

Considerations in Design of Interior Spaces for Autistic Children

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ABSTRACT

Autism nowadays has become one of the most prominent neurological disorders around the world. Despite having many medical and psychological endeavors and educational programs autism rate is increasing annually. Autism is a neurological disorder that is why finding a definite treatment seems to be difficult. Furthermore, especially in developing countries there is a lack of information about autism and how to behave with autistics, for that, many autistics get no education and do not have a chance to communicate with other people. This creates social, economic, and psychological problems in society. From 2000s onwards there are few attempts to search about autistics' needs in physical environment pertaining to architectural design. However, the disorder requires more research and observation to know which spatial qualities may enhance their performance in learning process, and encourage them to participate in the normal life. The Purpose of this study is to prepare a comprehensible design checklist for architects and interior designers to be used in design of spaces for autistics. The study focuses on children with autism at age 3-7 years while they are in preschools and kindergartens and preparing to go to primary schools. The design checklist is prepared based on the data obtained from literature survey as well as the information gained from the experts as psychologists, sociologists, and therapists who worked in autism centers and parents and siblings of autistics who answered the questionnaires. For that reason, two autism centers were chosen in Iraqi-Kurdistan as case studies. The result of this research is a collection of findings related to autistics' sensitivities in space, related to their seven senses. More interpretations have been done to translate this information to find what makes autistics comfortable to be used in spaces and what makes them distracted to be

avoided in the physical environment. This research highly recommends this design checklist to architects and interior designers who intend to design spaces for autistics, as it includes many design considerations for autistics based on a scholarly research.

Keywords: Autism, sensitivity in autism, universal design, senses of space, autism and interior space.

ÖZ

Günümüzde Otizm dünyadaki en önemli nörolojik düzensizlikler arasında yer almaktadır. Tıp ve psikolojik alanda gerçekleşen birçok girişim ve eğitsel programa rağmen otizm hala hızlı bir şekilde yayılmaktadır. Otizm nörolojik bir düzensizlik olduğundan ona kesin bir tedavi bulmak zor görünmektedir. Ayrıca, özellikle de gelişen ülkelerde otizm ve otistik insanlarla nasıl davranılması gerektiği hakkında bilgi eksiktir; bu nedenle birçok otistik insan eğitim alamıyor ve diğer insanlarla iletişim kurma şansı olamıyor. Bu da toplumda sosyal, ekonomik ve psikolojik problemlere yol açar. 2000'li yıllardan başlayarak mimarlık tasarımıyla ilişkin otistiklerin çevrede ihtiyaçları ile ilgili birkaç araştırma girişimi gerçekleşmiştir. Ancak, hangi mekânsal nitelikleri otistiklerin öğrenme sürecini ve onların normal hayata katılımlarını geliştirebileceği konusunda daha fazla araştırma ve gözleme gereksinim vardır. Bu çalışmanın amacı, otistikler için mekân tasarımında kullanılmak üzere mimarlar ve iç mimarlar için kapsamlı bir rehber hazırlamaktır. Çalışma 3-7 yaş arası kreş ve ana okulda olan ve ilkokula gitmeye hazırlanan otistik çocuklara odaklanmaktadır. Bu rehber, literatür taramasından ve otistik çocuklarla çalışan psikologlar, sosyologlar, ve terapistler gibi uzmanlar ve otistik çocukların aileleri ile yapılan anket sonucunda oluşan verilere dayanarak oluşturulmuştur. Bu nedenle Irak Kürdistan bölgesinde iki otizm merkezi araştırma alanı olarak seçilmiştir. Bu araştırmanın sonucunda hem çok duyarlı, hem az duyarlı otistik bireylerin yedi duyusuna bağlı olarak oluşan mekânsal öğelere karşı hassasiyetleri ile ilgili veriler toplanmıştır. Bu veriler fiziki çevrelerde otistikleri rahatlatmak için kullanılması gereken ve onların dikkatini dağıtan ve mekânda kaçınılması gereken öğeleri bulmak üzere yorumlanmıştır. Araştırma, otistikler için mekân tasarlamaya

niyetlenen mimarlar ve iç mimarlara bilimsel arařtırmaya dayalı ve otistikler için mekân tasarımında dikkate alınması gereken birçok hususu barındıran kapsamlı bir tasarım rehberi sunmaktadır.

Anahtar kelimeler: Otizm, otizmde duyarlılık, evrensel tasarım, mekân algısı, otizm ve iç mekân

To all families with autistic children, and my family (Hozan, Saryan and Nwa), also to our parents and siblings.

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Chapter 1

INTRODUCTION

1.1 Background Information

Autism as a term is not new. In fact, its first use dates back to the ancient Greeks and it is originated from the word of ‘autos’ which was used for some people who had no social interaction (WebMD Medical Reference, 2013).

In 1943, psychiatrist Leo Kanner, identified autism as a disorder. During some observations he could distinguish 11 students of producing similar outputs in behavioral activities (Jeffrey and Baker, 2013). Since then, people have tried to find out the causes and factors increasing the syndrome. The word autism as a syndrome has been used for almost 70 years. Autism has remained a bit vague and has been attached to a specific part of brain. A malfunction of the neurological system gives Autism patients some semi-abnormal behaviors which affect their daily routines. The autism society of America now defines autism as “the result of a neurological disorder that affects functioning of the brain” (The autism society of America, 1993).

Autism situates on mental and developmental challenges as a branch of Pervasive Development Disorders (PDDs) under the ‘special needs’ diagram, however, autism seems to be linked with sensory challenged branch, as some individuals diagnosed with autism have difficulties with sensory impairments, as shown in figure (1) which was presented by Mostafa (2003).

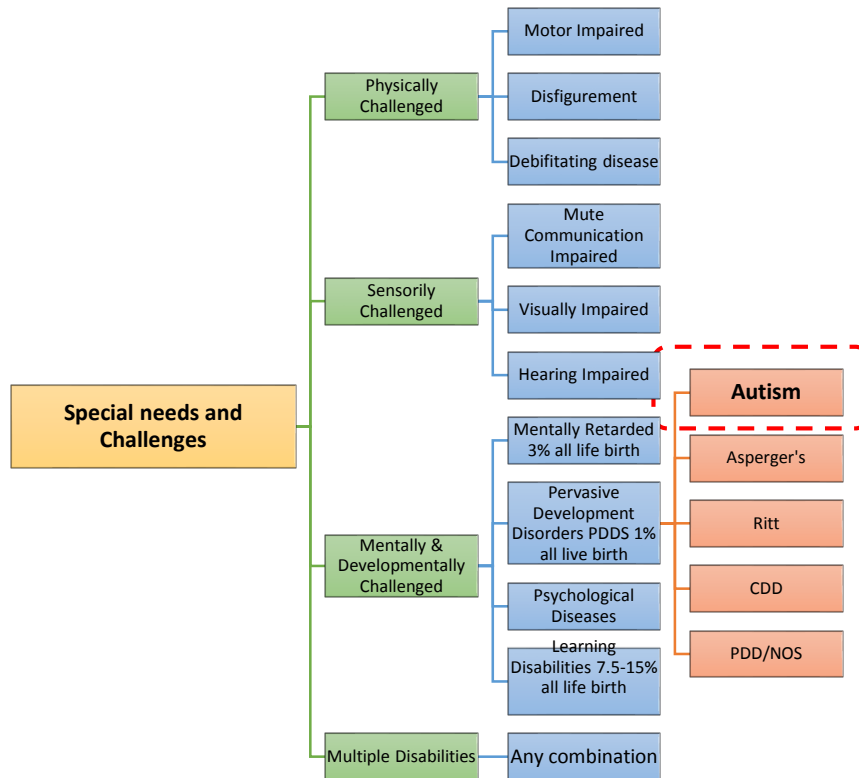


Figure 1: Illustrated chart of 'special needs' arrangement (Mostafa, 2003)

Fullerton et al. (1996) believe that many factors are responsible for autism, like genetics and neurological injury during birth. Meanwhile, many medical researchers have some doubts about some vaccines because it was found that autistics' brains contain more amount of mercury compared to normal brain. This was seen as an evidence of vaccines' effects on increasing autism as vaccines contain considerable amount of mercury (Null, 2013).

Autistics could be diagnosed through their lack of social communication, social interaction, and imagination. Their dysfunction of mind causes many bizarre behaviors, such as repetitive activities, hand flapping, rocking, losing eye contact, persisting on some limited daily routines and difficulties to learn new things (Mostafa, 2003). Furthermore, many families are unaware of autism due to lack of information on it.

During the observations and questionnaires of this research it was found that many parents who have autistic children do not have a proper understanding of the disorder and what is a suitable space for autistics. Few of them accept that their children have autism that is why there is a little number of autistic children in autistic centers. It has been seen that some of the autistic children live under a sever situation imposed by their parents, because they are treated as “mad” and are handcuffed in private rooms.



Figure 2: An autistic child handcuffed by her parents in Hajyawa district near Ranya.

Besides all these draw backs which autistics have in life, some people with autism have special talents in some various fields such as playing music, paintings and in some scientific fields. For instance, Albert Einstein and Isaac Newton had autism according to autism expert Simon Baron-Cohen. But in a form of condition which did not cause learning difficulties in them (Cited in Muir, 2003). “People with Asperger's syndrome [high functioning autism] have difficulties with communication and social interaction but can show an unusual, often obsessional, talent or skill in a particular area” (Burleigh,2015). This diversity in autism types

requires experts in the field to make more efforts in diagnosing. The nature of being different from each other, gives autistics special attitudes which may offer architects and interior designers a real challenge in design, for the sake of providing an equivalent space, a space which could have potentials of changing autistics' life.

Baron-Cohen, at Cambridge university and Ioan James from Oxford University dealt with the personal traits of Albert Einstein and Isaac Newton, and they found the main symptoms of Asperger syndrome which are: difficulty in social relationship, communication problems and obsession in some interests. Newton was not a talky



Figure 3: Isaac Newton (URL3)

person, he always concentrated on his works, and actually, he often forgot to eat. He had very few friends and he was indifferent with them. Few people attended his lectures and sometimes he spoke for an empty room. At the ends of his age, he had a severe depression. (Muir, 2003)

Einstein was a loner boy with obsession in repeating some sentences, he could not speak well until seven years old. Again he had several intimate friends, and he was notorious for his confusion during lectures. He had trouble with social interactions, for that despite his intelligence he was not successful to easily find a job.

Einstein's family life was difficult with his wife, because of unusual behaviors. He had three children and because he had tactile sensitivity, he did not let them touching him. This sensitivity is an evidence on Einstein's being autistic (URL1).

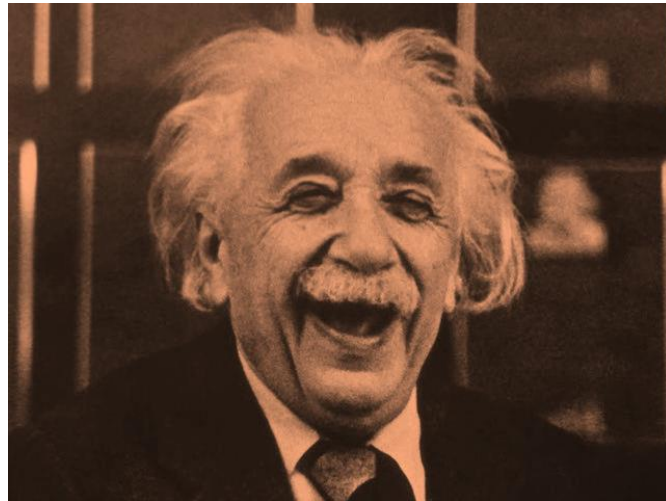


Figure 4: Albert Einstein, who had autism (URL2)

According to Smith (2009), Charles Darwin also had autism obviously. "...He avoided socializing and took long solitary walks, walking the same route daily. He was a compulsive letter writer, but these were almost devoid of social chat... He was a rather obsessive-compulsive and ritualistic man."

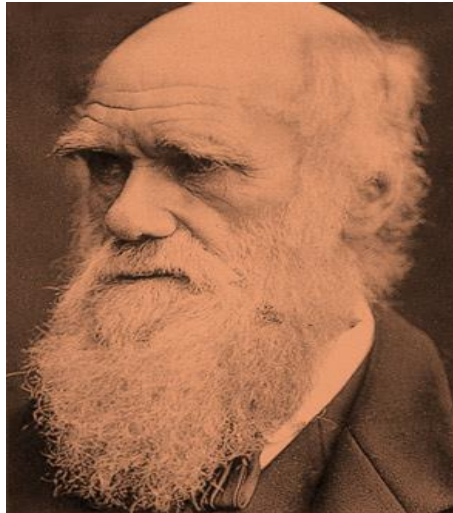


Figure 5: Charles Darwin (URL4)

Also, Michelangelo, the famous artist of his time suffered from autism. Smith stated that: “Michelangelo’s single-minded work routine, unusual lifestyle, limited interests, poor social and communication skills and various issues of life control appear to be features of high-function autism or Asperger’s syndrome” (Burleigh,2015).

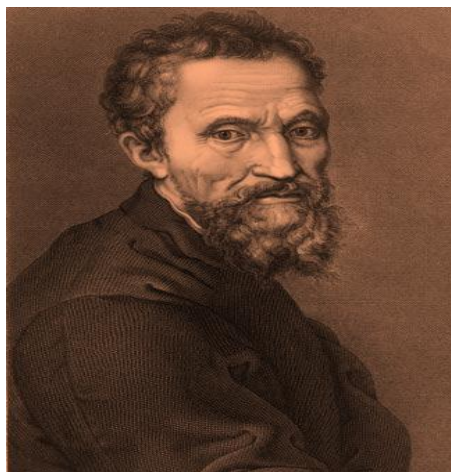


Figure 6: Michelangelo (URL5)

Also some other famous people like Hans Christian Andersen, Andy Warholl, and Emily Dickinson had autism as well (URL1).

Many studies like Al-Saad (1998), Schopler and Mesibov (1994), and Koegel and Koegel (1995), state that a necessary and a sufficient education, also surrounding environment have the ability to improve autistics' mental capacity. Furthermore, some studies reported that interior space quality can change behavior of children with autism. "An appropriately designed built environment will help to reduce undesirable behavior [by those with ASD] which will contribute to learning [within elementary school]" (Lock, et al, 2011).

Since 1970s in the United States the rights of disabled people came in to considerations in the territory of design, the designs were thought in a way to be barrier-free for people with special needs. This barrier-free design was called universal design.

This design could be defines as "...that can be used by everyone, regardless of age, gender or disability. It is made up of many elements such as society's and individual's attitudes, the design of products and communications and the design of the built environment itself" (ODPM, 2003). Simply realizing from this definition, it can be said that inclusive design is a process not an event, which should be considered during designing for human need, this need may be a gadget or an environment so as not exclude any human being from using it.

'Inclusive design Toolkit' which is a page administering by University of Cambridge explains inclusive design as "The British Standards Institute (2005) defines inclusive design as: 'the design of mainstream products or services that are accessible to, and usable by, as many people as reasonably possible... without the need for specialized adaptation or design'" (University of Cambridge, 2015).

Terms like universal design, design for all, human centred design, green design and life span design refer to an approach which is called inclusive design theory. Universal design could be substituted by Inclusive design when human demands as economy and social needs were interacted, “Inclusive Design is an alternate formulation emphasizing that Universal Design must be aware of social and economic difference and include the participation of users throughout the design process” (Rains, 2009).

So as to understand better of universal design, its principles have to be explained. There are seven principles for universal design which are prepared by North Carolina State University:

PRINCIPLE ONE: Equitable Use

The design is useful and marketable to people with diverse abilities.

PRINCIPLE TWO: Flexibility in Use

The design accommodates a wide range of individual preferences and abilities.

PRINCIPLE THREE: Simple and Intuitive Use.

Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level.

PRINCIPLE FOUR: Perceptible Information

The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities.

PRINCIPLE FIVE: Tolerance for Error

The design minimizes hazards and the adverse consequences of accidental or unintended actions.

PRINCIPLE SIX: Low Physical Effort

The design can be used efficiently and comfortably and with a minimum of fatigue.

PRINCIPLE SEVEN: Size and Space for Approach and Use
Appropriate size and space is provided for approach, reach, manipulation, and use regardless of user's body size, posture, or mobility (NC State University, 1997).

From the principles of universal design, an idea would be formed about how designers and architects can create such a barrier free environment for autistics having potential to embrace all sensory needs of them. Autistics have very delicate situation, and a very intensive attention have to be considered to calm them down. The concept of universal design then inclusive design has come from considering physical disables, children and elder people's requirements. However, the situation seems to be critical for a case such as autistics, who they have problems in brain.

Mostafa (2003) believes that it is impossible to arrange a set of guidelines to serve all types of autism, rather everything should be tailored according to individual cases. From this notion it can be said that autistics need deeper considerations to be set in designs for them. Collecting data from autism experts, families of children with autism and accurate observations will help in understanding which points should be considered in design a suitable environment for them.

Medical and psychological pioneers seem to have rational activities to combat the syndrome. However, little research has been conducted on design of spaces for autism. The contribution of interior architecture to supply a suitable physical environment for autistic individuals is not satisfactory, having no standards and well-organized guidance, regarding to design for autistic people based on their perceptual needs. The purpose of this research is to examine the effects of interior environment on autistics' perception. It also attempts to develop a holistic understanding through

observations in autism centers and investigating quality of space and its influence on autistic repetitive behaviors. From this point of view the intervention of interior architecture seems to have a significant role in the process of education for the autistics, because breaking these behaviors via providing a suitable interior environment gives autistics the possibility to think of other activities and learn new things.

