What to Consider in Designing Appropriate Interior Spaces for Children with Autism

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Abstract: The primary aim of this study is to investigate the role of 'colour and light' on the perception of children with autism and to indicate the most preferred colours and lights for an interior environment for them. Related documents were reviewed from studies published in journals, books, internet sources etc., also data collation was done in a local special learning school in the city of Famagusta; Northern Cyprus called 'Special Education Centre' (Özel Eğitim Merkezi). The centre cares and treats children with autism. Finally, in the study, a comparison between literature review outcomes and the results from the field study was done. Consequently a 'checklist' was prepared as a guiding light for architects and interior designers to help them in the design of living spaces for people who have autism.

Key words: Autism, Autism sensory, Architecture and autism, Light, Colour.

1 Introduction

The word autism belongs to the Greek word 'autos' that is used for people out of touch when it comes to social interactions. The word was coined over 100 years ago and it has been used since then (WebMD, 2013). The popular use of the word in our world today began in early 1943 when psychiatrist Leo Kanner observed that 11 of his most highly intelligent students were continually obsessed about loneliness and showed different attributes at certain times of insanity. These encouraged him to delve into a deeper understanding of this area (Baker, 2013). Autism still is a vague issue with just a little notion of it being linked to a specific part of brain's malfunctioning which in turn affects the neurological system and makes people with autism do abnormal behaviours. Thus, such patients have serious abnormalities in their daily life.

There are many factors that are participating in the syndrome of 'autism'. These include neurological injury attributable to birth and genetic factors (Fullerton, Stratton, Coyne, & Gray, 1996) etc. Psychological research centres and autism organizations declare the threat of the problem and attempt to reduce the effectiveness of autism over society via various media publications, awareness schemes and new ways of treatment. However, the problems and issues related to architecture and interior architecture have not received enough attention yet. Thus, very little endeavours so far have been put in researching autism patients' needs when it comes to space design.

The contribution this study hopes to bring is simply providing a design checklist for light and colour to help architects recognize various effects that these have on children with autism. Therefore through the study, it has been tried to create various markers that will help interior designers when designing an interior space environment for people with autism at home or in the learning centres.

Exploring the needs of people with autism starts from testing their sensory perception of each colour and light type as they have a different visual sensory that has impacts on the brain. For these patients, the malfunctioning of this visual sensory is what architects should pay attention to in designing. Understanding their psychology in view of their reactions to surroundings will permit architects to translate these aspects into architectural interpretations and to design fulfilling environments which help those with autism. Participating architecture in this case, therefore, is very crucial, because having a suitable environment, especially in interior spaces would offer people with autism an environment that responds to their needs and help in concentration when it comes to learning and returning to the real life after treatment and medical interventions.

2 Methodology

The methodology of the study basically is a comparison between the obtained data from the literature review and a case study which was realized as a part of the research and evaluating all the results together. It should be noted that the data collected in the field study mainly were based on interviews and questionnaire responses of teachers and trainers from Special Education Centre in Famagusta, North Cyprus. This centre is the only place where children with autism are treated and cared for in the city. However, the children who attend this centre are not all diagnosed with autism; the centre also includes children with various forms of mental disabilities.

The purpose of this work as already has been stated is to prepare a checklist for designing interior spaces for children with autism. Special evaluation techniques were put in place as well as document reviews and data collection from the autism centre on reactions, modes, behavioural pattern, responses etc. of people with autism. The stages followed were as below:

1 An inclusive literature survey has done to find out the issues related to the perception of colour and light by people with autism.

2 This information has been transferred to a list of issues to be considered in relation to colour and light usage in the interior spaces for these users.

3 Using the above mentioned studies a questionnaire containing both open-ended and close-ended questions has been prepared and distributed to the people working in Special Education Centre.

4 Interviews were done with 4 families of children diagnosed with autism.

5 The results of the questionnaires and interviews were compared with the results of the literature survey.

6 As the last step of the study a comprehensive check list related to the usage of light and colour in interior space for people with autism has been prepared.

3 Autism

Generally, autism can be diagnosed by lack of social communication, social interaction and social imagination . Autism has many characteristics as Al-Saad (1998) argues, like psychiatry impairment which leads to preferring staying alone most of the times, language and communication deficiency, sensory abnormalities to light, colour and acoustical problems. Accumulatively these result in low self-

esteem and other social infringement. It is also common for them to be confused about what is happening in their surroundings and they have rarely the capability to read other people's emotions like sadness, sarcasm, happiness etc. (URL2, 2012).

