

Conference Paper

Visual Discomfort Health Concerns in the Future Cities of the Arabian Gulf: Case of Bahrain

Fay Alkhalifa, Nehal Almurbati, Joao Pinalo Silva, and Arnold Wilkins

Department of Architecture and Interior Design, University of Bahrain, Bahrain ²Department of Psychology, University of Essex, UK

Abstract

Like the rest of the world, the landscape of architecture has changed in many of the Arabian Gulf cities with the introduction of new design technologies and parameterisation methods. Some of the contemporary designs of building facades comprise of perforated walls generated by computer software. Such perforations are similar in their shapes and nature to the Lotus Seed Pod. An image with specific spatial properties that have been found to negatively affect its viewers and cause a state of visual discomfort termed tryphobia. The new condition, recently studied by a limited number of researchers triggers physiological and psychological reactions that range from headaches, sickness to even vomiting in some extreme cases. Using on-site surveys as the primary method for investigation, this research measures the baseline of the tryphobic population in Bahrain to be between 26.50% and 39.32%, a number that is much larger than the UK's estimated baseline of 13–17%. The results also showed that reactions to natural stimuli are much more severe than manmade ones. Nevertheless, reactions to manmade stimuli are still significant. The study highlights the need to further investigate the effects of parameterisation methods on building designs in relation to visual discomfort.

Keywords: Tryphobia, visual discomfort, Architecture, Bahrain

Corresponding Author:

Fay Alkhalifa

Received: 18 September 2018

Accepted: 10 October 2018

Published: 15 October 2018

Publishing services provided by
Knowledge E

© Fay Alkhalifa et al. This article is distributed under the terms of the [Creative Commons](#)

[Attribution License](#), which permits unrestricted use and redistribution provided that the original author and source are credited.

Selection and Peer-review under the responsibility of the Sustainability and Resilience Conference Committee.

1. Introduction

A closer look into the architecture practices of today highlights the pioneering numerical approaches of the 'digital design' that are celebrated by well-known universities around the world like Harvard, MIT and UCLA (Oxman 2008). Many of these approaches are dependent on the computing skills of the practitioners who enjoy experimenting with new conceptual forms using the various software's that are now made available to the design community. Forms created in such processes are often 'alienated' from

OPEN ACCESS

their surroundings. This rapid change in architecture and design requires an understanding of the implications of the created forms on the public and the building users' preferences, stimulation and the physical and psychological health of its occupants.

Sensible architects have been for long recommending the consideration of all ecological and human health factors involved when developing a new project (Cordero, 2001 and Evans and McCoy, 1998). By adopting sustainable visions, sensible architecture has been not only about energy efficiency but also cater to the best interest of both the occupants of the developed design and the earth in its heart. This research discusses visual discomfort in the contemporary architectural scene by focusing on tryphobia; a discomfort resembled in a set of physiological and psychological reactions induced by viewing images or forms of certain spatial properties, mainly clusters of objects.

2. Literature Review

2.1. Shift in architecture paradigm

The change in architecture typology has been linked to the theories and design concepts that rapidly changed since the 18th century. While architects had always used their drawing skills before building their projects these drawings have been the architect's medium to generate ideas and spaces to inform design decisions. The perspectives were used in Renaissances and projective geometry was the highlight in Modernism that leaped the design forward. Traditional architecture was known to be an 'additive process', in which design development and complexity was achieved by overlapping independent signs traced on many layers of papers, yet it could not manage forces and constrains (Terzidis 2004) (Tedeschi, 2014).

The later use of Computer Aided Drafting (CAD) software made the architecture paradigm progress as it helped in improving the ability to perform repetitive tasks as the diagram of Peter Eisenman's House IV did in the 60's. Architecture typology has changed from form-making to form finding in the late 19th century, when the work of Gaudi (1852-1026), Otto (1925) and Isler (1926-2009) had rejected typology and investigated self-formation processes in nature as a way to design buildings and organise them. The architecture paradigm continued to shift with the development of CAD and introduction of Computer Aided Manufacturing (CAM) systems until the current trend of Algorithm Aided Design (AAD) and 3D printing of buildings.