1.2 Problem Statement

No design will be done without a reason behind or a client requirement. Therefore, design is a prescription by the designer to a specific situation. Some people consider design especially interior space design as a real mentor. Augustin (2009) mentions interior space as a teacher of nonverbal communication as important as verbal communication trainer.

Autism soars annually, according to Schafer (2014), “Autism Spectrum Disorder (ASD) is the fastest growing developmental disorder in the United States”. If there is not a consensus strategy to stop it, autism will be among the greatest global issues in the next few years.

The autistics’ world is quite different, they suffer from some stimuli around, such as loud sound, intensive light, bright colour, smell, and touching. Their senses and perception in space is critical; therefore, children with autism need special design for their interiors to live and grow in.

1.3 Aim and Objectives

As Autism spectrum disorder (ASD) has a wide range of definitions and needs, it is a mental disorder which drives human into an abnormal situation due to mind

dysfunction. That is why autistics have different perceptions in space, as they have physical challenges when interacting with the built environment. They become easily distracted by what they perceive which may be normal to neuro-typical individuals, such as sound, colour, texture, glare, light, movable objects, and so on. For these reasons this study tries to investigate the autistic perceptual needs in interior spaces considering in both the autism centers and residential units with autistic patients. Furthermore, this research seeks to go further by preparing a checklist for architects and interior designers including autism requirements in interior spaces by considering autistics' sensory needs. This thesis attempts to provide a guideline to help designers to design space for autistic children, so that they feel comfortable in a stress-free environment and giving them the chance to live and learn in it. Therefore, this thesis tends to achieve these objectives:

- To understand what is autism and what are the impairments they may have.
- To realize autistics' perception in space, and to know how they feel in space.
- To understand the influences of space on autistics.
- To investigate the properties a suitable space for autistics should have.
- To create a guideline to be used by designers during space designs for autistics.

For this reason, parallel to medical and psychological attempts, intervention of architecture and interior design seems to have a reasonable request; however, lack of knowledge on the autistic needs in space constricted the connection channel between architecture and autism. This research tries to bridge the knowledge gap in the literature and searches the real impact of interior and space design features such as proportions, colour, light, acoustics, texture, safety, and shape in spaces to be used by autistics. Based on these studies a design checklist for architects and interior

designers is proposed so as to be applied easily whenever they design for the autistics.

1.4 Methodology

The methodology of this qualitative study depends on documents reviewing from autism organizations and research publications. Also analyzing documents from architects and researchers from the field of autism as well as investigating some existing designed centers for autism around the world.

To achieve the aim of the study two autistic special centers in Iraqi Kurdistan, the region which the author has come from, were visited to collect data through interviews and questionnaires with experts such as psychologists, sociologists, therapists working there as well as families and siblings of autistics. . Furthermore, it was helpful to conduct self-observations in therapeutic centers which many parents had continues visits to there for their autistic children to have speech therapy.

Therefore, data collection techniques and methods of the study are as follow:

- Document review of existing resources about autism deficiencies and their sensory to physical environment.
- Questionnaires and interviews with psychologists, therapists, sociologists, parents of autistic children and their siblings.
- Self-observation of autistic children especially in therapeutic clinics during the speech therapy.
- Watching video records and documentaries to understand more details pertaining to the autistic behaviors.

The results of the questionnaires and interviews have been evaluated quantitatively to obtain reliable information on the subject. At last, the attained knowledge in literature and in the field study have been used to create a comprehensive design guideline to be used in the design of spaces for autistic children.

1.5 Implications of Research

The present study is expected to serve the designers in design of spaces for autistics. The study is projected to demonstrate the positive and negative impacts of interior design on autistic behaviors. It is an architectural intervention along with other related fields. The efforts of this study is to prepare a design checklist that may include autism sensual desires to be used as a guide possibly in everywhere in interior spaces, because a well-designed physical environment could change autistic's behavior and it may encourage them to learn, aftermath returning to the society life.

1.6 Scope and Limitation

The study focuses on interior physical environment for autistic children in autism centers. There is an issue which will define the ambiguity of autism which is called 'spectrum'. It means that autism has a wide range of degrees of the disorder from moderate to severe, from hypersensitivity to hyposensitivity which are different in reactions to the physical environment. This is one of the challenges in front of this thesis. For this reason, the study may outline the knowledge but will be more specific on severe and hypersensitive autistic needs, and investigating their behavioral needs in interior spaces. Covering the subject is not an easy task because of the novelty of the topic and autism tangle needs. Having limited procedural examples and less executed designed autism centers is another concern. The study field of this research is Iraqi-Kurdistan, all interviews and questionnaires are being done there. Also this

study mainly focuses on autistic children in these autism centers who are between 3-7 years old.

Chapter 2

AUTISM

2.1 Historical Background of Autism

According to Weintraub (2013), “The word ‘autism’ which has been in use for about 100 years, comes from the Greek word ‘autos’ meaning ‘self’. The term describes conditions in which a person is removed from social interaction - hence, an isolated self.”

From this description it is obvious that autism as a term is not new, however, its first use as a disorder, dates back to 19th century. McGuinness (n.d), in his writing about history of autism, mentions a series of events which are clearly references for having autism during that period of time. The first recorded evidence about autism, which was recorded by McGuinness, is a study by Jean-Marc-Gaspard Itard, a French physician. In Itard’s study there is a story about a boy, the so-called ‘Wild Boy of Avalon’ who his real name was Victor in 1828. Itard shows Victor’s behaviors which had lived alone during his childhood, as imitation in speech, and extremely interesting to some limited particular subjects. It is an information that Victor might have a sever autism.

McGuinness (n.d) believes that, Paul Eugen Bleuler, Swiss psychiatrist, was the first to use the term of autism in 1910. Bleuler was outlining symptoms of schizophrenia, supporting by the Greek word of ‘autos’ (meaning self). Same symptoms today is

called Synesthesia, albeit with a wider range and more complex manners. Bleuler, connected human senses (touch, taste, smell, sight, hear, pain, colour, graphemes, etc.) with the schizophrenia which are being 'mixed up'. In 1938 Hans Asperger of the Vienna University Hospital, referring to Bleuler's outcome, invented the term "autistic psychopaths" during a lecture in Germany about child psychology, henceforth, the term was changed to Asperger's syndrome.

Many researchers agree that American child psychiatrist Leo Kanner was the first using the word 'autism' as is used. "In 1943 ... Kanner studied 11 children. The children had features of difficulties in social interactions, difficulty in adapting to changes in routines, good memory, sensitivity to stimuli (especially sound), resistance and allergies to food, good intellectual potential, echolalia or propensity to repeat words of the speaker and difficulties in spontaneous activity" (Mandal, 2015).

2.2 Definition of Autism

Backner, (2010) defines autism as "... a low incidence disability affecting verbal and nonverbal communication and social interaction, which is generally evident before age 3." (Quoted in Shriver, Allen, & Mathews, 1999, p.3). According to Autism Speaks (which is an advocacy organization in the US that sponsors autism researches around the world) "Autism spectrum disorder (ASD) and autism are both general terms for a group of complex disorders of brain development. These disorders are characterized, in varying degrees, by difficulties in social interaction, verbal and nonverbal communication, and repetitive behaviors" (URL 22). From this point of view, autism is a malfunction of brain, it affects the intellectual ability, physical functions, and perception. Generally, ASD individuals' difficulties can vary in different ages. For instance, during childhood ASD individuals may have problems

in verbal communications and eye contact, while autistic teens may have lack of abilities in learning and making friends.

The term 'Autism Spectrum Disorder' is now commonly in use for representing the disorder which previously had called autism, as a collection for some similar cases "The term 'Autism Spectrum Disorder' includes Autism/Autistic Disorder, Asperger's Syndrome and Pervasive Developmental Disorder – Not Otherwise Specified (PDD-NOS). Other terms you might hear are 'high functioning autism', 'classic autism', 'Kanner Autism' or 'atypical autism' ” (Autism speaks, 2015).

Autism spectrum Australia (which is a non-profit organization in Australia), explains the word of 'spectrum' which is used with autism, as the range of the difficulty degrees of people with autism. Some may be able to live relatively normal and has the capacity to learn, while others may have difficulties with learning and living in a sociable way.

For further understanding; Bhandri (2015), in WebMD, elucidates and defines all disorders which have been gathered under the umbrella of Autism Spectrum Disorder (ASD) as:

- **Autistic disorder:** This is what most people think of when they hear the word "autism." It refers to problems with social interactions, communication, and imaginative play in children younger than 3 years.
- **Asperger's syndrome:** These children don't have a problem with language -- in fact, they tend to score in the average or above-average range on intelligence tests. But they have the same social problems and limited scope of interests as children with autistic disorder.

- **Pervasive developmental disorder or PDD** -- also known as **atypical autism**: This is a kind of catch-all category for children who have some autistic behaviors but who don't fit into other categories.
- **Rett syndrome**: Children with Rett syndrome, primarily girls, start developing normally but then begin losing their communication and social skills. Beginning at the age of 1 to 4 years, repetitive hand movements replace purposeful use of the hands. Children with Rett syndrome are usually severely cognitively impaired.
- **Childhood disintegrative disorder**: These children develop normally for at least two years and then lose some or most of their communication and social skills. This is an extremely rare disorder and its existence as a separate condition is a matter of debate among many mental health professionals. (p.2)

Autism is four-fold and more common in boys than in girls. Rice (2011) reports that “For every girl, four or five boys were affected by the autism spectrum disorders”. Some researchers give reasons for this imbalance, Sarris (2013) refers to Researcher Simon Baron-Cohen et al. who explain “...autism is the result of an ‘extreme male brain.’ Their brains are geared more heavily toward ordering things (considered a male trait) but not empathizing with people (a female trait)” (Baron-Cohen, et al, 2011; cited in Sarris, 2013).

According to (Constantino, & Charman, 2012) there is some kind of protective factor in girls that somehow keep them away from developing autism even if their families are involved with. Nonetheless, this is not always true, because many statistics showing diagnosed girls with autism. For this controversial matter, Sarris (2013) points out that “When girls lack such protection, whatever it may be, they tend to develop a more severe form of ASD. Studies have shown that girls with "classic" autism generally have lower nonverbal intelligence than boys” (Sarris, 2013).

Conversely, other opinions could be found like Attwood (2006) who believes that “Whether due to culture or biology, girls in the general population are often less aggressive than boys, according to Dr. Attwood. That means girls with ASD are less likely than boys with ASD to have behaviors that trigger a referral to a psychologist or psychiatrist in the first place” (Attwood, 2006; cited in Sarris, 2013).

The rate of autism has increased briskly, as shown in Table (1). In 1980s only 1 child was diagnosed in 10, 000 children, while has reached 1 in every 50 children in 2013. According to some statistics the rate has become 1% of the total globe population (Brugha, McManus, Bankart, & et al., 2011).

Table 1: Mental health and autism statistics (URL 23)

Year	All Disabled Mentally Ill Per 1,000	Rate of Autism	All Disabled Mentally Ill With Inclusion of Autism Per 1,000
1850	.2	*	.2
1903	1.86	*	1.8
1955	3.38	*	3.38
1987	13.75	1 in 10,000	13.76
2003	19.69	1 in 150	26.39
2013	26.2	1 in 50	46.2

*Prevalence not recorded at statistically significant level or “aborbed into overall mental disability statistics.”

Statistics derived from those bastions of radicalism, the US Census Bureau, Social Security and the National Institute of Mental Health.

2.3 Autism Severity Degree

Before mentioning autism subtypes classification, it is essential to explain what autism severity degree is. Bernier (2012) defines severity in autism as “Severity is often defined in terms of language ability, intellectual functioning or the presence of problematic behaviors such as aggression, all of which contribute significantly to an individual’s ability to function in social, academic and employment situations”. The

aforementioned behaviors are not the core features of ASD such as social interaction, social imagination, and repetitive behaviors, however; for achieving an easy way to diagnose them accordingly, these minor behaviors are used in the diagnosing process.

In this respect, autism has degrees from mild, and moderate to severe. Wilson (2014) classifies all types of disorders of ASD according to functioning level, as shown in table (2). Each subtype of ASD is different according to its level. Some of these subtypes do not have mild level like Rett’s syndrome and Childhood disintegrative disorder, while some others have not severe level as Asperger’s and Pervasive developmental disorder.

Table 2: Types of autism and functioning level. (Wilson, 2014)

Autism subtypes	Mild ASD	Moderate ASD	Severe ASD
Asperger's	Yes	No	No
Classic autism	Yes	Yes	Yes
PDD-NOS	Yes	Yes	No
Rett's syndrome	No	Yes	Yes
Childhood disintegrative disorder	No	Yes	Yes

These degrees of severity show the independency level in autistics, because severe cases need more support than the lower levels.

Arming with the knowledge on severity degree seems to be significant for interior designers and architects, because they have to think of design based on the understanding of the autistic traits. Diagnosing severity degree opens a vista to look

deeply into autistics psychological needs in space. Because according to the degree of severity in autistics some of their fringe behaviors may be changed from subtype to another. Some of the autistics need support permanently, and they need a special design after all.

2.4 Hypersensitivity and Hyposensitivity

Many ASD individuals has sensory difficulties. Either, this difficulty may be hypersensitivity or hyposensitivity. “We have seven senses: sight, sound, touch, taste, smell, balance ('vestibular'), body awareness ('proprioception'). People with an ASD can be over- or under-sensitive in any or all of these areas. You may hear this referred to as being 'hypersensitive' or 'hyposensitive’” (The National Autistic Society, 2015).

Wong (2009) clarifies hyposensitivity problem as “... When a child is ‘under-sensitive’ to stimuli and has trouble processing information through their [sic] senses” (Wong, 2009).

Autism discussion page (2014) elucidates cases which people with hyposensitivity autism may experience:

➤ Visual hypo-sensitive

- Very attracted to visual stimulation, often stares at light.
- Seeks out intense visual stimulation.
- Loves turning lights on and off.
- Loves mirrors, shiny objects, reflecting surfaces.

➤ Auditory hypo-sensitive

- Speaks loudly.

- Very noisy person.
- Turns volume up loud.
- Hums or makes vocal noises constantly.
- Loves items/activities that have distinct sounds (motors, pounding, etc.)
- Tastes and Smell hypo-sensitive
- Tends to smell or taste everything.
- May seek out strong smells and tastes.
- Will often identify people and objects by their smells.
- May put inappropriate objects in their mouth, smell others hair, or want to lick things.
- Vestibular (Movement) hypo-sensitive
- Very active, always on the move.
- Craves movement, climbing, falling, and spinning.
- Fearless, impulsive movements without regard to safety.
- Rarely gets dizzy.
- Difficulty sitting still.
- Proprioception (Stimulation to joints and muscles) Hypo-sensitive
- Often unaware of body position in space.
- Awkward and clumsy.
- Floppy, poor muscle tone.
- Often needs to lean on objects and people.
- Often bumps or crashes into things.
- Craves pushing, pulling, banging, crashing.
- Tactile (Touch) Hypo-sensitive
- Needs strong touch to be registered.

- Tries to handle or touch everything.
- Insists on holding an object in hand.
- May touch too forcefully.
- Graves touch; is clingy. (Autism discussion page, 2014)

The above illustrated situations concerning to hypo-sensitivity shows that 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.

The situation for hyper-sensitivity seems to be different. Wong (2009) defines hyper-sensitivity as; when“... child’s sensory awareness is too acute” (Wong, 2009). This means that, person who has one of these problems cannot practice his/her senses as normal. For instance, a person with a hyper-hearing may be distracted by most environmental sounds even very normal sounds. There are hyper-sensitivity characteristics which are described by The National Autistic Society (2015):

➤ Visual Hyper (over-sensitive)

- Distorted vision: objects and bright lights can appear to jump around.
- Images may fragment.
- Easier and more pleasurable to focus on a detail rather than the whole object.

➤ Auditory Hyper-sensitive

- Noise can be magnified and sounds become distorted and muddled.
- Particularly sensitive to sound and can, for example hear conversations in the distance.

- Inability to cut out sounds – notably background noise, which often leads to difficulties in concentrating.

➤ Tactile Hyper-sensitive

- Touch can be painful and uncomfortable; people may not like to be touched and this can affect their relationships with others.
- Dislikes having anything on hands or feet.
- Difficulties brushing and washing hair because head is sensitive.
- Only likes certain types of clothing or textures.

➤ Taste and Smell Hyper-sensitive

- Finds some flavors and foods too strong and overpowering because of very sensitive taste buds. Has a restricted diet.
- Certain textures cause discomfort; some children will only eat smooth foods like mashed potatoes or ice-cream.
- Smells can be intense and overpowering. This can cause toileting problems.
- Dislikes people with distinctive perfumes, shampoos, etc.

➤ Balance (Vestibular) Hyper-sensitive

- Difficulties with activities like sport, where we need to control our movements.
- Difficulties stopping quickly or during an activity.
- Car sickness.
- Difficulties with activities where the head is not upright or feet are off the ground.

➤ Body awareness (proprioception) Hyper-sensitive

- Difficulties with fine motor skills: manipulating small objects like buttons or shoe laces.
- Moves whole body to look at something. (The National Autistic Society, 2015)

These sensory difficulties are different from an autistic to another one. This will be another challenge for autism experts, as well as architects and interior designers, because it is essential before any step, to know who you are working for. Interior spaces have an intricate relationship with human senses and psychological dimensions. For that reason, the situation will be more critical for autistics who their brains function improperly. This deficiency in brain, influences the way the brain receipts environmental signals, and how the brain analyses them.

According to The National Autistic Society (2015) hypersensitivity and hyposensitivity in autistics is called ‘sensory integration difficulty’ or ‘sensory sensitivity’ because they affect autistics’ daily sensory information.