Ahrentzen, Steele, and Christensen (2009) state some diagnostic behaviours of people with autism or Autistic Spectrum Disorders (ASDs) as excessive daily routines, OCD (Obsessive Compulsive Disorder) which shows of as repeating watching the same video, having the same food, maintaining in the same place, resisting to change his/her surrounding things, having some kind of repetitive hand or arm flapping and walking on their toes.

3.1 Autism Sensory Sensitivity

People with autism have difficulties with sensory system meaning visual, olfactory, gustatory, tactile and auditory senses. According to a scholar research done by 'The National Autistic Society' (URL3, 2014), people with autism are either hypersensitive or hyposensitive. "The hypo-sensitive individuals need stronger input stimulators to their nervous systems to respond it. An example can be a child with having no pain or proactive in seeking things" (Shareef & Farivarsadri, 2016, p. 23). On the other hand people with hyper-sensitive autism may be distracted by most of the environmental stimuli. This is a more common type of autism and also they are more affected by the environmental conditions. That's why in the scope of this study this type of autism (hyper-sensitive) is considered.

3.2 Architecture and Autism

The responsibility of architecture has exceeded far from creating shelters or a protective cover from the environment for people. Rather it has become more scientific, advanced and receptive to changes in society. Changes in people's lifestyle, economy, and natural disasters and so on, affect architecture and architecture reacts to and reflects those changes in turn. But architecture's participation to autism issue seems to be very limited so far.

Considering the needs of people with ASD when it comes to sensory perception, Mostafa (2008, 2014) describes a sensory design theory, which means the more favourable an environment is, the more positive effect is on ASDs learning outcomes. Visual aids like proper room colour (i.e. painting) can be supportive tools to help people with autism; also proper room lighting can be constructive for presenting visual materials and for calming down their distorted minds, especially natural lighting or daylight. That is why it is proposed that natural lighting should be considered in a high range in designing spaces for people with autism.

McAllister (2010), proposes an inclusive design concept for educational spaces for people with autism which includes total depriving of outer influences, so as to give them a better chance to concentrate and learn as much as they can. Proper room closure and good space management are also vital. According to McAllister, a calm, well-designed space in regards to proper natural light distribution with suitable colour affects people with autism to be psychologically prepared for better listening and concentration. At the same time, McAllister addresses that the environment should be convenient also for teachers so as to help them teach in a proper way.

Further understanding of the issues mentioned above is detailed below and colour and light as important elements of space are discussed.

3.2.1 Colour

Colour is one of the variables which probably have many influences on human

psychology, and it has a critical effect on ASDs' perception. Colour has many classifications and specifications which would make it impossible to cover it all in this study. Thus, only categories which have direct relationship with the paper's purpose will be mentioned.

Colours can be classified as:

1 Warm colours: yellow, orange and red

2 Cool colours: green, blue and purple.

3 Neutral colours: black, grey and white (URL4, 2014).

The characteristics of colour: Elliot (2015) refers to various classification methods which colours can be arranged accordingly. The three perceived attributes which are used to define the colours are hue, value, and saturation (Chroma).

1 Hue: hue is the name of the colour, or the pure spectrum colours.

2 Value: it defines the darkness and lightness of a colour. Black and white when added to a colour would change the value of that colour from one degree to another and converts its colour's saturation. Various tints, tones and shades of colours can be created according to how much white, grey or black are added to the main hues.

3 Saturation or Chroma: it represents the intensity or purity of the colour. In other words the dominance of the basic hue of colour from the colour wheel. (URL5, 2017)

Colour has psychological effects on people with autism as they are sensitive to colours. According to Cherry (2012), soft colours comfort and bright colours fascinate people with autism. He argues that beneficial colour could change from one person with autism to the other. Therefore it is important to determine a colour with positive effect for a single patient and this process can be undergone by leaving them under the influence of a colour for a long time under observation to get the right result. Cherry (2012) illustrates the effects of different colours on human perception as below:

1 Red: Stimulates the mind, increases appetite and blood circulation.

2 Bright yellow: Overstimulates and reflects light.

3 Pale yellow: Causes calming in mind.

4 Blue: Reduces blood pressure and keeps calm,

5 Green: Related with nature and inspiration, Soothing.

6 Orange: Disturbance and overstimulation.

7 Rose or Light pink: Soothing. (Cherry, 2012)

Also, Torky, AbdelRahman, and Rashed (2013) recommend the use of soft and neutral colours for children with ASD. When designing spaces these colours can be used for the ceiling, floor, wall, and furniture. They mention that applying pale grey is a convenient way of using colour and near to perfect for people with autism. They emphasize also on the importance of homogeneity in colour.