2.2. Parametric architecture

The use of code and mathematical relationships in Architecture has a long tradition (Starvic and Marina, 2011). From hypersurfaces to the exploration of blobs and folds many architects continues to explore new forms (Tersidis, 2004). The traditional space formation and proportions were gradually informed, transformed and reformed by computational and technological possibilities and digital processes. These processes have developed in the past few years with the intensive use of computation capabilities, where codes in architecture are now instructing certain attributes to a building form generating what is now known as Algorithm Aided Design (AAD).

The use of dedicated software solutions for the creation of three-dimensional building models is becoming vital in current architecture practices. Computer Aided Drafting (CAD) software and recently Building Information Modelling (BIM) makes creating complete logical-functional models of a project possible. The benefits of using this technology ranges from increasing architect's visualisation, abstraction skills and productions, improving visual communication of designed buildings while reducing design cost (Fiamma, 2003 and 2011).

In 1939, the Italian architect Luigi Moretti invented the definition "Parametric Architecture". Moretti in collaboration with the mathematician Bruno De Finetti when they investigated in their research the link between the different parameters and the dimension dependent on it in a project that was showcased in an innovative exhibition in Milan, in 1960. In his design of a soccer stadium, Moretti linked the parameters to viewing angles and economic feasibility, where he attempted to optimize views from every position in the stadium.

In the late 1980 the most profound progress has happened in architecture when designers tried to escape simple editing's and manipulated the software from the inside to find unexplored solutions through programming (Tedeschi, 2014). This resulted in creating more complex forms that are beyond human capabilities when allowing the computer to model through a step-by-step procedure or algorithm. The nature of an algorithm in mathematics is to run a procedure that perform a task or return a solution to a question through a finite list of well-defined basic instructions. Parametric or Algorithmic design allow the architect to be the editor of these algorithms using programs like Rhinoceros and Grasshopper developed By Robert McNeel & Associates in 2007 that will allow them to form complex geometries out of simple algorithms.

The increasing use of 3D printing, the wide-spread movement of fab labs, and the creation of innovation hubs or ecosystems in cities reinforce the idea that parametric architecture and digital fabrication technologies is rapidly becoming ubiquitous (Tedeschi and Andreani, 2014). Parametric urbanism in smart and sustainable cities is expected to become the target of architects today that are adopting procedural thinking not typological (Fusero et al., 2013). However, it is equivalently important that current architects respect occupant comfort and health while designing buildings especially ones that have holes due to the parametrisation process it had gone through.

2.3. Trypophobia and architecture

The repulsion of clusters of small objects or holes that are reminiscent of cluster of holes is what Trypophobia was defined with (Cole and Wilkins, 2013). The birth of this phobia is linked in its discovery to the rapid advancement of technology (Aminuddin, and Lotfi, 2017). The inducing stimuli may be a visual scene or an image that presents clusters of objects close in proximity to each other. It was also suggested that not only clusters of pumps or holes cause discomfort, but also clusters of other objects, like eyes, could stimulate an aversion reaction. Examples of these images are found in nature as seen in the patterns of a barnacles and honeycomb. Few researchers were capable of recording the symptoms of this phobia conditions such as sweating, discomfort, panic and even vomiting (Le 2015). Limited literature exists in relation to this condition and it has not yet been classified as a phobia by DSM-5.

By comparing the natural images to architectural ones, some spatial properties are common making them a possible tryphobia trigger and stress generator which could result in visual discomfort leading to headaches and seizures in susceptible people (Fernandez and Wilkins, 2008). Buildings can stress and stimulate its users by the amount of information it has in a setting or object that has different complexity, variety and intensity (Evans and McCoy, 1998). Parametric building designs for sure has a level of complexity and variety in its stimulation but too much stimulation is argued to cause distraction and overload that may interfere with users' cognitive process that may demand concentration. This research argues that current architecture trends like parametric architecture forms and spatial properties can cause distress to some individuals visual system in Arab cultures similar to that in the United Kingdom or Japan were other studies had taken place.