There are many obstacles on the way of designing for autistics, because no one may have a quite hyper-sensitivity or hypo-sensitivity, it is usual when an autistic individual may be partial hypo in some senses and be hyper in some others. Design of centres for autistics can be done in a way which agglomerate autistics general desires and needs in spaces, where the using of this spaces have to be arranged by the staff in these centres. Designing a private home for an autistic individual seems to be a bit easier because it would be done regarding to the diagnosing results and the degrees of the disorder.

2.5 Causes of Autism

There are some beliefs that say environmental pollutions may have role on increasing autism “Mothers exposed to high levels of pesticides and air pollution may also be at higher risk of having a child with ASD” (URL 22).

According to this idea, it is essential to provide a space free from off-gassing materials and other pollution producing sources. Although, reasons behind having autism seems to be unclear yet, there are more reasons which are participating in appearing autism. Autism Victoria (2011), illustrates that environmental and genetic factors are mainly responsible to cause autism.

Similarly, Autism Speaks (2015), describes that the genetic risks also maternal illness during pregnancy, physical hurts of babies during birth and inadequacy of oxygen to the babies' brain may cause autism.

The ambiguity of autism issue has made it difficult for the researchers to observe all possibilities which may cause autism. Some of today's researches refused the idea of 'vaccines cause autism'. From the last two decades, people believed that most probably some kinds of vaccines may have influences on appearing autism. Especially, when pediatricians declared that, there is more amount of mercury in the autistics' brain. Because it is clear that some kinds of vaccines depend on mercury in the process of weakening viruses.

2.6 Autism Characteristics

Autism spectrum Australia (2015), explains autism characteristics as: "Autism is characterized by marked difficulties in behavior, social interaction, communication, and sensory sensitivities. Some of these characteristics are common among people with autism; others are typical of the disability but not necessarily exhibited by all people on the autism spectrum" (Autism spectrum Australia, 2015).



Figure 7: An autistic child

All of these behaviors are more intricately related to surrounding environment. Autistics are affected by the environmental attributes and they attempt to react to these changes.

2.6.1 Behavior

Some special behaviors can be accepted as the most prominent feature of autistics, because they may express some unusual behaviors due to their difficulties in coping with the surrounding environment. These behaviors are outcomes of their attempts to cope with the environment. At the same time, autistic individuals have sensitivities to some environmental features like sound, visual matters and feelings, as a result they behave in abnormal ways. Besides these reactions, ‘Autism Spectrum Australia’ reported some other behaviors that may include:

- Unusually intense or focused interests.
- Stereotyped and repetitive body movements such as hand flapping and spinning.
- Repetitive use of objects such as repeatedly switching lights on and off or lining up toys.
- Insistence on sticking to routines such travelling the same route home each day and doing things in exactly the same order every time.
- Unusual sensory interests such as sniffing objects or staring intently at moving objects.

- Sensory sensitivities including avoidance of everyday sounds and textures such as hair dryers, vacuum cleaners, and sand.
- Intellectual impairment or learning difficulties (Autism Spectrum Australia, 2015).

It is most important for a designer or an architect to have at least basic knowledges on autistic behaviors, because design absolutely has impact negatively or positively on these behaviors. Many behaviors have restrictions on the way of learning, if the design focuses on a behavioral diagnosing to know which element cope with their needs, it will assist learning process. This one of the design goals can be to convert these routines which autistics always used to experience.

2.6.2 Social Interaction and Communication

Although, in most of the sources social interaction and communication are described separately, they are tightly interconnected. And they are other impairments of autistics. These problems of people with autism are difficulties in establishing relationships with the others. Also they have more difficulties in understanding facial expressions which are considered as important subjects in human interactions. Autistics often have trouble in sharing ideas with other people, because they also have difficulty in their speech and verbal communication. Sometimes this delay in speaking may cause lack of social relationships. Because they may feel uncomfortable when they have a conversation with others since they are unable to communicate well.

Space, especially interior space may be amongst the most significant factors that have psychological impact on autistic individuals. For this reason, this research attempts to concentrate more on autistic characteristics, for the sake of translating the autistic needs into an appropriate well-designed space. Furthermore, space could be a

supportive element for social interaction problems. It may have a positive role to boost self-confidence. When a space is designed based on the idea of social interaction, it encourages occupants to interact with each other. Besides the forgoing discussion, autistics have some preferences as Autism speaks (2008) argues “Many individuals with autism have a good sense of humor, a love of or affinity for music, strong rote memorization skills, or a heightened sense of colour or visual perspective—use these to motivate interest in social interactions or to give a student a chance to shine and be viewed as competent and interesting” (Autism speaks, 2008).

Furthermore, another issue of autistics is deficiency in eye contact, they probably may not maintain a normal eye contact at all. It is believed that if person with autism is reached to a point to have an eye contact, he/she will accept to continue learning. In this point of view, interior designers have the responsibility to tackle the problem, by providing a welcoming space environment where an eye contact is guaranteed.

Communication considers as another problem of ASD individuals, however, not all of them have the same difficulty. National Institute on Deafness and other communication Disorder (NIDCD) (2014) argues communication issue in autistics as “...Children with ASD often are self-absorbed and seem to exist in a private world where they are unable to successfully communicate and interact with others. Children with ASD may have difficulty developing language skills and understanding what others say to them” (NIDCD, 2014).

Furthermore, the Hanen center (2011) explains some behavioral communication difficulties in ASDs life, especially the effect of audible and visual distractive

objects, such as vacuum cleaners sound and fans. Which is most of the times autistics cannot focus on what people says around because of being distracted by a background noise or movable object.

In this point of view, and by understanding the way autistic children prefer for communication, a link can be found between the autistic communication behavior and interior space design. The challenge may be to concentrate on what may interest autistics' thinking when they attend a room or any education spaces. An interior space where is free of any environmental sounds may attract autistics attention to people talking. This will be an essential step in education process, because some experts who are working in autism field think that, if communication problem was solved it would be a milestone for the next recovery steps. "For some younger children, improving verbal communication is a realistic goal of treatment. Parents and caregivers can increase a child's chance of reaching this goal by paying attention to his or her language development early on" (NIDCD, 2014).

Social interaction mainly associates with language abilities, for most of autistics this language delay causes many problems in their daily life as Autism Spectrum Australia illustrates "This [Social interaction] impairs their ability to share interests and activities with other people. For this reason they are likely to appear distant and aloof. Because they are often delayed in their speech and struggle to make sense of other non-verbal forms of communication, they may withdraw into repetitive play and behavior and avoid interaction" (Autism Spectrum Australia, 2015).

Social interaction could be greatly boosted when a space will be designed accordingly. Interior designers have the ability to design respecting to a diagnosed

problem which is social interaction, for that reason, colour of the space, proportion, light, shape and other variables directly or indirectly have influences on social interaction. That will be discussed thoroughly in the next chapters.

Chapter 3

AUTISM SENSORY AND PHYSICAL ENVIRONMENT

It is obvious that how environment affects behaviors in human beings. The characteristic and personality of an individual is more intricately related to the environment who he/she has come from. “Racial differences in personality can to a large extent be traced to the influence of different environments to which people of different races have been subjected for generations” (Mathew, 2012). Also the way people behave is directly related to the quality of the environment. For instance, it is said that people who live in scarce and severe climatic conditions are always aggressive, which comes from the act of environment and making reactions by people (Mathew, 2012).

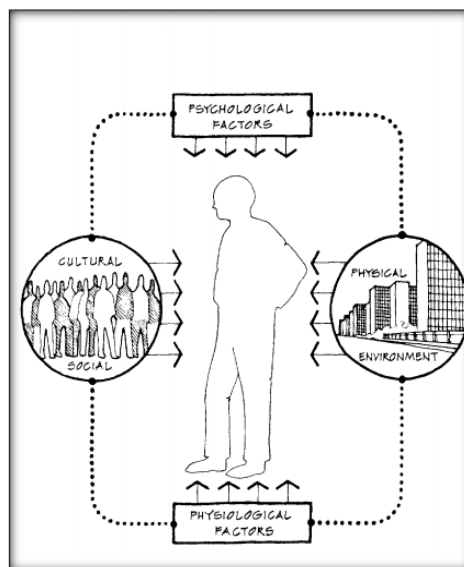


Figure 8: Factors that affecting human beings (Moore, 1979)

From this point of view, the role of designers is crucial in creating a psychologically-preferred design. From very long before the role of architects and interior designers has exceeded the limit of designing spiritless shelters. Architecture has become a profession which basically deals with all human needs in a designed space, like considering psychological, cultural, social, physiological needs, and the effects of physical environment around human body. A good design can provide a freedom of behavior, at the time privacy and socialization. Because it is design which moulds human behaviours after all.

In the same way, pointing out the main behavioural problems in autistics assist architects and interior designers to design a fulfilled environment for them. The essence in the design for autistics could be a space where answers to their behavioural and sensory needs. Some scholars have researched about autistics needs in space. Each of them developed some suggestions to enter the field according to their relations to autistics or their level of understanding. The space which may be designed for autistics has to be armed with an adequate knowledge about their deficiencies in spaces, so that the designed space would regulate these shortages they have.

3.1 Perception Process and Autism

Cherry (2015), psychologist and human behaviour expert, defines perception as “... our sensory experience of the world around us and involves both the recognition of environmental stimuli and actions in response to these stimuli... Perception not only creates our experience of the world around us; it allows us to act within our environment” (Cherry, 2015).

Perception includes all human senses; hearing, seeing, touching, tasting, smelling, vestibular and proprioceptive. Through these senses, the cognition process moulds in mind. All of the normal activities in human's daily life achieve via contributing senses into surrounding environment. For example, when people see something in environment it is organized through an automated process by brain, such as; entering light into eye, forming as an image on retina up siding down, then comparing with what has been formed already (Cherry, 2015). So every sense has its process in brain with a different procedure and a specific part of brain being responsible for.

The above description is related to a normal process of perception, even in a neurotypical person this process can be very complex. Though, the situation will be so different and more multifaceted if the brain is dysfunction. For instance in people with autism, they have problems in brain. "Autism is a brain disorder that often makes it hard to communicate with and relate to others. With autism, the different areas of the brain fail to work together" (WebMD, 2015). For this reason they perceive their surroundings in a different way.

3.1.1 Autism Neurology and Effects on Sensory Perception

Many researchers and autism experts expressed autism as a neurological disorder. Using Magnetic Resonance Imaging (MRI) and Positron Emission Technology (PET) scans, they have found some brain dysfunction parts in autistic individuals which are responsible for perception problems in autistic individuals (Schafer, 2014). Some other researchers reported that autistics brain is absolutely different from those who do not have ASD (Shriber, 2010). According to Harden et al. (2001) a rapid growth happens in the volume of autistics head during a period of time, when they become young children, sometimes this change will be noticed as an indicator for

diagnosing children with ASD. This abnormal growth of brain causes some disconnection and missing in some parts of the brain (Carper et al., 2002).

The above mentioned matters concerning to brain, negatively affect the process of perception, because it reduces the regularity of operating system of the brain. According to Shriber (2010) many autistics have smaller size brain stem (which is the base part of brain that connects brain to the spinal cord) than the normal children without ASD. While the main process of automatic and vegetative responses, alerts and consciousness as well as the information that we collect through senses to reach the brain, is controlling by the brain stem (Bear, Connors, & Paradiso 2007). Schafer (2014) illustrates in her research that the “transmission time of incoming information in the brainstems of children with ASD is longer” (Schafer, 2014; quoted in Akshoonoff, Pierce, & Courchesne, 2002).

The foregoing discussion opens a vista of entrance, to observe where all these sensory difficulties of ASD came from. ASD individuals have problems with their surroundings, sometimes they feel that they are exotic and not coming from this environment. The trouble which they have is entitled as perceptual difficulties. Paron-Wildes (2013) describes perception process in ASDs in her book *Interior Design for Autism from Birth to Early Childhood* as if a neurotypical child is settled in a foreign country. As it is difficult to navigate this new environment, he/she experiences new colour, texture and smell, also expects rude and sudden reactions in approaching everyone. Likewise, he/she does not know the language of used by people, so he/she obliges to use body language to express him/her self (as cited in Schafer, 2014).

Besides the feeling as strangers; hyposensitive individuals perceive environment as a whole object, as Temple Grandin, the professor who has grown with autism, argues the situation of ASDs in space surrounding as "...only see images, scenes, or spaces as a whole, not as individualized parts" (Grandin, 2010). This case is true for hyposensitive ASD individuals. Contrarily, hypersensitive cases with ASD prefer focusing on details and fragmentations (National Autistic Society, 2015). In both of the cases, the effect of visual environment is clear as any changes in details or general frame work can affect their perception in the space and make them distracted. These elements may be colour of a wall, a carpet, a light source or a furniture.

This disconnection between ASD brain and functional parts of their body absolutely changes their sensory. Especially in interior space environment, which will be the focus point of this thesis.

Autism experts also report another brain difference between autistics and neurotypical individuals which is a part called 'amygdala' this part of the brain is responsible for controlling threats and emotions. Respecting to these experts' findings, this part is noticeably larger in autistics, and can be easily activated especially when autistics face communication and eye contacts (Howard et al., 2000). That is why 'anxiety and panic' are common among autistics.

According to autistic experts, most of the insufficiencies in autistics are sourcing from brain distortion. The information supported that in some kinds of autism like Asperger's syndrome, there is also another difficulty which is mainly related to a specific consistent of the brain, Temple Grandin (2010) illustrates that these group of

autistics have an extended occipital lobe which undertakes vision procedure, it means that vision process is overdeveloped. Conversely, another part which is called parietal lobe is smaller and constricted. This shrinkage of this part distorts the connection process between brain portions (Grandin, 2010; Shriber, 2010). Here is the problem, when normal individuals see an object or a figure, their brain via these regular procedures will form a model which is called prototype, wherever and whenever this person see this figure again, the brain responds and recognizes it. Nevertheless, the situation is dissimilar for autistics. Temple Grandin (2010) argues the phenomenon and says; when autistics stare a church's steeple they may have some alternatives for this form not a generalized figure which brain saved for the whole idea which is a church steeple, as could be seen in neuro-typical individuals. The whole procedure will produce "lack of synchronization between the various portions of the brain, and can effect everything from a person's ability to plan and organize" (Schafer, 2014, p.14; quoted in Shriber, 2010), because their mind have not kept a mental image causing the brain insufficiencies which were described above.

3.1.2 Pioneering Design Concepts Related to Autistics

In spite of lacking of knowledge on architectural side related to design for autistics, some serious endeavours so far could be found. Magda Mostafa from Egypt, Humphreys from the UK, and Kijeong Jeon from the US are architects who researched on the subject and could conclude some crucial points on autistics' needs in space, which is thoroughly illustrated below.

3.1.2.1 Humphreys

One of the contributors who is an architect worked on space organization in autistic centers, and he has an autistic brother, is Humphreys in UK. By deeply focusing on

his brother's behaviors he could suggest some criteria to be used in design of spaces for autistic children (who he did a research).

Humphreys' criteria are shortly as follow, and are reflected in one of his designs in Newcastle, United Kingdom. He describes these concepts as:

- a. Calmness, order and simplicity: Humphreys emphasized on reviving medieval Cistercian cloisters (early medieval architecture), by using the same material for walls, pillars and floors, to have limited colours and textures, to make the sense of simplicity and calmness. In his design, sense of order was achieved by locating a courtyard in each block and using golden ratio, it also provides a simple circulation and visual references.
- b. Minimal details and materials: this is an extra addition to the previous point, providing minimum visual distraction and creating sense of order.



Figure 9: Newcastle Autism Center, United Kingdom. Designed by Humphreys. Using less details, curved walls and mute colours (Humphreys, 2008)

- c. Because he believes that more detailed spaces confuse autistics, and he avoided using hard edges in corner walls.

- d. Proportion: to create of harmonious proportions inside interior spaces, Humphreys used and suggested Golden proportion, returning to Greek and Vitruvius principles.
- e. Natural light: Humphreys supports entering sun light to autistics spaces, at the same time he warns about the possibility of producing glare, dazzling, shadow, and excessive contrasts. Because autistics may be overstimulated by them, as well as they may be confused by shadows. For that reason a deep thinking on the way of entering sunlight is important. And each of skylights, clerestories, and strip windows could be most preferred for autistic spaces.
- f. Proxemics: Humphreys suggests having more space in autism centers, because they are different in relationships with people. Based on this difference and autistics relationships it could be rational to speak about a special proxemics. For that reason, ASD individuals need more space in classrooms, corridors, halls, etc.