Further researches have been made to define the ASDs' preferred colours. (URL3, 2014) states that because of having Visual Hypersensitivity in ASDs, it is

proven that they suffer from red and yellow colours and some of them do not have the ability to see blue. So architects should take these into consideration.

Tucker (2013) refers to the interior designer Carolyn Feder (an expert interior designer working on spaces for people with autism) who suggests tranquil hues such as pale blue, soft green and muted purple as the most suitable colours for ASDs, because Feder believes that people with autism need a calm environment and assumes that soft hue colours would have the potential to give spaces that kind of tranquillity. Likewise, neutral colours like 'Ivory, beige, light mocha, muted teal and soft grey are muted colours which can be used in their spaces.

Finally, it should be noticed that although white is a neutral colour use of it alone should be avoided as it may remind the children with autism unpleasant doctor visits (Anous, 2015).

In summary based on researches Elliot (2015); Cherry (2012); Torky et al. (2013); Mostafa (2008, 2014); Tucker (2013) done on perception of colours by people with autism the following points related to the use of colours in interior spaces for people with autism can be concluded:

1 Avoid saturated and bright colours because they cause glare and make eyes uncomfortable in certain situations.

2 Using red and yellow (saturated warm colours) should be avoided.

3 Use neutral colours like Ivory, beige, light mocha, muted teal and soft grey but avoid using white.

4 Use tranquil hues like pale blue, soft green and muted purple (cold colours).

5 Use pale grey.

6 Homogeneity in painting should be considered.

7 Blue can be applied in some situations but it should be remembered that some of them cannot see it.

3.2.2 Light

Light does not have a concrete definition as a result of its diversity of meaning when it comes to its experience, perception, view, and knowledge. However, when it comes to physics it can be defined as an 'emission of electromagnetic rays' (Pradhan, 2015). Stark (2014) describes light as 'electromagnetic radiation' perceived by the human eye. This radiation happens over an enormously wide range of gamma. The human eye can translate light so as to detect surroundings, it is the way to see and recognize things. Light sources can be divided into natural and unnatural (artificial) lighting.

Natural lighting: It can be easily said that it is a light which comes from the sun. It is known as white light but actually consists of a spectrum of colours inside. Human eyes have a limitation to see all of the rays of the day light and mainly can see from red to violet in the colour spectrum, the infrared and ultraviolet rays are invisible to human eyes.

Unnatural (artificial) lighting: It is a kind of invention by the human to substitute natural lighting when the sun is absent. Candles, oil lamps, fire itself, electrical lamps and laser are all artificial lightings. But nowadays electrical lamps have a great contribution to our lives and have many kinds of sources, as is mentioned in (URL6, 2014):

1 Tungsten filament bulbs: it is a type of light used in households. It is made up of a thin metal inside a bulb that becomes hot when electric waves pass through it and glows to produce light in yellow-white colour.

2 Neon lights: It is a gas-based type which basically consist of a closed glass bulb or tube filled with a kind of inert gas. When a voltage is given to the electrodes at the end of the glass the gas begins to glow. It can have various colours.

3 Fluorescent tubes: Fluorescents are gas conceptive models, consisting of a tube filled with a mercury vapour, when electricity passes through the gas it gives off ultraviolet light. This ultraviolet light is absorbed by the phosphorous powder that coats the inside of the tube and is changed into a white light.

4 LED: Light-emitting-diode is the newest artificial model of lighting, a tiny electronic device that emits light, and has the ability to produce various coloured lights. (URL7, 2014)

Lighting is among the sensory sensitivities for people with autism and it has influences on their perception of space depend on whether the natural or unnatural lighting have been used. Generally, natural lighting benefits both mental and physical well-being of human, because it is the best for the eye as it includes the whole range of ray spectrum perceptible by the human eye and man has adapted to its use from past times. Therefore, any changes in this spectrum can influence human and create provocativeness or some abnormality. The issue is probably more different for people with autism because they are not only being affected by the light, they might even suffer because of it. '(URL3, 2014) describes the possibility of distracting effect and suffering of ASDs in places that are lightened by Fluorescent or harsh lighting due to flickering and hums. One of the advantages of the use of natural lighting over fluorescent is its full spectrum feature. Thus, whenever possible full-spectrum lightings should be used as 'Full-spectrum lighting has colour rendition that is much closer to natural light than fluorescent lighting' (White, 2009).

Torky et al. (2013), propose using natural light through clerestory windows to avoid noise effects as well as surrounding distractions. Furthermore, avoiding industrial lighting types like fluorescent that have flickers is also suggested. Thus, in this case, natural light can be brought in by allowing proper orientation of the openings with the least possibility of glare inside. Proper natural light infiltration into the room or space can be conducted through designing skylights and tall sided windows as White (2009) suggests.