3. Research Methodology

Trypophobia is a psychological condition that has never been investigated in Bahrain before. Thus, the first logical step in the formation of the research design was to locate studies, which were done elsewhere in the world, and adopt their methodologies if possible to the Bahraini scene.

This research adopted the Trypophobia Questionnaire (TQ), a method for measuring proneness to tryphobia that was used in a number of studies in the UK and Japan before, see (Cole & Wilkins 2013; Le 2015; Chaya et al. 2016). Some researchers questioned the viability of the TQ, nevertheless, no alternative measuring tool for the condition yet exist. (Imaizumi & Tanno 2018) assessed the Rasch-based psychometric properties of the TQ measuring proneness to tryphobia. Their study concluded that although they were able to prove slightly improved psychometric properties by using the Rasch model, nevertheless, their findings were not conclusive enough to determine whether another version of the TQ should be used.

The Trypophobia Questionnaire (TQ) requires the participants to view pictures of stimuli's, in most cases, the Lotus Pod Seed and a honeycomb. Then to rate on a scale from "1. Not at all" to "5. Extremely" the degree to which they experienced the following emotions upon viewing the pictures:

1. Feel freaked out
2. Feel aversion, disgust or repulsion
3. Feel uncomfortable or uneasy
4. Feel like panicking or screaming
5. Feel anxious, full of dread or fearful
6. Feel sick or nauseous
7. Feel nervous (e.g., heart pounding, butterflies in stomach, sweating, stomach ache, etc.)
8. Feel like going crazy
9. Have an urge to destroy the holes Feel itchiness
10. Feel skin crawl
11. Have Goosebumps

12. Feel like crying
13. Vomit
14. Get chills
15. Have trouble breathing
16. Shiver

In addition to stimuli's from nature and for the purpose of this study, participants were also asked to view two pictures of buildings that have spatial properties closest to the natural stimuli's and rate again on a similar scale the degree to which they felt the emotions mentioned above.

The ethical committee at the University of Bahrain reviewed the questionnaire in December 2017, and the following month, a total of 117 responses from the public were collected by students in various places around the country using iPad of a similar size. On average, it took the participants about 7 minutes to complete the questionnaire. 64 female and 53 male participants took part in the study, the youngest of which was 18 years old and the eldest was 83. 44 of the participants completed the questionnaire in Arabic and 73 used the English version.

Survey Monkey was used to design the questionnaire and collect the data from iPad. Each of the questions in the survey was designed to answer one of the research inquiries. After asking for some demographic information, the first questions aimed to measure the baseline of the tryphobic population in Bahrain and the most experienced emotions upon viewing the images. The last question aimed at investigating the difference between reactions to natural and humanmade stimuli's.

All of the gathered data were stored in Survey Monkey in a secured account online. The data set was then organized using Microsoft Excel and processed using SPSS to find the relationship links between the responses.

4. Research Findings

The responses gathered by the contributing students and analysed by the research team demonstrated that 39.32% of the participants have indicated that tryphobic images affected them at least once a year, thus, can be categorised as tryphobic to at least a slight degree. 10.26% of the participants indicated that tryphobic images

affected them once every month or more, those can be considered moderately tryphobic and 8.55% of the participants' noted that tryphobic photos affected them once every week or more, thus, are severely tryphobic.

Participants' reaction to natural and manmade stimuli's needed to be compared. Results indicated that 73.5% of the participants did not feel any reaction towards natural stimuli's. Therefore, are not tryphobic". 26.50% of the participants had some degree of reaction to the natural stimuli's. Accordingly, the research findings indicate that the baseline for the tryphobic population in Bahrain is between 26.5% and 39.32%. It was also noted that in average 5.98% of the participants indicated that they experienced the reactions to natural stimuli's moderately and only 1.71% of the participants experienced considerable and extreme reactions.

The most experienced emotions to natural stimuli's were feeling uncomfortable or uneasy, feeling aversion, disgust or repulsion and having goose bumps. On the other hand, the least experienced emotions were feeling like crying, vomiting, having trouble breathing, feeling like panicking or screaming, feeling like going crazy and shivering.