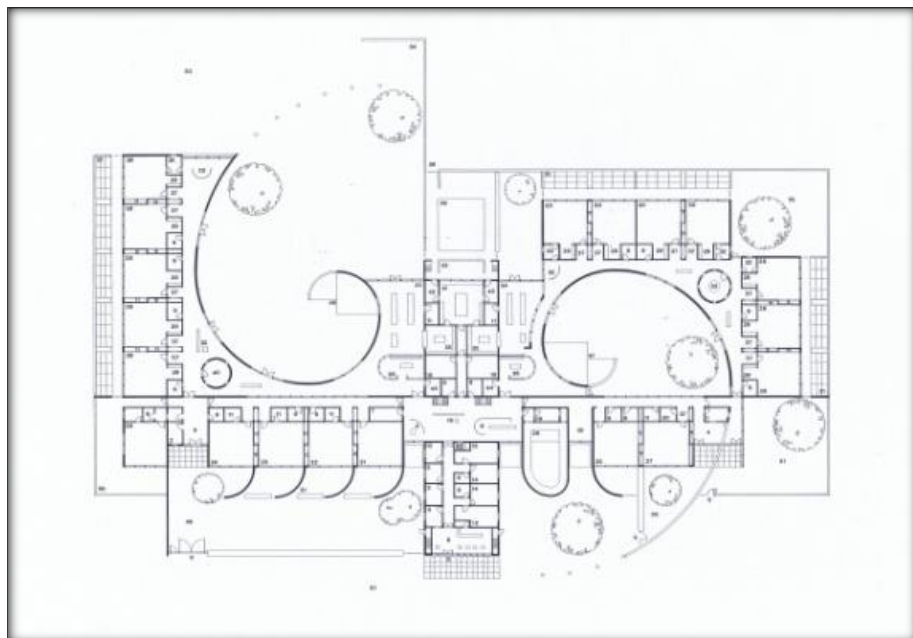


Figure 10: Newcastle Autism Center plan. Golden ratio principles were used as calm, order and as a compass for knowing their position wherever they walk (Humphreys, 2008)

- g. Containment: This concept is related to a place where ASDs can be monitored and at the same time they can have a free space to wander. This place should be safe and free of bizarre obstructions. Humphreys looks back to ancient architecture, especially Zen courtyards and natural forms for inspiration as they have a great degree of containment.
- h. Observation: This point is an extension of the previous point, Humphreys suggests to have some hideous places where it is possible to observe autistics, but without direct intrusion.
- i. Acoustics: People with ASD regularly have problems in tolerating sounds which can change according to the type of disorder and degree of severity. However, they need a good acoustic space, because most of them are distracted by sounds and have difficulties in differentiating sounds (Humphreys, 2008).

3.1.2.2 Kijeong Jeon and His Design for the COVE

Another pioneer in the field of designing for autism is 'Kijeong Jeon'. He was recommended to design a center for autism in The COVE (it is a nonprofit organization that provides services for people with autism and other developmental disorders). He tried to find design criteria from previous autism centers but he found nothing. From this point his challenge to know more about autism sensory needs has begun. He used the empathy approach by putting himself in autistics' situation to know which things affect their senses and what thing makes them distracted to research about. Finally, he could find a clear path to design a center for COVE as inclusive for autistics sensory needs (Gerdes, n.d).

Kijeong Jeon says "I'd never heard of autism so I did some immediate research. What intrigues me is that people with autism respond sensitively to lighting, sound,

acoustics, tactile sensations, scents – environmental factors...” (Gerdes, n.d).



Figure 11: A design for COVE by Kijeong Jeon, using subdued lighting, fiber optic lighting, less distracting colours and some non-structural pilasters to increase the sense of security. Photo by Kijeong Jeon. (Gerdes, n.d)

So these points which he had noticed became the basic of his design. He began with interpreting their sensory needs in interior spaces. Also he found out that when spaces respond to their needs, autistics feel calm and less distracted.



Figure 12: The calm room with its fiber optic lightings and preferable colours by autistics. Photo by Kijeong Jeon. (Gerdes, n.d)

By designing a multi-sensory environment, Jeon succeeded in providing a soothing space. For instance, he supplied a calm room for individuals who get brain overloading, after almost 30 minutes they become calm and they forgot their stress. Jeon used fiber optic lighting tools in design of the room so as to be touched, also he learned that violet and pink colours are the most accepted ones from autistics' side. He wanted to collect two senses together like sight and touch to be perceived in one object as in fiber optics.

3.1.2.3 Magda Mostafa

In 2003, Mostafa started to do her PhD research on accommodating autistic needs in architectural design. During her study she could discover some valuable information on autistic individuals via their parents, therapists, pediatricians and her observations. Also Mostafa corresponded many families with autistic children to accumulate more information.

Her achievements could be summarized as:

- Autistics need an acoustic space to be far from distraction sources.
- Compartmentalization will increase the sense of concentrating in educational spaces.
- Zoning in design is essential according to types of activities, for example classrooms should not be put side by side to therapy and play rooms.
- Autistics are picky about colours, some colours stimulate them while some others give them sense of serenity.
- Each of smell and touch senses are important to be considered in design for autism.
- Natural lighting is essential for them but in indirect way.

According to her achievements she tried to design a proposal for an autism center which is showed below.

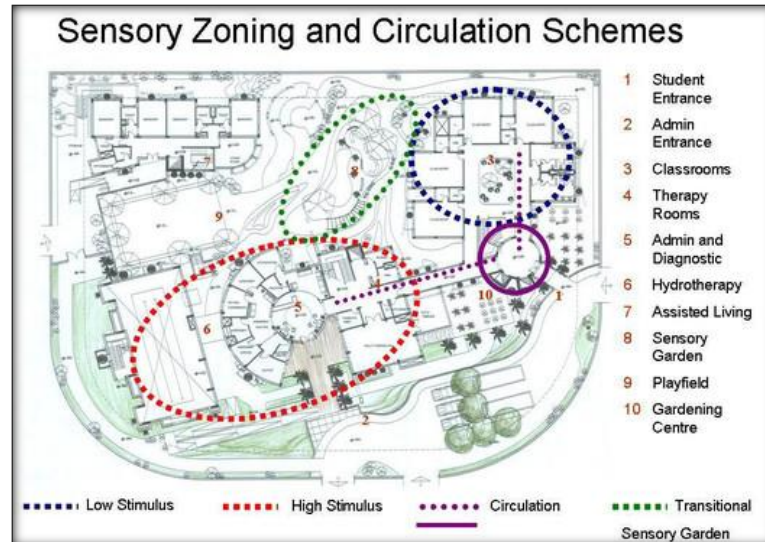


Figure 13: A sensory zoning design for autism, designed by Magda Mostafa in Egypt (Mostafa, 2014)

Mostafa concentrated on physical environment influences on autistics' perception. She used some geometrical interlocked forms with some harmonious colours in her design, as shown in (Fig.9). In her outcomes there are some concrete decisions related to acoustic, colour, smell, touch, and taste.

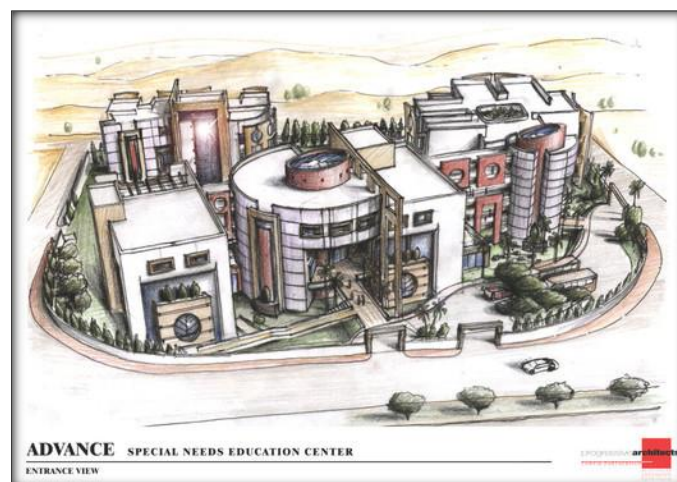


Figure 14: Outside view of Magda Mostafa's design for autism (Mostafa, 2014)

Mostafa dictated that bright and warm colours have negative impact on autistic perception, and white colour has a positive effect in their life. However, many recent researches have proved that white is not a supportive colour for autistics. “Even though white is a neutral colour, avoid stark white paint colours because they aren't soothing and might remind your child of unpleasant doctor's visits” (Tucker, 2015). A summary of the main focal points related to design for autistics suggested by these three researchers and designers are illustrated in the table (3) below.

Table 3: Shows the way of thinking of each Humphreys, Kijeong Jeon, and Magda Mostafa to autism spaces related to senses (prepared by author)

	Humphreys	Kijeong Jeon	Magda Mostafa
- Sight			
Light	- Prefers natural lighting - Indirect light is more beneficial via sky lights and clerestories...etc.	-Mostly depends on a suitable indoor lighting. -Avoids of using common lighting sources. -Mostly indirect lightings are provided.	-Natural indirect lighting is preferred.
Color	- Uses limited colors - Uses calm and mute colors - A diluted and muted purple is the most positive color.	- Violet and pink colors are most preferred. - Using multi-color in spaces -Using fiber optics -Providing colored lighting.	-White, and cool colors should be used. -Colors should be harmonious in spaces.
Shade	- Shade should be avoided		
Glare	- Negative to have in autistic spaces		
Proportion and visual character	- Golden ratio and classical orders are used - Designing curvilinear shapes, and non edge - Courtyards are important to look at it and for social interactions		-Compartmentalization should be done for autistics' spaces to reduce visual distraction.
Proxemics	- Requires more space for them, especially in transitional places and corridors.		
Calm spaces	- Generally spaces could be calm if simplicity is achieved (using least details in spaces)	-Calm rooms are provided in his designs full of fiber optic tools and soothing colors.	-Calm rooms are described as positive space to have.
Auditory	- A good acoustical space is required		-A good acoustical environment is very essential.
Touch	- Textural materials should be used with limits	-Supplies fiber optics with preferred colors to be touched by autistics to calm down them	-Playing with textures are important in autistic spaces.
Smell			-Smell should be thought, zoning should be considered to put all smell producing spaces far from other activities.
Taste			-Autistics are sensitive to taste materials, it should be considered in design.
Vestibular			
Proprioception			

In the table above, the three researchers and designers have some similar concepts also some different approaches. For instance, Humphreys' way of thinking is all about creating a tranquility in space designs for autistics, by applying mute colours, less detailed surfaces and dull materials to avoid brightness in interiors. While Kijeong Jeon is mainly focused on using high stimulated colours accessible to be touched, he believes that these provocative things can calm down autistics during their hyper-anger situations. For Mostafa the most important thing is defining a space in the shape of compartmentalization which can be easily controlled visually and acoustically. Also space zoning is another point which she proposed in her criteria to separate spaces according to activities.

3.1.3 Design Thinking According to the Seven Senses and Other

Considerations for Autistics

Below there is a thorough description about design thinking related to autistics' seven senses in space, which autistics have impairments with them, as it is illustrated in table (4) below.

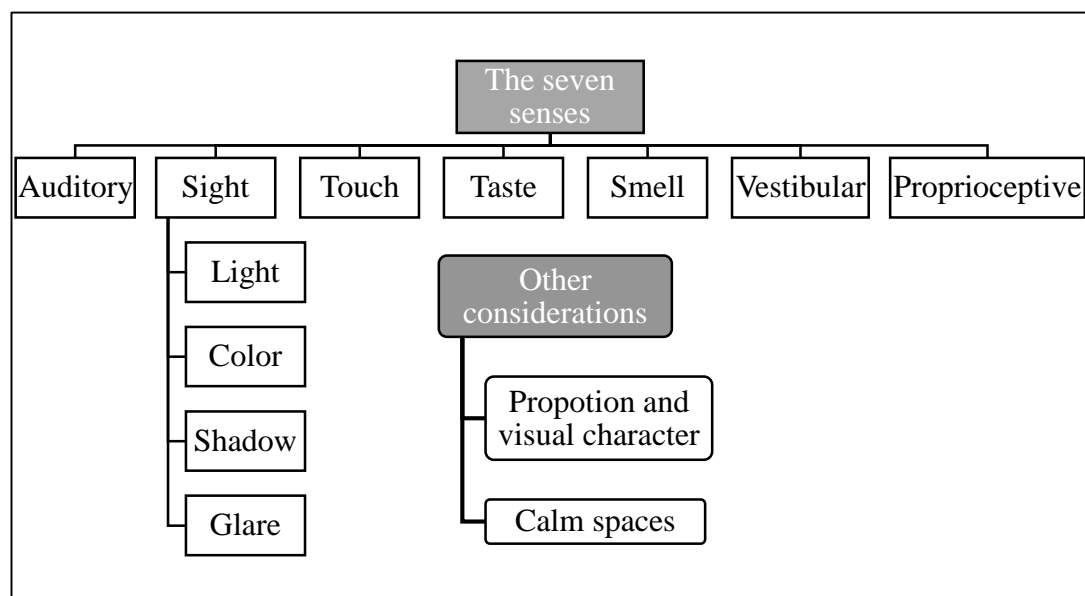


Figure 15: Thinking in design for autistics according to seven senses and other considerations (prepared by author)

3.1.3.1 Auditory

It is considered as one of the most prominent impairments in autistics and it concerned as the first sensitive sense by them (Mostafa, 2003). Autistics (hyposensitive ones who are the majorities) can easily be distracted by background noise which is difficult to neuro-typical ones to hear.

Mostafa (2003), observed it in autistic centers and residential homes with autistic people that autistics suffer from noises, especially background noises that may come from outside. She proposes a suitable acoustic space but not a fully acoustic one which has a great difference with outside environment. Because she thinks that a fully acoustic space is unreasonable and will affect autistics when they pass from this space to another spaces or to outside. She believes autism centers should have some spaces with different degrees of acoustic isolations so as to gradually return autistics from these acoustic controlled spaces to the general environment. Mostafa, proposes to avoid placing sewerage pipe and water pipe passages near to learning and sleeping spaces of autistics, because they could easily hear the sound and it would distract them.

Autistics easily distract by rain sound, so slanted (oblique) slabs may be a solution to reduce this sound. Also they can hear sound coming from adjacent areas. For that reason, a great attention have to be taken for all of the spaces in autism centers especially in learning classes and speech therapy places. Classes have to be designed far from sound producing activities like music, play areas, and administrative zones (Mostafa, 2003).

Beside this point, one of the researchers, Mostafa (2008) suggests to have a variation in the acoustical spaces, from a highest degree acoustical space to a lower degree. Because she believes that if autistics stay all the time in a fully acoustical space it may increase their difficulty in adapting to outside environment. Instead of that, they have to be trained in these different acoustical spaces according to their degree of sensitivity. Then could be transferred to another one after some improvements, so as to be prepared for the outside environment.

LearningSpring School for autism, is one of the centers which is designed in a way that least of sounds from exterior and interior influence autistics. Cork floors, natural wall fabrics, and bamboo coursework are used to absorb noise and preventing echo (Coen, 2012).



Figure 16: LearningSpring School in New York. Designed by: Platt Byard Dovell White Architects (Coen, 2012).

A great attention should be given to acoustical solutions in the autism centers. Constructing cavity walls, applying acoustical materials in the walls, slabs, and roofs

are necessary. Also window panels have to be at least double layers to hinder outside noise. In this way, echo can be muffled and this lets autistics hear sound inside better. Then it will encourage increasing attention span, particularly in speech therapy and class rooms.

Some of the acoustical materials has hazardous fine particles, which could be unintentionally going to the breathing system of human. The example of material is asbestos, which is widely has been used. This problem might be more effective to destroy the autistics' health.

3.1.3.2 Sight

Colour, light, glare, dazzling, and flickering lights could be the most important visual elements to be considered in design of autistic spaces. Each of them has significant influences on autistics feelings and perception.

➤ Light

Lighting is among the sensory sensitivities for autistics, it has influences on their perception in space. Generally, natural lighting is beneficial for both mental and physical activities in human, it is considering as the model of eye limit and man adapted to use it and live with it.

Furthermore, sun light could benefit overall health. Therefore, any changes of this limit triggers human into unfavourable mood state. The instance for autistic individuals is more different because they may not only be affected by this, even they might suffer from it. According to the literature, the indirect way of sun light into autistic spaces is mostly preferred, as they distract easily by direct sun light (Smyth, 2009).

Some sources like Henry (2001), Moreno & O’Neal (2000) and Long (2010) described the possibility of distracting and suffering of ASDs in case of being in place that enlightened by Fluorescent or harsh lighting, because of having flickering and hums, so autistics are vulnerable to sense these sub changes. This may cause them headache, eye strain and increasing repetitive behaviours such as; hand flapping, eye flickering and bouncing.

One of the other factors that advises using natural lighting over fluorescent, is its fully spectrum feature, which contains all of the spectrum colours, “Full-spectrum lighting has colour rendition that is much closer to natural light than fluorescent lighting (White, 2009)”. Therefore, “One of the major problems with standard fluorescent lighting is that it is incomplete, only offering illumination in a few of the possible visible spectra” (URL 7, 2015). This will create a misconception in autistics when they live under fluorescent lighting in indoors.



Figure 17: London’s Netley School for autism, designed by Haverstock Associates. Using greenish mute colour, indirect sunlight and upward artificial lighting (URL 15)

It has observed that, natural sunlight with its full colour spectrum has positive role on autistics' perception, however, it should enter the spaces indirectly (Henry, 2011). In some autism center designs like 'London's Netley School for autism' took this point into consideration, designers used clerestories, skylights, and strip windows for sunlight entrance. Natural sunlight assist autistics perception in space to see every colour and texture as they are because of having fully-spectrum colour. Also this will not change their perception to outside world because in both cases natural light exists (Henry, 2011).

In the National center for autism in UK, which is designed by Penoyre and Prasad, the exterior walls are covered with natural wood and red brick to make a comfortable sense by its natural muted colour without feeling stress. Light penetrates to the space through strip windows under the ceiling and some skylights are also provided to avoid direct sunlight. Inside colours and materials are chosen according to both hyper and hypo sensitive ASD individuals. Somewhere all walls, floor, and ceiling are painted with neutral muted colours for those ASDs who have hypersensitivity, while some other spaces have stimulating colours like yellow for hyposensitive ones.



Figure 18: National center for autism in UK, designers: Penoyre and Prasad. Using brick and wood on exterior façade to have a none-distractive vision (URL 16)

Autistics are sensitive to live under artificial lighting environments, they are easily distracted by some sorts of artificial lighting sources such as fluorescents.

