINDINGS

Hair[31] mentioned that all the standardized factor loadings should be statistically significant if the standardized factor loadings are higher than 0.7.The CFA model physical environment for mental fatigue restorationis shown in Fig. 1. In addition, Table 1 represents the factor loading with its p-value for each indicator. The finding of parameter estimates and goodness of fit measurement model. The results revealed five notable components: 1) Nature, 2) Color, 3) Lighting, 4) Music, and 5) Finishing. The second order confirmation element analysis results included the relative Chi- square/DF=2.823, the Root Mean Square Error of Approximation (RMSEA) of .091, the Root Mean Square Residual (RMR) of .010, the Comparative Fit Index (CFI) of .991, the Tucker Lewis Index (TLI) of .981. This component analysis allowed for quality measurement of tourism safety as reflected by the Composite Reliability (CR) of .943 and, the Average Variance Extracted (AVE) of .769.



Chi-square=14.115, DF=5,
Chi- square/DF=2.823,
CFI=.991, TLI=.981,
RMSEA=.091, RMR=.010

Figure 1 :the confirmatory factors of physical environment for mental fatigue restoration.

Items	Loadings	R^2	e	CR	AVE
Physical Environment (PE)				0.943	0.769
Nature	0.888	0.789	0.211		
Color	0.885	0.783	0.217		
Lighting	0.883	0.780	0.220		
Music	0.871	0.759	0.241		
Finishing	0.857	0.734	0.266		
Sum	4.384	3.845	1.155		

Table 1 :Factor Loadings (n = 400)

V. CONCLUSION

The measurement model of physical environment for mental fatigue restoration had goodness of fit with empirical data. The most nature has explained variance of physical environment 78.9%, thecolor has explained variance of physical environment 78.3%, the lighting has explained variance of physical environment 78.0%, the music has explained variance of physical environment 75.9%, and the finishing has explained variance of physical environment 73.4%.The measurement model of physical environment for mental fatigue restoration hadComposite Reliability (CR) are lower than 0.7 (CR = 0.943), and had Average Variance Extracted (AVE) are lower than 0.7 (AVE = 0.769).

ACKNOWLEDGMENT

The author would like to express sincere thanks to King Mongkut's Institute of Technology Ladkrabang for kindness and support to this paper.

REFERENCES

[1] Mobach, M. (2009). Eenorganisatie van vleesensteen. Uitgeverij Van Gorcum.

[2] Fottler, M. D., Ford, R. C., Roberts, V., et al. (2000). Creating a Healing Environment: The Importance of the Service Setting in the New Consumer-Oriented Healthcare System. Journal of Child Health Care, 45, pp. 91-106.

[3] Dijkstra, K., Pieterse, M., &Pruyn, A. (2006). Physical environmental stimuli that turn healthcare facilities into healing environments through psychologicallymediated effects: Systematic review. Journal of Advanced Nursing, 56(2), pp. 166-181.

[4] Ulrich, R. S. (1983). Aesthetic and affective response to natural environment. In I. Altman & J. F. Wohlwill(Eds.), Behavior and the natural environment, pp. 85–125.

[5] Ulrich, R. S., Simons, R. F., Losito, B. D., Fiorito, E., Miles, M. A., &Zelson, M. (1991). Stress recovery during exposure to natural and urban environments. Journal of Environmental Psychology, 11(3), pp. 201–230.

[6] Ulrich, R. S. (1979). Visual landscapes and psychological wellbeing. Landscape Research, 4(1), pp. 17–23.

[7] Hartig, T., Johansson, G., &Kylin, C. (2003). Residence in the social ecology of stress and restoration. Journal of Social Issues, 59(3), pp. 611–636.

[8] Parsons, R., Tassinary, L. G., Ulrich, R. S., Hebl, M. R., & Grossman-Alexander, M. (1998). The view from the road: Implications for stress recovery and immunization. Journal of Environmental Psychology, 18(2), pp. 113–140.

[9] Fredrickson, B., &Levenson, R. W. (1998). Positive emotions speed recovery from the cardiovascular sequelae of negative emotions. Cognition & Emotion, 12(2), pp. 191–220.

[10] Kaplan, S. (1995). The restorative benefits of nature: Toward an integrative framework. Journal of Environmental Psychology, 15(3), pp. 169–182.

[11] Kaplan, S., & Berman, M. G. (2010). Directed attention as a common resource for executive functioning and self-regulation. Perspectives on Psychological Science, 5(1), pp. 43–57.

[12] Kaplan, R., & Kaplan, S. (1989). The experience of nature: A psychological perspective. New York: Cambridge University Press.

[13] Van den Berg, A. E. (2005). Health impacts of healing environments; a review of evidence for benefits of nature, daylight, fresh air, and quiet in healthcare settings. UMCG.

[14] Ulrich, R. S., Zimring, C., Quan, X., & Joseph, A. (2006). The environment's impact on stress. Improving healthcare with better building design, pp. 37-61.

[15] Smith, J. (2007). Health and nature: the influence of nature on design of the environment of care, The Center for Health design.

[16] Ulrich, R. S., Zimring, C., Zhu, X., DuBose, J., Seo, H. B., Choi, Y. S., & Joseph, A. (2008). A review of the research literature on evidence-based healthcare design. HERD: Health Environments Research &Design Journal,1(3), pp. 61-125.

[17] R. B. Tofle, B. Shwarz, S. Y. Yoon, and A. Max-Royale. (2004). Color In Healthcare Environments - A Research Report, Coalition for Health Environments Research (CHER), United States.

[18] R. S. Ulrich et al. (2008). A Review of the Research Literature on Evidence-Based Healthcare Design. HERD: Health Environments Research & Design Journal, 1(3), pp. 61-125.

[19] Buchanan, T. L., Barker, K. N., Gibson, J. T., Jiang, B. C., & Pearson, R. E. (1991). umination and errors in dispensing. Am J Hosp Pharm, 48, pp. 2137-2145.

[20] Devlin, A. S., &Arneill, A. B. (2003). Health care environments and patient outcomes a review of the literature. Environment and behavior, 35(5), pp. 665-694.

[21] Pelletier, C. L. (2004). The effect of music on decreasing arousal due to stress: a meta-analysis. J. Music Ther. 41, pp. 192–214.

[22] Chanda, M. L., and Levitin, D. J. (2013). The neurochemistry of music. Trends Cogn. Sci. 17, pp. 179–193.

[23] Nyrud A. O., Bringslimark T. (2010). Is interior wood use psychologically beneficial? A review of psychological responses toward wood. Wood and Fiber Science, April, 42(2), pp. 202–218.

[24] S. Hershberger. (2001). Book review of interaction and nonlinear effects in structural equation modeling, in: Randall E. Schumacker, George A. Marcoulides(Eds.),Structural Equation Modeling: A Multidisciplinary Journal, 8, pp. 490–492.

[25] J.F. Hair. (2010). Multivariate Data Analysis: a Global Perspective, Pearson, Upper Saddle River.

[26] J.W. Hoelter. (1983). The analysis of covariance structures, Socio. Methods Res. 11(3), pp. 325–344.

★★★