The findings showed a difference in the respondents' reaction towards natural and manmade stimuli's. It was found that 85.47% of the participants did not feel any reaction to man-made stimuli's. In the other hand, 14.53% of the participants had some degree of reaction to man-made stimuli's, 5.13% had at least moderate reactions to the humanmade stimuli's and similar to natural stimuli's 1.71% of the participants experienced considerable and extreme reactions to man-made stimuli's.

As for the degree of reactions, the most severe emotions to humanmade stimuli's were feeling uncomfortable or uneasy and having goose bumps and the least severe were feeling like crying and having trouble breathing.

In conclusion, the findings indicated that reactions towards natural stimuli's are more severe than humanmade stimuli's, almost double. Nevertheless, responses toward humanmade stimuli's are still significant and are worthy of further exploration. 14.53% of the sample reacted in some degree to the humanmade stimuli's, and 1.71% reported severe reactions. This raises serious questions about the effects of humanmade stimuli's in our urban environment on the health of this percentage of the public if more buildings were designed in ways to induce tryphobia.

5. Discussion

The results of this study add to the accumulating body of literature that discusses visual discomfort in general and tryphobia in particular and are some of the very

few that linked the condition to architecture. Ruggiero et al. (2009) discussed the relationship between visual discomfort and the features of traditional architecture like symmetry and repetitive simplicity. In contrary, this study draws insight on the relationship between visual discomfort and contemporary parametric design.

The responses gathered in this study presented similar findings to the UK research of Cole and Wilkins (2013) and Le et al. (2015) and the Japanese study of Chaya et al. (2016). The results confirmed the sensitivity of some of Bahrain's participants to tryphobia inducing stimuli's. The Bahraini sample, similar to the Japanese represented a higher discomfort level than the British (Chaya et al., 2016, 2016; Cole & Wilkins, 2013;). This suggests the possibility that the substantial incidence may not be particular to Bahrain but generalize to Asia. Thus, the findings are of great importance to Bahrain and the region because such high levels of discomfort to both natural and humanmade stimuli's could easily cause headaches and seizures to vulnerable subjects (Fernandez and Wilkins, 2008).

The findings confirm that some of the contemporary architectural solutions deviate from the consistent spatial properties that are comfortable for the visual system to process. Such findings are in line with Ostwald (2004) claim that digital architecture is now becoming a nihilistic playground for architects who are interested in the generation of new forms. The paradigm shift in architecture has changed the basic principles of design, and the known architect's values, expectations, theories and knowledge in designing buildings and cities as concluded by Terzidis (2004). The results of this study could be used to suggest visual comfort guidelines to contemporary architects who are practicing in the digital paradigm; for instance, a stop function could be added to design software's when the created shape is no longer visually comfortable in a particular scale. Moreover, the findings here stresses the need to use visual comfort as a parameter that governs algorithms in parametric architecture, particularly when designing buildings that requires such special attention to the visual comfort of occupants like health care facilities.

The research findings showed that the reaction of the participants was stronger to natural versus man-made stimuli, which seems to be in accordance with the possibility recently raised by researchers that the phobia might be associated with an evolutionary residue of a reaction to toxin or skin disease.

There is a possibility to generalise the findings of this study to other neighbouring Arabian Gulf countries since similar cultural and behavioural patterns are dominating.

Nevertheless, country specific surveys are encouraged, particularly in the Gulf Cooperation Council as a next step towards the advancement of knowledge on visual comfort in the region.

Additionally, the understanding of visual discomfort generated by the contemporary designs of building should be the focus of design education in college. Students should learn at an earlier stage that although the computer software's of today allow the design of numerous highly complex shapes, they are not necessarily comfortable to the eye or healthy to their occupants and that the basic design principles of symmetry, harmony, contrast, hierarchy, and rhythm should always be the guiding principles to any design. This study recommends a more guided and informed digital design process for both architecture practitioners and students and that radical intervention to the basic design principles are tested for issues of visual discomfort.