Many researches like Mostafa, (2003), Niederhofer (2005), and Henry (2011), describe negative effects of fluorescent lights on autistics' perception, because autistics are stimulated by flickering and humming produced by fluorescents which may hardly be noticed by neuro-typical people. This visual stimulation affects autistics brain and causes increasing repetitive gestures like hand flapping, rocking, eye blinking, as well as headaches. For that, it is better to have incandescent lighting sources with dimmers to control the preferred illumination, because of the steady and stable lighting output. Majorities of the researches pointed out the importance of incandescent lighting collaborating with daylight instead of fluorescents. Also it should be applied hidden to autistics' eyes, and should fall indirectly to the spaces.

➤ **Colour**

Colour as an element has an incredible role in human mood and perception. Architects and interior designers always depend on colour for most acceptable visual environments, or sometimes to create illusions of length, width and height of the spaces. Colour is also considered as one of the simplest and the most economical ways for being applied to the spaces in spite of its effective influence. Autistics, more than neuro-typical brain individuals could be influenced by colours, for having these sensitivities which vision difficulty is one of them.

According to Autism classroom (2013) (a site which is designed to provide assistance to educators who are educating children with autism), colours can be classified as below regarding to their effects to autistics.

- a. Red: it has negative influence on autistics' brain, increases heart rate, aggression, respiration, and also the appetite. It is more stimulating, intense and overwhelming.
- b. Green: it is most preferred colour by autistics, it makes them relax and it is easy to eyes. It is used with more colours. All of its tones are considered to be positive to autistics except lime green tone.
- c. Blue: it represents calmness and has a positive impact on autistics' mind. Increases productivity, rest and loyalty. It reduces the appetite of food. Darker tones produce sadness and depression.
- d. Yellow: it strains eyes and causes distracting, anxiety and anger.
- e. White: it gives energy, refreshing and pristine. However, if it is used too much becomes boring.
- f. Purple: it encourages rest and makes feel warmer, for example, if it is used in a space with the same temperature of a blue room.
- g. Black: it is among these colours which have negative influences on autistics. It gives them depression, fear and agitation.
- h. Grey: it is described as negative as black, while lighter tones are more preferred.
- i. Brown: it makes rooms more intimate and feeling cosy, also beige tones open up small spaces, and positive in bed rooms.
- j. Pink: it is put under the favourable colours by autistics, makes them calm and happy. But during being a long time in pink rooms, autistics feel stressful and anger.
- k. Orange: it gives energy, be useful if it is used in play rooms.

Furthermore, Tracker and Media, (n.d) illustrated that, tranquil hues as pale blue, soft green and muted purple are amongst most suitable colours for ASDs, because they

should be in a calm environment with a colour which gives them rest and this would be soft hue colours, also neutral colours like Ivory, beige, light mocha, muted teal and soft grey are muted colours they could be used in their spaces.

➤ **Shadow**

Autistics are unbearable to adapt changes around, they like experience their daily routines without alternations. Shadow is one of the occurrences which possibly makes changes in interiors due to inappropriate lighting distributions. It is reported that shadow has a negative effect in places for autistics. It is believed that shadow could change the tones of the colours, which is a change for them when they see two different tones beside each other caused by the shadow (Henry, 2011).

Similarly, Humphreys (2008), based on observation of his autistic brother, has designed window openings with chamfered corners to diminish shadow of daylight. Humphreys has observed his brother's emotions when he has been in a space with different shade and light patches. Because autistics feel strange if they settle in a new place. Shadow gives autistics the sense of transformation, which may occur during different times of a day. They may see colours dissimilar and finally it could distort their perception.

A good electric lighting system will have the potential to reduce shadow, especially for some areas like corniches and corners. In under shaded areas colours might possibly lose their exact characteristics as value, hue and saturation. Therefore, shadow may trigger a bad influence in interiors for autistics.

➤ Glare

Florida Solar Energy Centre (FSEC) illustrates the causes of glare inside the buildings as “There are many potential sources of glare within buildings. They include direct sunlight, reflected beam sunlight, a bright window surrounded by dark walls and furnishings, poorly designed electric lighting systems, and improperly used luminaries” (URL 9, 2014). From this point of view, controlling lighting sources in designs for autistics is crucial, because of having visual sensitivity in autistics, glare absolutely can confuse and distract them. Also glare has a negative influence on autistics’ perception. It is stated that wherever the glare exists, it will distort autistics behaviours, it will make them confused and they cannot see their surroundings as well (Henry, 2011).

Torky, AbdelRahman and Rashed, (2013), endorse using of natural lighting, through using of clerestory windows in a way far from creating glare. Windows and light passages should be designed curiously, to prevent glare in spaces for autistics. Huge window panels and bright-painted walls must be avoided in design. Instead, mute colours should be applied and small windows but more in numbers should be placed. Illumination of walls, ceiling and furniture must be homogenous, to reduce the effectiveness of glare, at the same time window shades and trees have to be engaged perfectly, so as not to let the sunlight enter the spaces directly which probably creates glare (URL 9, 2014). Furthermore, infiltration would be conducted for sun lighting by skylights and tall-side windows as White (2009) has mentioned.

An improper electric illumination system produces more glare in spaces, particularly if the lighting sources are not hidden (Mostafa, 2003; and Henry, 2011).

Shiny floors, furniture and other coverings inside will increase glare's intensity and its amount. Every glass, most possibly those which are placed in doors or any other inner windows which does not have a function to look through, should be tinted glasses. Dining and teaching tables should be made of a non-reflective material or upholster with a preferred colour cloth. Precautions to provide a glare free environment for autistics, may probably promote their peak emotional state, and will assist them in learning quickly after all.

3.1.3.3 Touch

Touching is considered as one of the effective senses in design of autistic spaces. The sensitivity to touch vary according to the types of autism, for example, a person with hyposensitivity needs body stimulation and seeks for touching everything to make him/herself relaxed. They are known as sensory seekers. Quite oppositely hypertensive ASDs escaped from touching the things, even they have difficulties with their clothes. That is why they seek for some smooth objects (Autism Discussion Page, 2013).



Figure 19: Squeezing play tools for hyposensitive ASDs (URL 13)

Design of a suitable interior space for hyper sensitive ASD individuals could be achieved via considering textures of finishing materials, furniture, and types of carpets using in interior spaces as the surfaces should be soft and have least friction to touch.

Also hyposensitive individuals need some stimulating play equipment, similar to ‘Temple Grandin’ squeezing machine, as shown in Figure (12) to be included in the space.



Figure 20: Temple Grandin’s squeezing machine (Grandin, 1992)

Grandin was diagnosed as autism when she was a child and her type of autism was hyposensitive, that is why she was sensitive to touch. Thus she invented this machine to stimulate her body as she says after using it she tolerated to be touched by others.

Contrarily, hyper sensitive individuals affect even by their clothes. They are very sensitive to any kind of textures. They like soft and gentle surfaces. For that reason, every furniture, carpet, play toys, and curtains have to be considered carefully, so as

not to distract them. Touching water and swimming is observed that has positive influences on autistics activities and perceptions (Hatch-Rasmussen, 2015).

3.1.3.4 Taste

Generally, autistics want to taste known and unknown materials around. So it is vital to consider in design using safe materials, and any kind of toxic materials should be avoided (Autism discussion page, 2014). Wall paintings may be one of the cautions, because most of the paints contain anti-bacteria in content. This chemical materials have hazards to autistics.

Any kind of toys should be avoided which may work with alkaline batteries. These batteries can leak during after a period of using, these chemicals are dangerous liquids which is poisonous. These are dangerous if the autistic children put them in mouth while playing.

3.1.3.5 Smell

Again there is a difference between the two kinds of autism according to sensitivity to odors. Hypo sensitives are indifferent about odors, or they require strong odors to stimulate their olfactory sense. While hyper sensitives are highly responsive to any kind of smell. They may smell toilets and kitchen from their classes easily.

Similarly, The National Autistic Society (the leading UK charity service for autistic and their families, which they provide information, support, and pioneering services) argues smell issues in autistics as: “People with autism can become overwhelmed by subtle smells that you may not even notice, such as someone's deodorant or perfume, or the smells of fabrics, etc. Clements and Zarkowska (2000) suggest using a background fragrance in space to block the intrusion of uncontrollable smells” (The National Autistic Society, 2015).

For that reason, it is better to have zones in design for autistics, by means of functional grouping, in a way that kitchen and toilets being separated from the learning, playing and sleeping zones (Mostafa, 2003).

A proper ventilation and wind direction in the buildings also has impact on a suitable odorless indoor environment. Using exhaust fans and exiting ducts also work for this purpose. Kitchen and toilets should be carefully placed in the main design, regarding to orientation, wind direction, and relation with other spaces. Air circulation and natural ventilation will be significant in design. Also furniture and any other tools that may make smells should be carefully chosen, because smell may influence autistics perception then it will cause triggering behavioral conversions.

Another point which have to be kept in mind is being aware of off-gas producing materials in furniture and wooden substances. These materials have the potential to lower the indoor air quality. It may change indoors to a sick building syndrome which has a negative effect on human beings as a whole and particularly for autistics.

3.1.3.6 Body balance (vestibular)

Dr. Edward Ritvo (2013) defines vestibular system as: “A system in the body that is responsible for maintaining balance, posture, and the body’s orientation in space. This system also regulates locomotion and other movements and keeps objects in visual focus as the body moves” (Ritvo, 2013). Also Hatch-Rasmussen (2015) defines vestibular system as:

“... System refers to structures within the inner ear (the semi-circular canals) that detect movement and changes in the position of the head. For example, the vestibular system tells you when your head is upright or tilted (even with your eyes closed). Dysfunction within this system may manifest itself in two

different ways. Some children may be hypersensitive to vestibular stimulation and have fearful reactions to ordinary movement activities (e.g., swings, slides, ramps, inclines)”. (Hatch-Rasmussen, 2015)

As autistics have defects in this sense also, from this point of view, they may not be able to keep body balance and orientation like neuro-typical ones, and their brain and body are not functioning with each other properly.

Balance insufficiency is different in both types of autism. Nonetheless, in both kinds is abnormal. For instance, hypo sensitive individuals becomes too active. Hypos; are highly vigorous in climbing and jumping from the vertical objects without any fear and dizziness. For that reason they rarely sit, and for the safety issues they always have to be observed. Because they look for something to stimulate their sense of balance. But Hyper sensitive autistics have problems with keeping their statue vertically. They cannot control their movements during walking or playing. They do not have ability to walk easily upstairs since they may fall down.

Design considerations for hyper sensitives should contain self-supporting elements so they can fix their body forwards. All types of handrails, stairs, and outdoor steps should be thought carefully, because most probably they can climb these things and it may cause them safety problems.

As a response for this situation, design for autistics should provide spaces for therapies related to vestibular sense so as to train them and change this deficit. Additionally in interior spaces soft materials should be used to cover the walls and floors. Also design should be a well-ordered space and should have a clear axis

especially in transitional spaces like corridors, to avoid confusion. Right angular walls and cluttered spaces will affect autistics negatively (Humphreys, 2008).

3.1.3.7 Proprioception (Stimulation to Joints and Muscles)

This sense which arranges the body and the brain function related to movement is dysfunction in autistics. Their body may not in the tune with the brain when brain sends signals.

Also it could be explained as position of human body related to surroundings. Kennedy (2010) describes proprioceptive sense as: “The proprioceptive sense, is entirely related to the position and understanding of an individual's current location. It is the ability to feel, understand and visualize the body and the relationship between its parts” (Kennedy, 2010; P.1). People who have difficulty with this sense suffer from lack of coordination in movements. Body joints, muscles, and brain do not work together. These people may do not have ability to perform simple physical activities. Furthermore, most of bizarre habits of autistics such as hand flapping, stomping, and rocking are related to the proprioceptive sense.

Hypo individuals are not aware of their body position in space, they have a lot of accidents in the surrounding environment, and by all means they are clumsy, for this reason a neat and free barrier indoor space is perfect.

Hyper individuals have difficulties with concentrating to small objects regarding to moving activities. For instance, it is not easy for them to play with a small ball or working with a small painting brush. Also when they want to see something they intuitively move their whole body towards it. It seems to be logical if the design could provide explicit messages visually. For that reason they need support by

providing simple climbing and hanging play objects, clear visual clues from passages, supportive elements like; chairs, tables and handrails to regain their posture (Kennedy, 2010).

Every furniture, using tools, and visual guidance have to be expected far from any visual illusions, so that they could perform their activities in a right way. Also they need to add soft materials, and round furniture edges to be saved from impacts. Placing standing columns in transitional spaces may create some circulation problems for them.



Figure 21: supportive play for proprioceptive impairment (URL 12)

Other Considerations:

➤ Proportion and Visual Characteristics

Autistics are sensitive about proportions of the spaces. Small spaces may make them suffocating, while huge spaces may confuse them and they feel that they are lost. Open plans and long spaces give them visual distraction, therefore, they cannot find their way easily.

The furniture used in the centres should not be chosen randomly, rather they should be chosen carefully in respect of colour, dimensions, textures, and free of decorations. It recommends that all spaces should contain cupboards to collect all equipment and toys when they are not in use.

Any movable object like fans or exhausted fans or any other things like them will affect autistics' attention, these kind of devices also may produce sounds during working so they should be avoided in autistics' spaces.

It is generally said that autistics need wider spaces, a proper space for better imagination. This adequate space could calm them down and offer them rest, however, it is researched that hypo-sensitive individuals mostly feel comfortable in smaller spaces. "Hypo-tactile autistic users seem to prefer small intimate spaces" (Mostafa, 2003).

This means that, proxemics will vary from the two main hyper and hypo sensitive autistics. So it is essential in education spaces that students be settled according to their hyper and hypo sensitivities. Because hyper ones could not stand in tiny spaces whereas the situation for the hypo individuals is quite opposite.

Also for transitional spaces the wider space is required due to the repetitive behaviours of autistics because they flap their hands during walking. For that reason corridors and other transitional spaces have to be wider than the normal spaces which may design for neuro-typical children's schools. There is another benefit of these wide corridors where may be a chance for autistics to have social relationships (Coen, 2012).

➤ **Calm Rooms**

These spaces sometimes called ‘withdrawal spaces or quiet spaces’. According to the autism experts having these spaces are very essential. A calm space in learning classes can be a corner of the class or an alcove might be prepared, so that autistics can enter it during their tantrum and anger (Coen, 2012; and Puckette, 2013). The space may act as a temporary soothing shelter.

Likewise, another calming space is needed in the autistic centers, where it can contain as soothing elements for autistics such as play tools, suitable colour, preferred touching surfaces, a good acoustic and a quite suitable light (Autism speaks, 2016). This place can be used when the autistics cannot sooth in the temporary calm spaces in the classes. Autistics in this place may feel most private (Puckette, 2013). The calm space should only be used during extreme situations, so as not to let them alone and forget about social relationships, which is one of the impairments of autistics.

3.1.4 Design Responses According to Developmental Disabilities

The first difficulty on autism which could be easily noticed is developmental disability. Autistics have neurodevelopmental disorder which is lack of imagination, social interaction, sensory difficulties, communication, and behavioral changes (Autism Speaks, 2015). It is important that spaces designed for autistics consider these insufficiencies in autistics too. For that reason, it is observed that some autism center designs provide ample spaces for this purpose.

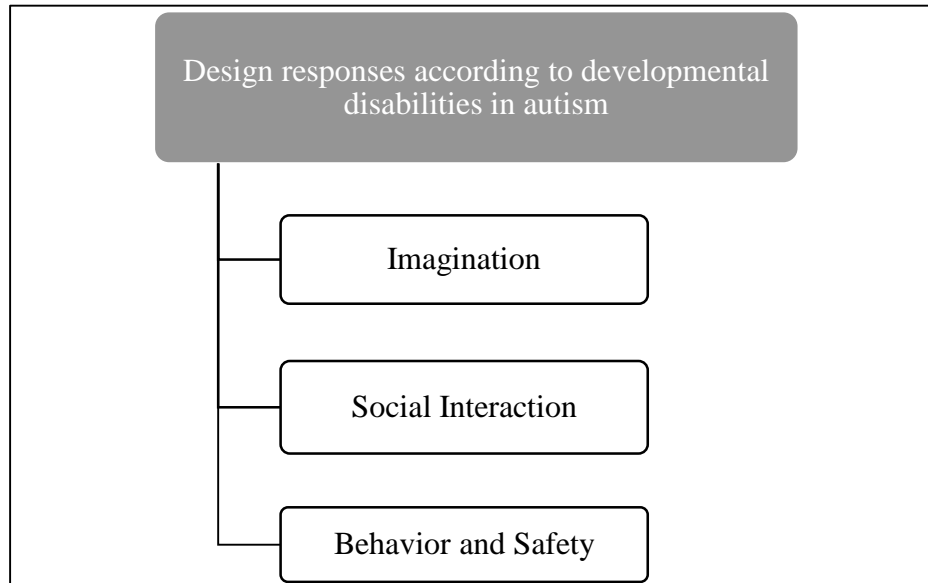


Figure 22: Design thinking according to developmental disabilities in autism (Prepared by Author)

3.1.4.1 Imagination

Lack of imagination in autistics will affect their performance in space. In other words, they may have difficulties in transitioning from place to place, because they may not have a good cognitive map in mind. Therefore, they need guidance and expressions to find their way in surrounding spaces. Sometimes colour will be a guide or pictorials will help them as in Figure (22).



Figure 23: New Manhattan school sensitive to the needs of autistic students. Playing with colour to provide easy way-finding (URL 17)

3.1.4.2 Social Interaction

A design for autism should encourage social interaction between autistics themselves and with other people. However, they may be confused in crowded spaces. In most of the designed centers for autism, a central courtyard is available where this place urges autistics to interact with each other. Furthermore, some designs provide some places even in corridors which are transition places to enhance communication and interaction with each other, which is shown in Figures (24).