In conclusion, lighting for ASDs' space is very important and it should be taken into consideration. For that reason, the following points can be considered while deciding about the lighting in spaces for ASDs:

1 Use natural light in every place as much as possible.

2 Avoid flickering artificial sources like fluorescent lights.

3 Conceal light sources which give direct light towards the eyes to avoid glare.

4 Use dimmers to adjust the light amount as needed.

5 Use controllable curtains for the side windows to control the amount and direction of the light.

4 The Survey

To test the validity of the above mentioned factors and to see whether they match with the experiences of the people working in the field, the teachers in Special Education Centre in Famagusta, Northern Cyprus were asked to answer the questionnaires related to the effect of colour and light on children with autism. 31 teachers in the centre participated in the survey. Figure 1 shows the years of work experiences of these teachers in the Centre.

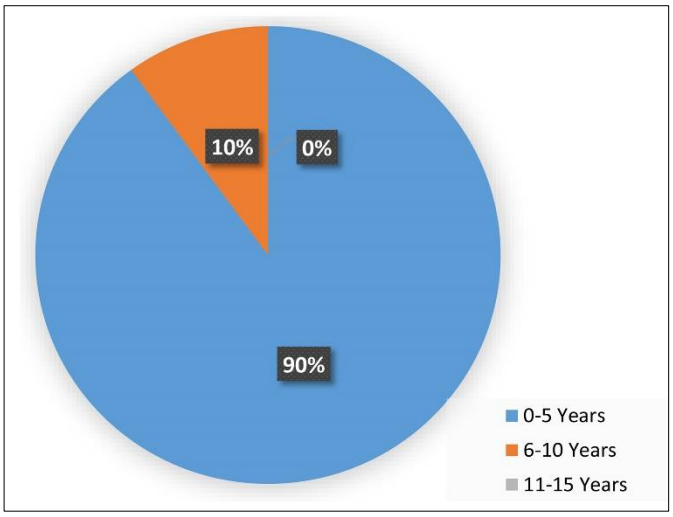


Figure 1. Teachers' experience in Special Education Centre

4.1 Data analysis of the questionnaires

4.1.1 Colour

As the first part of survey a set of colours (red, yellow, grey, green, blue and white) were shown to the participants and they were asked to separate the positive and negative colours for children with autism. As can be seen in Figure 2 most of the teachers (more than 70%) believed that each of grey, green, blue and white have a positive impact on children with autism in the classes when red and yellow have adverse effects on them.

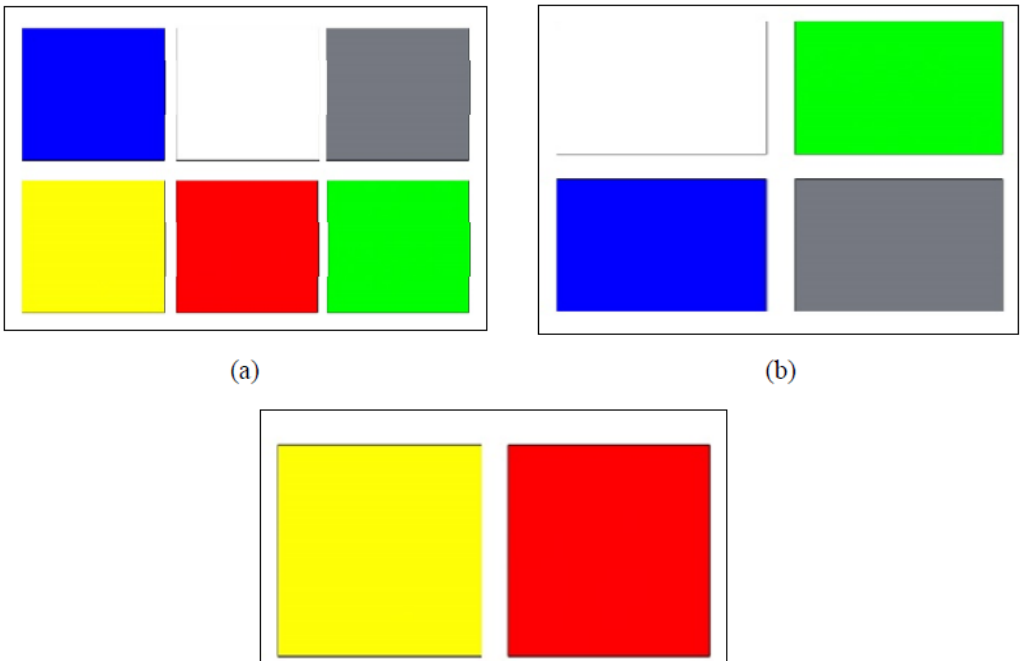
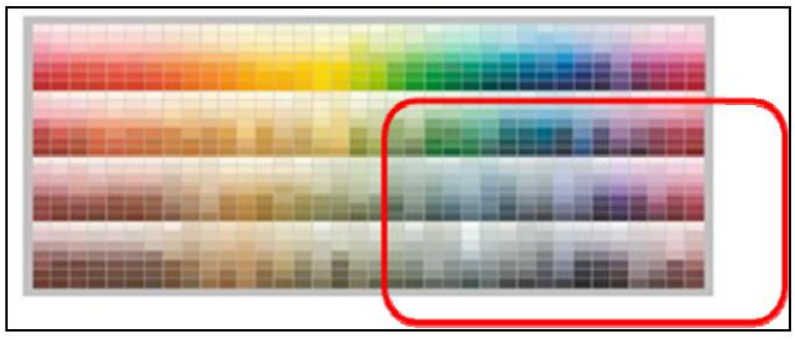