6. Conclusion and Recommendations

This study investigated the baseline of the trypophobic population in Bahrain and the severity of the condition in comparison to other parts of the world. The Bahraini sample, similar to the Japanese in the literature, represented a higher discomfort level to stimuli's than the British, suggesting the possibility that the substantial incidence is not particular to Bahrain but generalize to Asia and that culture is a determining factor in perceiving discomfort.

The study also compared between the respondent's reactions to natural versus architecture humanmade stimuli's. The results indicated a significantly larger reaction to natural stimuli's, almost double, nevertheless; reactions to architecture stimuli's were also notable suggesting the need to carefully assess the level of visual comfort of new digital designs. The study recommends setting guidelines of visual comfort into design software's to alert designers when they deviate from the comfortable spatial properties that are comfortably processed by the human brain.

Acknowledgement

This research was made possible because of the generous contribution and support of the Deanship of Scientific Research at the University of Bahrain. The funding was used to hire students to collect survey responses and to purchase software's for data sorting and analysis.

References

- [1] Aminuddin, I. and Lotfi, H.A., 2017. Understanding tryphobia: the fear of holes. *Malaysian Journal of Psychiatry*, 25(2).
- [2] Chaya, K. et al., 2016. Fear of eyes: Triadic relation among social anxiety, tryphobia, and discomfort for eye cluster. *PeerJ*, 4(9).
- [3] Cole, G. and Wilkins, A., 2013. Fear of Holes. *Psychological Science*, 24(10), pp.1980-1985.
- [4] Cordero, E., 2001. *Sustainability in Architecture* (Doctoral dissertation, Massachusetts Institute of Technology)
- [5] Evans, G.W. and McCoy, J.M., 1998. When buildings don't work: The role of architecture in human health. *Journal of Environmental psychology*, 18(1), pp.85-94.
- [6] Fiamma, P., 2003. Architectural design and digital paradigm: From Renaissance models to digital architecture. In *Connecting crossroads of digital discourse* (Proceedings of the 22nd Annual Conference of the Association for Computer-Aided Design in Architecture). India-napolis: ACADIA (pp. 247-253).
- [7] Fiamma, P., 2011. Architecture: from Generative Design. DISEGNARE CON, pp.152-161.
- [8] Fusero, P., Massimiano, L., Tedeschi, A. and Lepidi, S. (2013). Parametric Urbanism: A new frontier for smart Cities, *Planum, The Journal of Urbanism*, 27(2), pp. 1-13.
- [9] Imaizumi, S. & Tanno, Y., 2018. Rasch analysis of the Tryphobia Questionnaire. *BMC Res Notes*, 11(128).
- [10] Kupfer, T.R., Le, A.T.D., 2018. Disgusting clusters: tryphobia as an overgeneralised disease avoidance response. *Cognition and Emotion* 32, 729-741.
- [11] Le, A.T., 2015. *An exploration of tryphobia* (Doctoral dissertation, University of Essex).
- [12] Oxman, R., 2008. Digital architecture as a challenge for design pedagogy: theory, knowledge, models and medium. *Design Studies*, 29(2), pp.99-120.
- [13] Ruggiero, F., Florensa, R. S., & Dimundo, A. 2009. Re-interpretation of traditional architecture for visual comfort. *Building and Environment*, 44(9), .1886-1891
- [14] Stavric, M. and Marina, O., 2011. Parametric modelling for advanced architecture. *International journal of applied mathematics and informatics*, 5(1), pp.9-16.
- [15] Tedeschi, A. and Andreani, S., 2014. *AAD, Algorithms-aided Design: Parametric Strategies Using Grasshopper*. Le Penseur Publisher.

- [16] Terzidis, K., 2004. Algorithmic Design: A Paradigm Shift in Architecture? *Architecture in the Network Society [22nd eCAADe Conference Proceedings/ISBN 0-9541183-2-4] Copenhagen (Denmark) 15-18 September 2004, pp. 201-207, pp.201-207.*