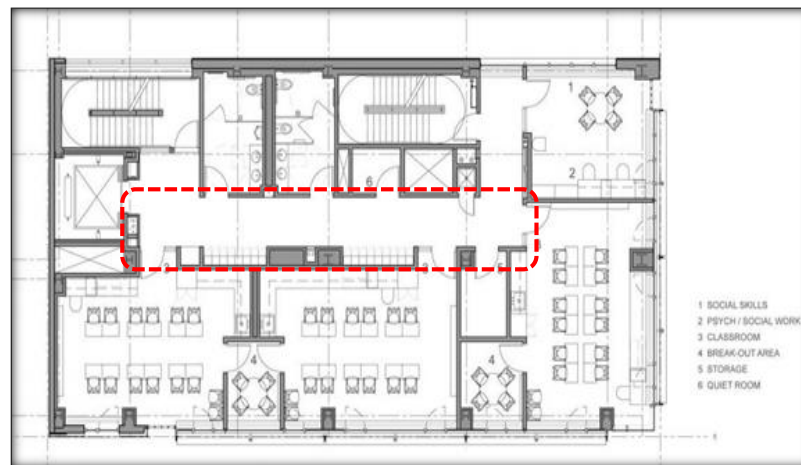


Figure 24: LearningSpring School in New York. Designed by: Platt Byard Dovell White Architects. Quiet alcoves can be found off the corridors throughout the building to promote informal socialization (Coen, 2012)

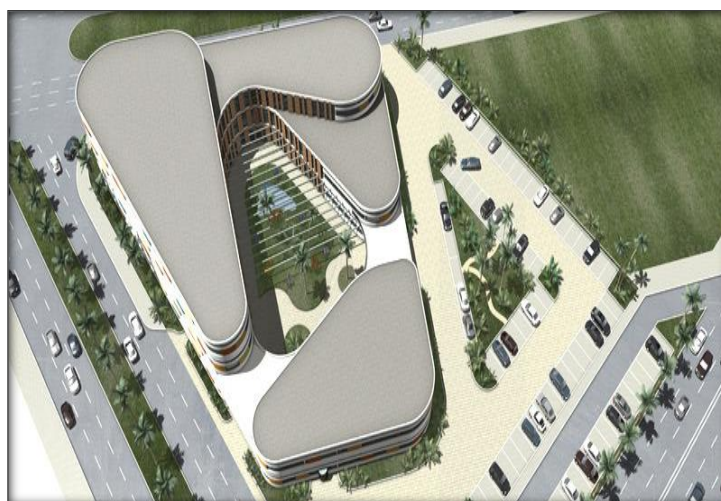


Figure 25: Dubai Autism Center, central courtyard (URL 18)

3.1.4.3 Behavior and Safety

Autistics' behaviors have to be thought in interior spaces, because sometimes these behaviors could trigger problems and self-injury during aggressive actions. Every design element like, colour, material, lighting, furniture arrangement...etc. could be considered for the sake of providing a calm place for the autistics. The designers should pay attention to bathroom fittings in a way that not create hazard to them, they should be placed properly and be placed in a suitable height. Height of electrical switches and devices is on other subject, because autistics are curious about how things may work so it is probably possible to do wrong actions with these things, also any kind of electrical wires should not be seen so as not be bitten by them. Door handles should be designed in a way being safely opened and closed and any kind of one side locks should be avoided. Using non-slippery tiles in autistic spaces is necessary as due to their unusual movements they may fall on slippery tiles. Revolving or double-part double-swing movable doors cause autistics feared, because of the visual distortion produced by these doors, so have to be avoided in autistics' spaces. Providing frameless chairs is important to have a safe sit and so that they cannot climb the sides. Handrails' should to be fixed and their properly height should be considered. Furthermore, horizontal bars should not be used so that they cannot climb. Using transparent plastic panels for windows except of glass is better to have as plastic is less fragile and unbreakable (URL 25).

Chapter 4

CASE STUDY

4.1 Introduction

The study field of this research is Iraqi-Kurdistan where the researcher has come from. It is situated in the North of Iraq, and constitutes of four main governorates ‘Erbil, Sulaimanyah, Duhok, and Halabja’. In all governorates except Halabja, the government has opened an autism center with a considerable attention; also parents with autistic children have a salary from the government. These centers start with primary schools’ time and they have summer holiday, it means that they are not always open. The centers are not specifically designed as autistic centers except ‘Duhok’s autism center’; instead of this the government has rented random buildings.



Figure 26: Iraqi Kurdistan map (URL 11)

These centers offer the autistic children speak and body therapies, and some learning and psychological programs. Furthermore, the private sector is also working on opening new centers for the same purpose. There are a lot of private organizations focusing on autism in the country, such as: Autism Association- Sulaimanyah branch, Autism Blue Organization, Sulaimanyah Autism Society ...etc. some of them have opened centers and branches. Many people are working in these centers as therapists, psychologists, sociologists, and pediatricians.

According to informal data there are nearly 1500 children who have diagnosed with autism (URL 27), whereas it is expected to have over 10,000 autistic children in Iraqi Kurdistan, supporting by the population of Iraqi Kurdistan and the increasing rate of autism. There are some reasons behind having low number of autistic children in the centers like cultural habits so parents sometimes would not want to accept that their children have autism. Also there is another reason which is lack of enough governmental autism centers as compared to the population in these cities, for many parents it is not easy to pay money for the private centers.

The researcher visited and made observations in two private autism centers, one in the city center of Sulaimanya governorate and the other in Ranya town. Both of the centers are opened by Autism Blue Organization. The questionnaires were filled by autism centres' personnel (Psychologists, Sociologists, and therapists), also by parents and siblings of autistic individuals. 60 questionnaires were provided, nonetheless, 57 of them were returned. 45 questionnaires have responded by autism centres' staff and 9 by parents and 3 by siblings of autistics. The purpose behind having this variety of respondents is to obtain the required knowledge from different sources.

4.1.1 Sulaimanya Blue Autism Center

Sulaimanya is the most populous city in Iraqi Kurdistan, more than half million population live inside the city. The autism center which was visited by the researcher is situated almost in the city center. There are many activities in the area like the biggest park, and most famous supermarkets which they make this area a very crowded place.

This center has 87 autistic children and 45 staff members. The staff consisted of varieties of professionals such as: psychologists, sociologists, and therapists (Speech and Physio therapists). Some of them had a long time experience of working with autistics.

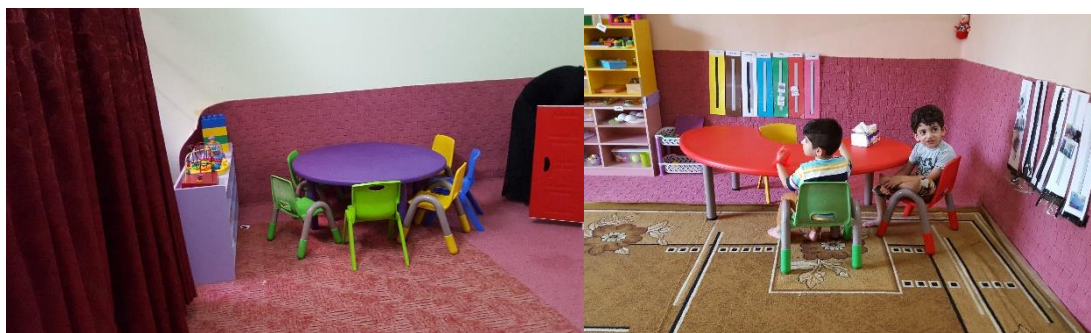


Figure 27: Interior of Sulaimanya Blue Autism Center (photo by author)

The building of this center was originally built as a residential house, nevertheless, they tried to change somethings. The walls were covered up to 1 meter high with carpets to save the children from hitting their heads to the walls. In the center a dark room is provided for the moments of children's tantrums. The staff reported that they can calm down kids' angriness in this room, because the children start to think and keep silence.



Figure 28: Sulaimanya Blue Autism center, creating compartments by arranging furniture (photo by author)

Inside some classes the furniture was arranged in a way to create some compartments. These defined spaces were somehow having privacy where autistic children may feel more comfortable during learning or rest.



Figure 29: Entrance of the center and the red curtain used (photo by author)

Every defined place is prepared for two kids so as to sit together and have a kind of social relationship as much as possible.

The lighting system is the same as before, there are all fluorescents, and electrical switches are too low for kids and they can touch them easily which seems be unsuitable for autistics. Also there were ceiling fans and exhaust fans which were used when needed. Inside the building there were some steps between the corridor and W.C. also between entrance and outside it had two steps. The outside environment of the building had no definite function and perhaps was not used by the center, somehow it was neglected.

Colour of interiors are aimlessly chosen for the spaces, it is a combination of hot and cold colours. In some places like the main entrance a red curtain is used which covered a wide area. Instead of that it was possible to use another cool colour and it would become more attractive for autistic kids, because cool colours are most preferred by autistics. Bright tones are used in some places, and furniture and toys are almost bright. Colours of some carpets are too crowded and seems to be inconvenient as shown in Figure (26).

Least view is available for the autistic kids, which is psychologically constructive for autistics. Windows as other elements are designed for a residential home and are too low. Also a single thin glass is used for the windows which makes it dangerous for kids, also the glasses are painted up to a height of almost 70 centimeters. The staff explained that painting is to capture the autistics' attention to inside rather than outside.

The spaces of the center possibly are not quite potential for social interaction of the children together, except some of the classes, due to the main design of the building. Even the main corridor which is in between the classes and administration is not quite wide to have a gathering. It is only used for passing.



Figure 30: Sulaimanya Blue Autism center, having steps between spaces (photo by author)

4.1.2 Ranya Blue Autism Center

Ranya is a town situated in the north east of Sulaimanya governorate. According to statistics of 2008 its population is nearly '200,000' inhabitants (URL 10).



Figure 31: Ranya Blue Autism Center (photo by author)

Like other cities and towns in the country here also there are a lot of autism cases, however, little of them have been educated and allocated in the special centers. There is no governmental autism center in the town. The only autism center is 'Ranya Blue Autism Center' which has established at the beginning of August 2015. There is just 5 autistic children in the center, but the staff were waiting for more in next days. Four people were working as main staff in the center and all of them are psychologists. And all of them have the experience less than 5 years with autistics. The physical environment of the center is simple and not very satisfactory. The building is in a neighborhood opposite to a secondary school. This center was in a quiet place as there is not a crowded transportation in the area.

The building was a residential house before, new furniture is provided, and it is considered that the building needed to be re-painted. Some specific furniture is also supplied like trampoline, indoor swings, studying tables and chairs, with lots of colourful toys which are used as learning tools.



Figure 32: Ranya Blue Autism Center, Interiors (photo by author)

Air cooler system are used for the cooling of the building. The main design of electricity is like before which appears to be unsafe. Fluorescent lighting is applied inside of almost all of the spaces. The outdoor of the center is covered by concrete and it is too small to have an activity in it. Windows and doors are made of metal and are too old, rust has covered most parts of them. Very few acoustical solutions is applied for the building, the walls and ceilings are all covered by a layer of gypsum plaster. Oil painting is done for almost 1.2 meter of the walls, and it is too shiny and bright. Glare is created clearly in some spaces due to the orientation of the windows and the oil painting.

Forty five questionnaires were filled by people working in these two centers, some were done during the working days of the centers, and the others were filled and resent them by emails.

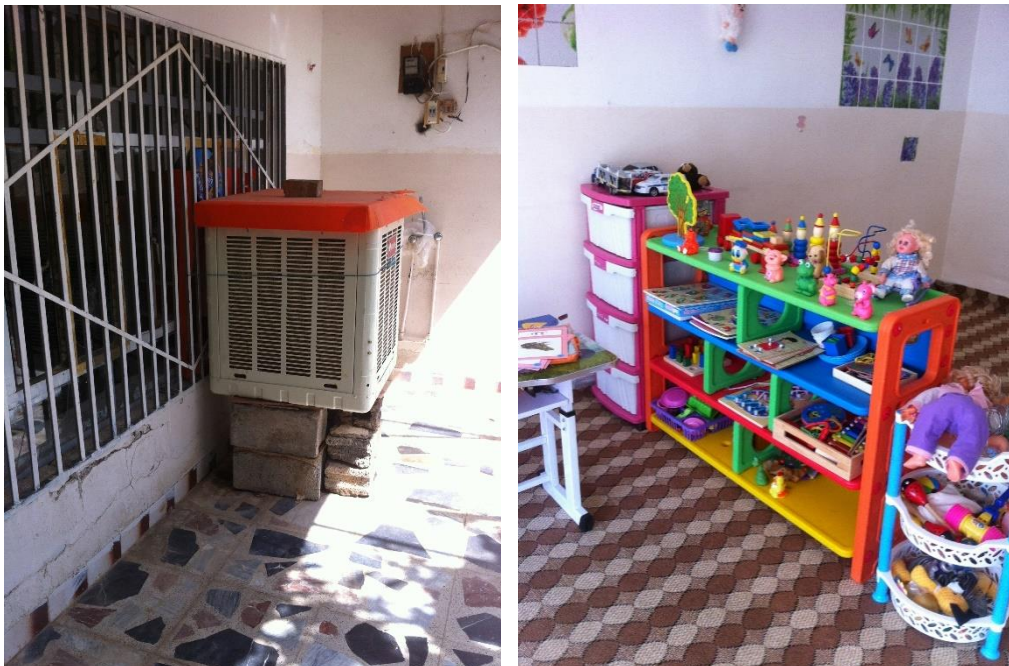


Figure 33: Ranya Blue Autism center, Furniture, and cooling units (photo by author)

The rest of the questionnaires were answered by parents and siblings of autistics, therapists, sociologists, and psychologists outside the centers.

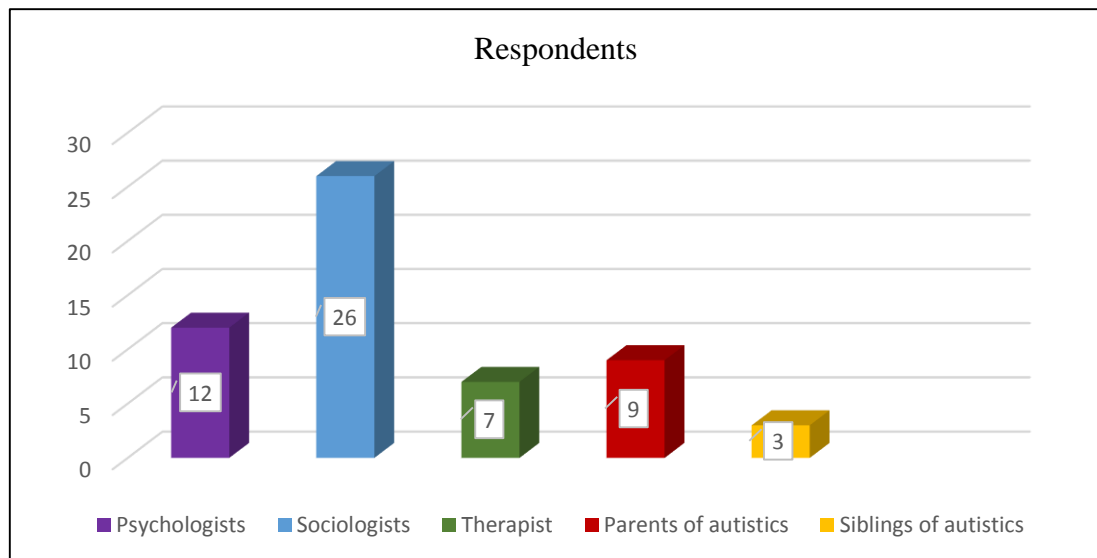
4.1.3 Questionnaires

For the purpose of data collection for this thesis a structured questionnaire was prepared. Which was a mixed questionnaire, contained both closed end and open end questions. It was prepared in English for autism centers' staff, families with autistic children and autistics' siblings, nevertheless, it was translated to Kurdish because very few number of respondents had known English. During data collection the researcher could find other autism experts outside the autism centers, who have knowledge on autism and they answered the questionnaires too. Some of the questionnaires were answered and sent by email after a month. The researcher visited some therapy centers which many experts were working there for speech and physical therapy, and he had the chance to meet these therapists and asking them these questions which presented in the questionnaire. The sample of the questionnaire is given in 'Appendix' part. The researcher also visited many families with autistic children to ask them the questions and learn more about autistics behaviors and desires in space, as some of the families did not let the others see their autistic kids nor they sent their autistic children to autism centers, because of the some cultural issues. Some families separated their kids and treated them differently. After one month of seeking and visiting autism centers, family homes and therapy centers, 57 questionnaires were answered which the answers mostly were in Kurdish. After that these answers were translated to English, evaluated, analyzed, and compared to the results which were obtained from the literature. So as to prepare a guideline for designers and architects to be useful whenever they design spaces for autistics.