Figure 2. (a) Mentioned colours (b) Positive colours (c) Negative colours

They also preferred secondary and intermediate cold colours more than primary colours as well as dull or pale colours, not the strong saturated ones and explained the positive and negative roles of these colours on people with autism. Figure 3 demonstrates the acceptable zone of colours mentioned by the majority of the teachers.



Source: URL8 (2013)

Figure 3. Acceptable zone of colour, less saturated, and muted cold colours

Table 1 Coinciding and differences between the literature and the field study

	Literature	Field study
1	Applying secondary colours vs basic colours	Equivalent
2	Using cool colours	Equivalent
3	Using neutral colours	Equivalent
4	Accepting subdued hues	Equivalent
5	Applying less saturated colours	Equivalent
6	Avoiding the basic value of colour	Equivalent
7	Avoiding warm colours (yellow & red)	Equivalent
8	Using natural light as much as possible	Equivalent
9	Avoiding fluorescent lighting sources	
10	Grey colour: has no effects	Positive and negative
11	White colour: if it is used alone is negative	Positive
12	Blue colour: some ASDs might not see it	No information

4.1.2 Light

Almost half of the teachers accepted that both natural and artificial lighting have effects on people with autism but they appreciated the use of sunlight whenever possible. Meanwhile, they believed that in some cases artificial lighting might increase ASDs' concentration on learning, as well they preferred indirect lighting using in both cases. But 80% of the participators stated that applying coloured lighting in autism spaces may change their perception of the reality. Furthermore, generally (more than 95%) did not prefer using fluorescent lighting sources because of having flickering and negative influences on people with autism.

5 Result and discussion

Evaluation of data collected in the field of study and comparing with the information obtained in the literature survey it was tried to find the matching parts and the differences. Accordingly, an inclusive checklist (table 1) has been prepared to be used by the designers working on this subject.

Grey is reported as a neutral and non-reflective colour which is widely applied in spaces for people with autism, it is claimed that it has neither a positive nor a negative influence (Whitehurst, 2006). Blue also is accepted as a colour which can be applied to spaces for people with autism even though it might not be seen by some of them.

For evaluating the actual effects of white, as it was different in the two sources, 4 different families of children with autism were asked about possible effects of white colour on their children based on their experiments and the result was found to be negative. Three of the families implied that their children with autism were not happy with the white colour.

Preferred light types to be used in spaces for people with autism:

1 Sunlight: indirect

2 Tungsten light: indirect to eyes

3 LED light: indirect to eyes with white colour

Conclusion

The evaluation of the literature review and an actual experimentation in the field both have been employed for understanding what colours and light types should be used in the spaces for children with autism. It is believed that the teachers of autism schools can also realize the needs of their students and pupils. In addition, the experiences of families with ASD children can be very valuable in this sense too.

Design of spaces for people with ASD needs to be based on knowledge about how these people perceive the world and react to the elements of space. Unfortunately not many sources are available to architects and designers in this regard. Thus, this study tries to at least partially fulfil this need for comprehensive information related to the subject by providing some checklists in relation to two very important elements of space, light and colour. No need to mention that to have a well-designed space for people with autism all elements of space and their effects on these users should be considered carefully which justify the needs for more inclusive and detailed further studies on the subject.

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Table 2 Demonstrates the more suitable colours for people with autism as the result of the studies:

Values	Shades	Tints	Tones
Blue			
Green			
Purple			
Neutral colours	Cocoa, Taupe, Grey	Cream, Ivory	

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