4.2 Data Analysis

Questionnaires:

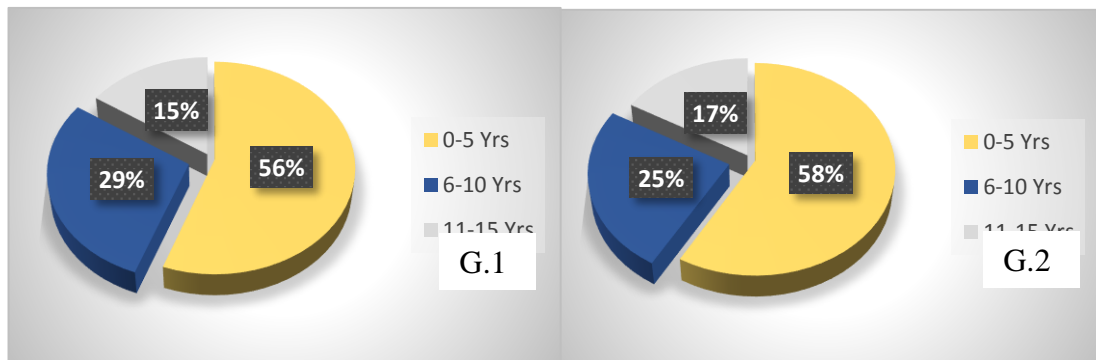
The prepared questionnaires were filled by two different castes: (G.1) experts (Psychologists, Sociologists, and therapists) and (G.2) families with autistic children (parents and siblings). There are a difference between the evaluations of the two groups, as it can be seen families with autistics have limited information about general characteristics of autism because they may have a chance to observe only their own children, while the situation for the experts is not the same.



Graph 1: Categorising respondents of the research

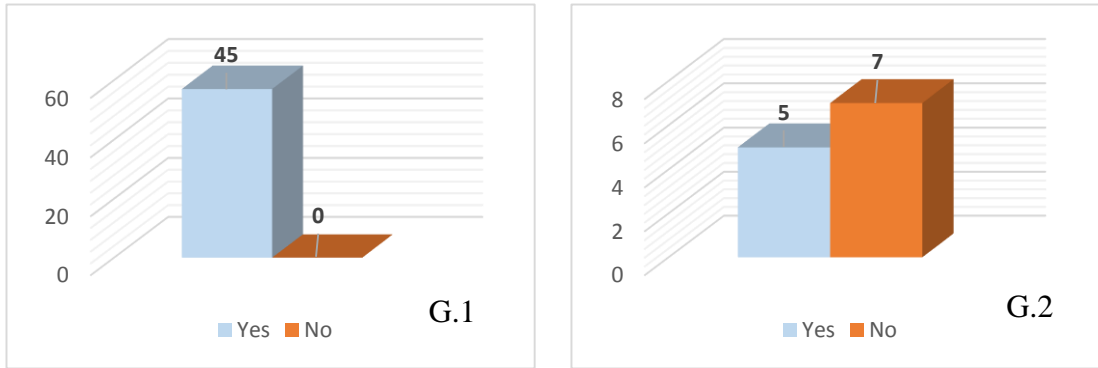
Autism centres have numerous children with different types and degrees of the disorder who are taught by the first group. Besides, because of their educational background during their study in universities and institutes, at least they have a kind of awareness about autism. Also the rate of participation of this group is more than the families, so in this research responses from this group is rather being considered. That is why the outcomes of the experts and the families with autistic children are separated.

- For the question “**How many years have you been living or working with autistics?**” majorities of the respondents of both groups ‘G.1’ 56% and ‘G.2’ 58% had the experience under 5 years with autistics. Only 29% of respondents in ‘G.1’ and 25% of ‘G.2’ had experience over 6 years. The rest who have experience over 11 years are 15% in ‘G.1’ and 17% in ‘G.2’, as shown in graph (2).



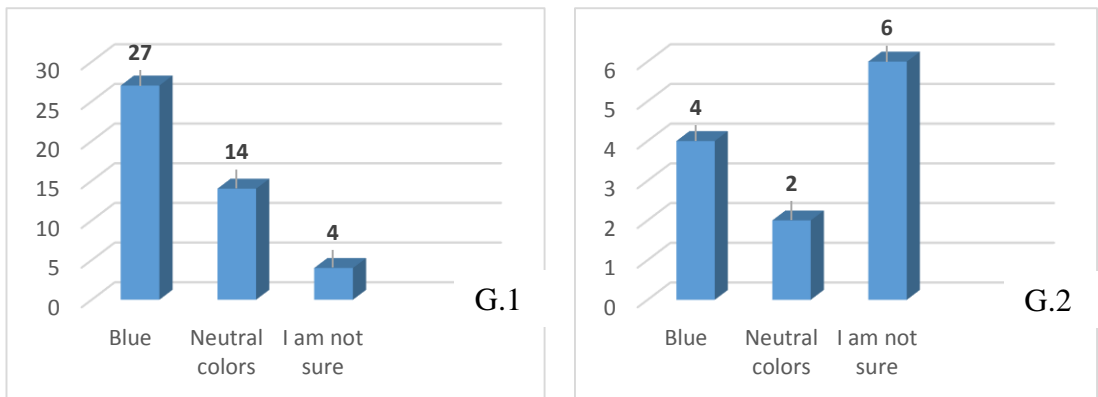
Graph 2: G.1 and G2, experience with autism in years

- The first question related to the research topic was about colour. It was a general question about their idea whether they believe that colour may affect autistics’ behaviors. The answer was 100% ‘Yes’ by all the respondents of ‘G.1’ and 42% of ‘G.2’ 58% of ‘G.2’ answered ‘No’. It shows that all of respondents of group one are aware of colour impacts. While the subject of colour does not fully understand by families with autistic children.



Graph 3: Impacts of colour on autistics answered by: G.1 and G2

- For the question of **“Which one do you believe is more suitable to be used in spaces for autistic children: white, neutral colours (greys, etc.) cool or others?”** most of the centers’ staff (G.1) believed that blue is the most familiar colour that is preferred by autistics. At the same time 31% of them agreed on the positive role of neutral colours on autistics senses and 9% was not sure about the subject. While the families seemed to be unsure of the subject as it is shown below. 50% of them were not sure and 33% also chose blue as the preferred colour by autistics, also 17% mentioned neutral colours as constructive colours for autistics.

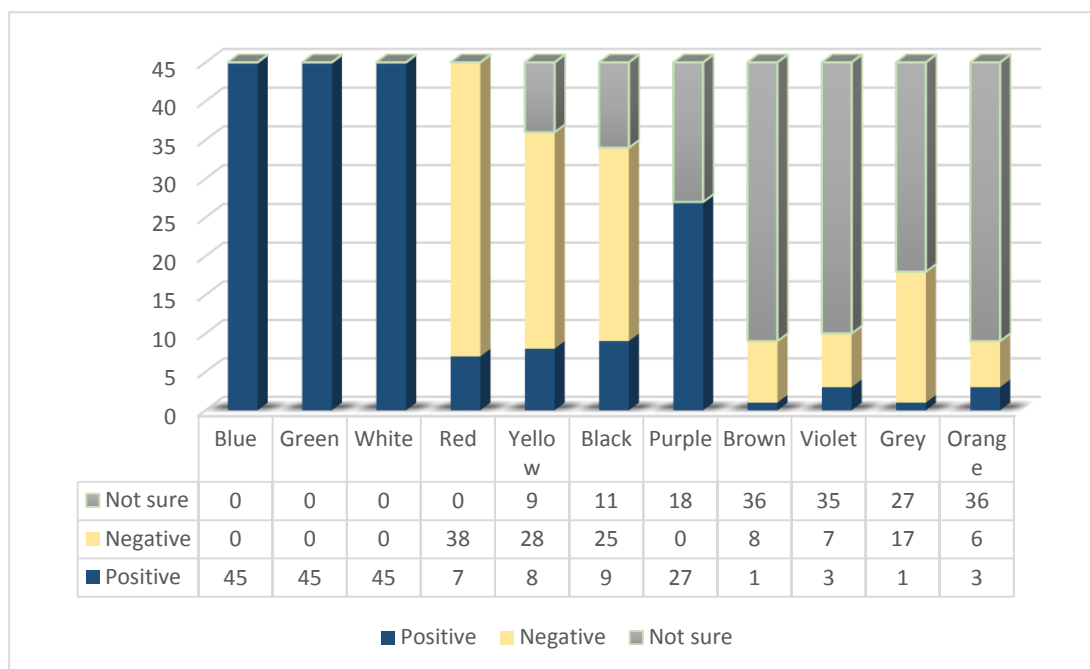


Graph 4: Colour preference by autistics answered by: G.1 and G2

- Consequently, the next question was more direct about all colours which were mentioned by them. The question was **“According to your experiences which**

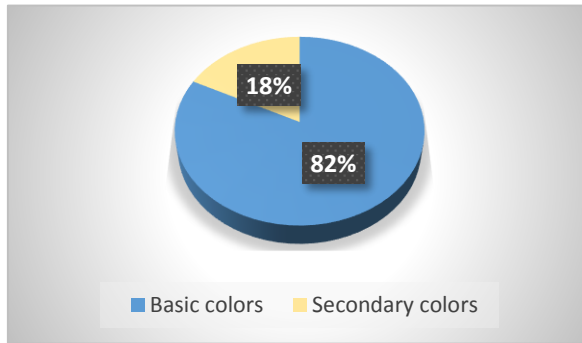
colours have more impact on autistic children? Which ones have negative, which ones have positive effect on them?” blue, green, and white were 100% accepted as positive colours by ‘G.1’. Also purple was among the positive colours.

Conversely, red, yellow, and black were distinguished as most negative colours to autistics. When other colours like; brown, violet, grey, and orange seems to be unknown to them to decide if they are positive or negative. For this question families of autistics’ participation was very limited, only two of them answered, they mentioned blue as positive and red as negative.



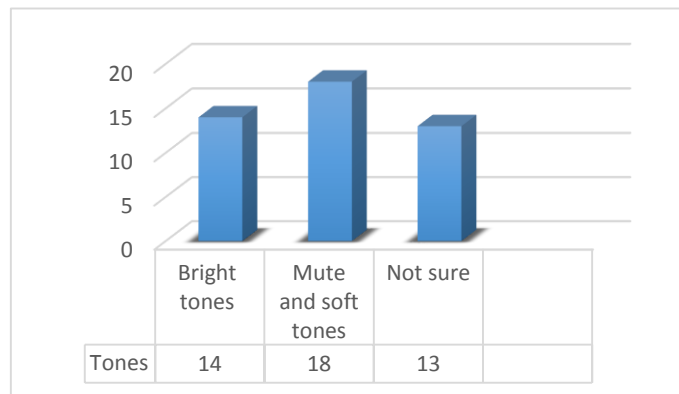
Graph 5: Colour preference by autistics answered by: G.1

- For the next question **“Which pattern of colour do you believe could be used for autistic children? Basic colours like (Red, Yellow, Blue.) or secondary colours such as green, violet or orange?”** 82% of the respondents of ‘G.1’ were agreed to use basic colours rather than secondary or subdued colours. And 18% chose secondary colours. Again this question was not answered by respondents in ‘G.2’.



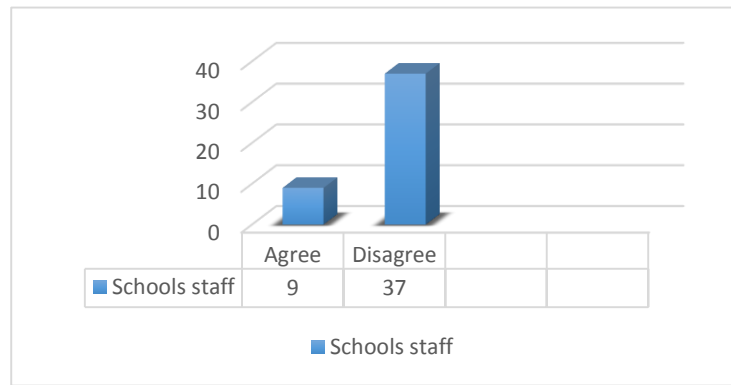
Graph 6: Basic and secondary colours answered by: G.1

There was a question about **“Which tones of colour should be used in spaces for autistics? Bright colours or soft, pastel ones?”** the ideas were different, 44% approved to apply mute and soft tones. It was observed that majorities of this 44% were therapists. Also 32% selected bright tones, and the rest were not sure about it. Only two of the family members (G.2) answered the question and both of them indicated bright tones.



Graph 7: Bright and soft tones answered by: G.1

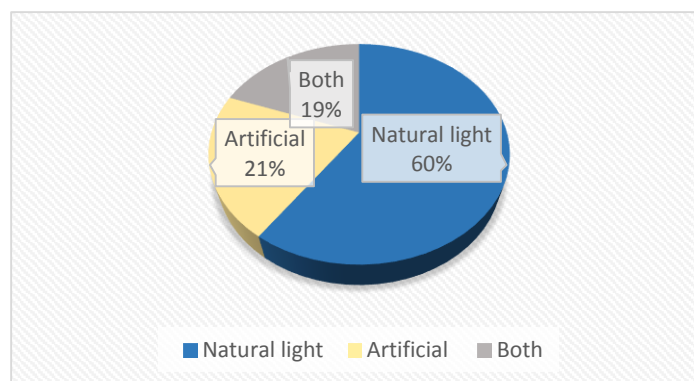
- The questionnaire contained a question about the colours applied in the centers, it was for those who were working in these two centers, as **“Which colours are used in interior of this school? Do you think they are suitable?”** 82% were disagreed to the colour which was applied to the interiors of the centers.



Graph 8: Colours used in autism centers, answered by: G.1

➤ **Lighting**

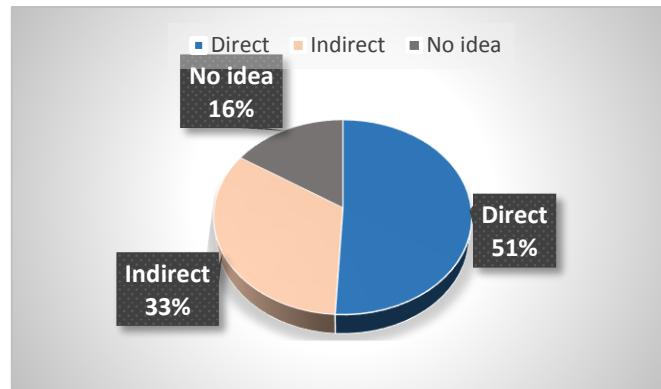
- The answer for the question about **“What kind of lighting do you prefer to be used in interior of the school?”** most of the respondents (G.1) 60% preferred sunlight or daylight (natural light) to be used in design of spaces for autistics. 21% agreed with artificial light to be substituted by natural light and 19% believed that both of them are important to be used in the spaces for autistics. ‘G.2’ quit the question.



Graph 9: Types of lighting sources to be used in autism centers, answered by: G.1

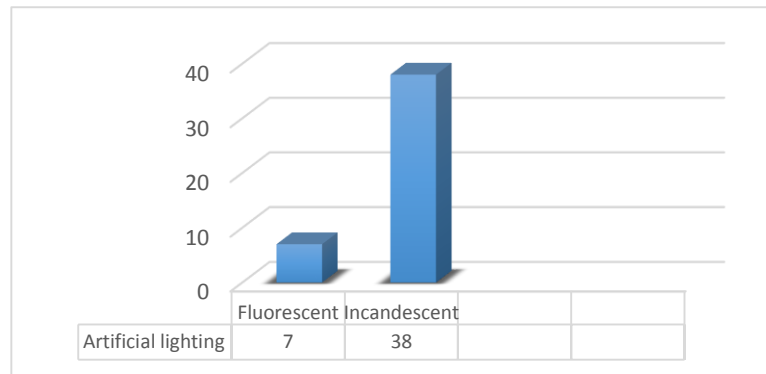
Another question about lighting was **“According to you which kind of natural light is better to be used in interior spaces for autistic people, direct or indirect?”**. Respondents in ‘G.2’ did not answered to this question, and for ‘G.1’ the

rate was like this; 51% thought that it is necessary to provide natural light in a direct way to autistic spaces. 33% accepted indirect way of entering light, while the rest 16% did not have any idea about it.



Graph 10: Way of applying natural lighting inside autistic spaces answered by: G.1

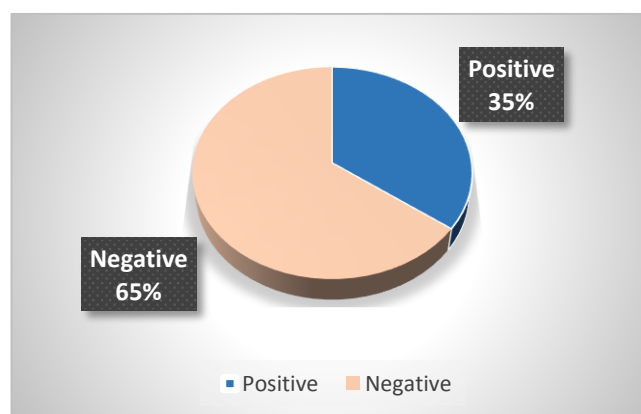
- A more specific question was asked about artificial lighting sources “**According to you which kind of artificial light is better to be used in interior of spaces for autistics, florescent, incandescent, etc.? Why?**” 84% of the respondents in ‘G.1’ agreed to use incandescent lighting sources, for answering “why” they stated that incandescent are most stable and soundproof as well as the kind of light is suitable for autistics brain. Nonetheless, 16% selected fluorescent lighting type as positive, they discussed that the produced light is most close to the sunlight so it does not distort their sense about real environment. Also three families (G.2) answered the question, and they marked incandescent lighting without any comment.



Graph 11: Fluorescent and incandescent lighting in autistic spaces answered by: G.1

- About using coloured lighting, 65% of respondents in ‘G.1’ did not prefer to use in autistics’ spaces for the possibility of confusing and obscuring the true colours of physical environment around them. Oppositely, 35% of them described coloured-lighting as a positive action, because they believed it may sometimes give them a different feeling especially during autistics’ tantrum and inside calm rooms.

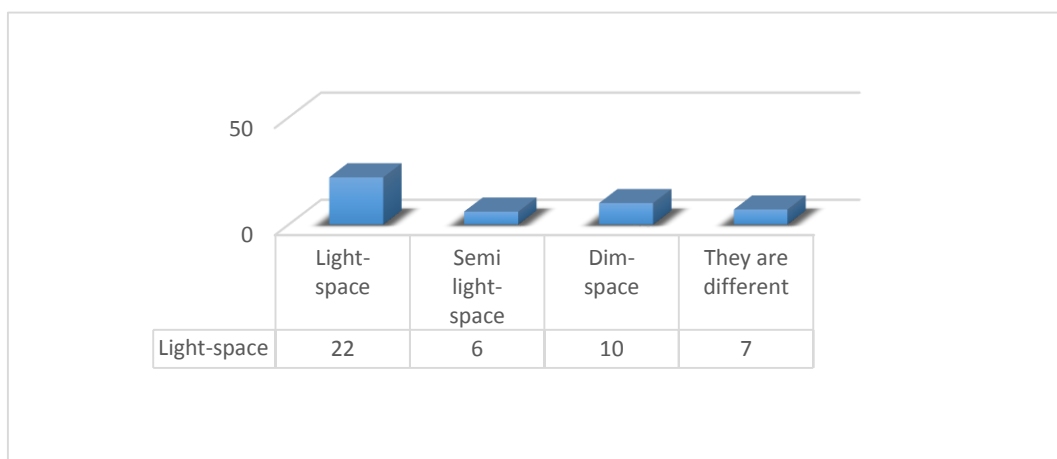
One of ‘G.2’ respondents filled this part and mentioned coloured lighting as positive to autistics’ mood.



Graph 12: Fluorescent and incandescent lighting in autistic spaces answered by: G.1

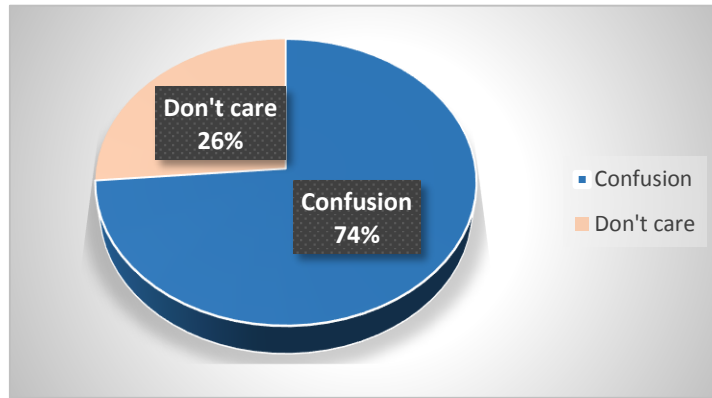
- The answers for this question “**Do autistics prefer spaces with a lot of light or more dim or shady spaces?**” were like this for G.1: 49% believed that a well-

illuminated space is the most comfortable space for them, because they may see things as they are. They pointed to the confession of autistics when they live in a shady place due to feeling fear and an increase in repetitive behaviors as the result, the rest marked different subjects. Just three of the families (G.2) answered to this question two of them selected light space and they illustrated that their autistic kids feel more relax in these lighted spaces whereas the third one chose they are different and it changes time to time even for one autistic child.



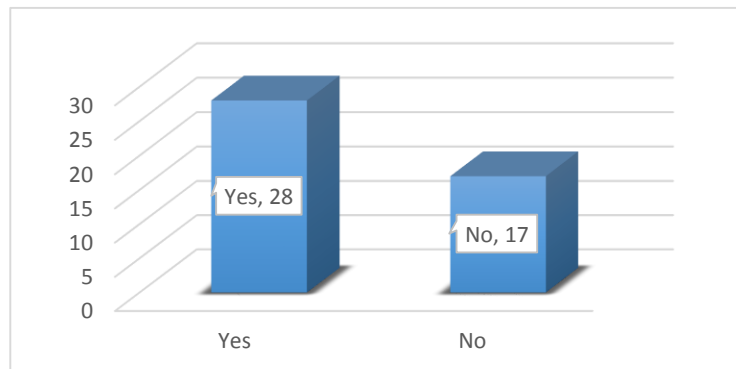
Graph 13: Lighted, shady, and dim spaces for autistics, answered by: G.1

- One of the questions was about glare influences on autistics **“Do you think that glare caused by light, has any influence on autistics’ behaviors? How?”** as a result 74% of the respondents of ‘G.1’ reported on the bad impact of glare on autistics’ perception. They said as soon as autistics may feel glare they will start confusing and losing their concentration. Contrarily, 26% said that they may not care about it. While only one family (G.2) answered this question and mentioned glare as a bad thing to have in autistics’ spaces.



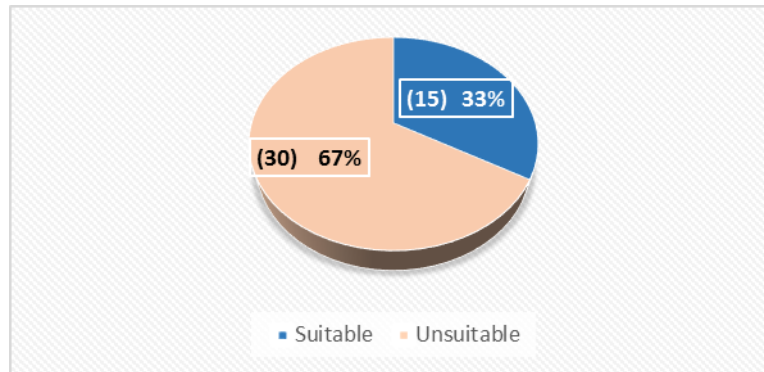
Graph 14: Influence of glare in autistics' spaces, answered by: G.1

- The respondents were asked about whether they had ever heard about the effects of the fluorescent light on autistics' perception or not, 61% of respondents in 'G.1' answered as 'Yes' and the 39% selected 'No'. Also all 'G.2' answered 'No'.



Graph 15: Having knowledge on Fluorescent's impact on autistics' spaces, answered by: G.1

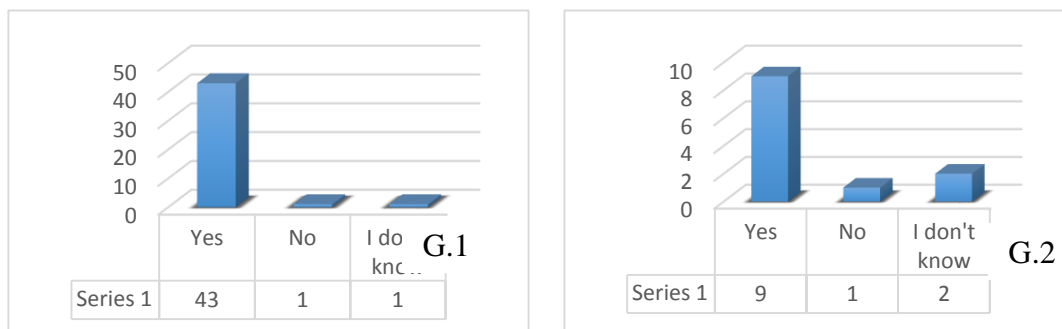
- A question was conducted about the types of lighting sources that were used in the centers **“Which kind of lighting is used in your school? Do you think it is suitable?”** all of respondents of 'G.1' stated that the most used lighting type which is used in the centers was fluorescent, 67% of them disagreed of that kind of light, and they supposed that this kind of lighting should be avoided due to its unfavorable effects on autistics' perception. And just 33% accepted the fluorescent lamps which were used in the centers. This question was not answered by 'G.2'.



Graph 16: Types of lighting used in centers, answered by: G.1

➤ **Acoustic**

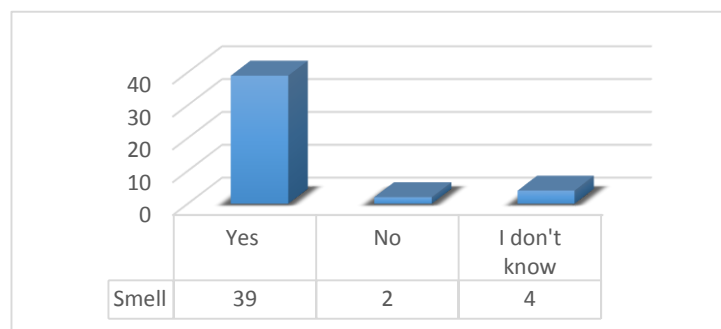
- Acoustic problems were among most mentioned matters by autism experts. To answer the question **“Do you think that the acoustic quality of space may affect autistics’ behaviors? If yes how?”** 95% of the answers by ‘G.1’ were ‘yes’, most of them assured that autistics could be easily confused by loud sounds, especially outside noise. Some of them proposed a tranquil area far from any kind of noise which may come from outside, like sirens of ambulances and police cars, also any kind of disturbing sounds should be considering during site selection for an autism center. For ‘G.2’ 75% of them answered ‘yes’ and they stated that a calm space will calm down them and it is a good idea to have a space like this, the rest answers were ‘No’ and ‘I don’t know’.



Graph 17: Having an acoustic quality in spaces of autistics, answered by: G.1 and G.2

➤ **Smell**

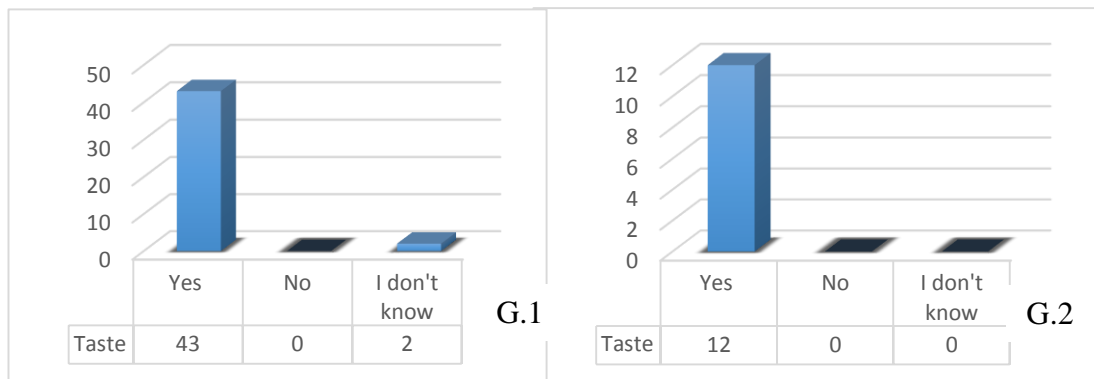
- Smell also was another sense which autistics may have sensitivities to. Respondents' answers to the question **“Do you think that smell may have any influence on autistics' perception of space?”** was like this for 'G.1': 85% answered 'yes'. They pointed to this sensitivity as autistics smell everything around. Some of them are extremely sensitive, if they do not like a smell around they become crazy and it will confuse them completely. Oppositely, some of them addict to a specific smell of things. It also deprive them from learning. Nonetheless, only one family 'G.2' answered to this question and explained his child's sensitivity to smell and that he/she does not like any smell.



Graph 18: Influences of smell on autistics' perception, answered by: G.1

➤ **Taste**

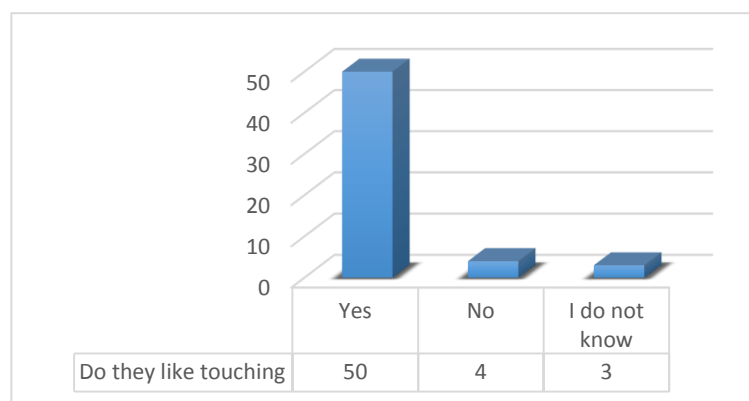
- Almost 96% of the respondents of 'G.1' answered the question of **“Do autistics tend to taste surrounding objects?”** was 'yes'. They mentioned that autistics tend to taste every object around, and they are very picky about taste of food and other things. Also to know things around autistics may test them by taste. Similarly all of the families of 'G.2' reported the same thing as described before.



Graph 19: Autistics' tend to taste things, answered by: G.1 and G.2

➤ Texture

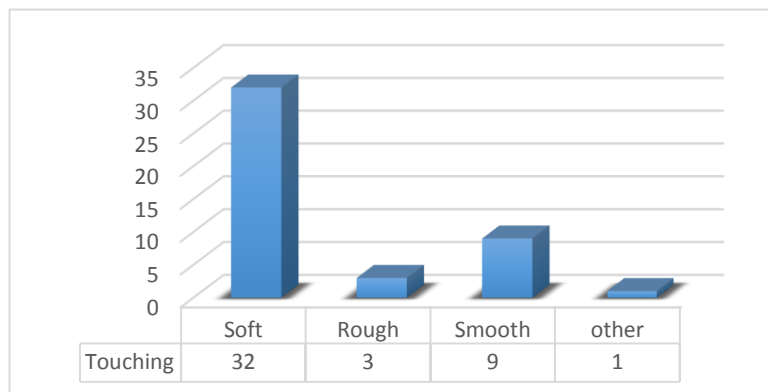
- Most of the participants of 'G.1' assured the autistics' sensitivity to touch things. The question was conducted like that **“Do autistics like touching objects around them?”** and 88% of them answered 'yes'. One of the Therapists described some cases during his experience with autistics said: “many times I provide them different kinds of textures which they can touch to calm down them.” The 'G.2' did not answer the question.



Graph 20: Autistics' tend to touch things, answered by: G.1

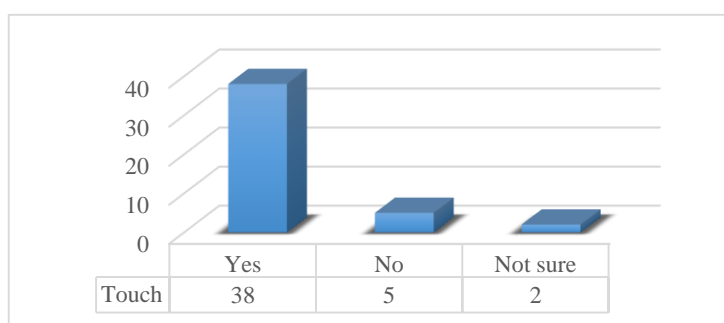
- Nonetheless, to know more about which kinds of textures autistics my like, the respondents (G.1) were mentioned some various textures. They pointed out to the differences in autism degrees the different kind of tendencies to touch objects. In

spite of the above mentioned issues, majority agreed that autistics more likely want to touch soft textures. As shown in the graph.



Graph 21: Types of texture preferred by autistics to touch, answered by: G.1

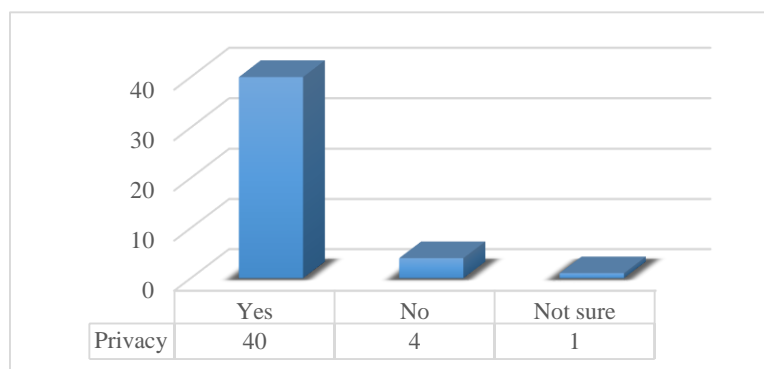
- As stated before, touching is one of the senses which autistics have sensitivities with and this fact can be used in calming them. In the questionnaire this question was provided **“Have you found any indicator that autistics may calm down after they touch something?”** 84% of the respondents in (G.1) accepted it. Likewise during the researcher’s visits to the schools and the therapists working places he noticed carpets with different textures, which were placed for the same purpose. In this question only two families answered the question and they ticked ‘Yes’ also they mentioned that their kids feel comfortable when they touch something soft.



Graph 22: Autistics’ good feeling during touching things, answered by: G.1

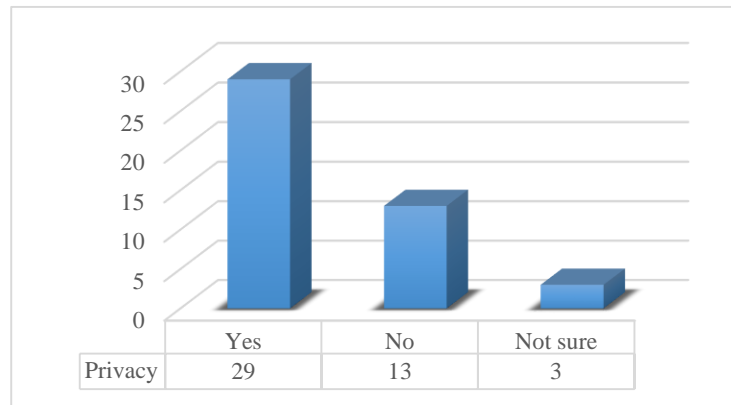
➤ **Privacy**

- Social impairment of autistics make them preferring to be alone. Parallel to this, majorities of the respondents who were asked felt this insufficiency in autistics. Autistics would like to have their own spaces and feel comfortable in it. They may look for a secluded space, free of intrusions by others. 86% of the respondents of ‘G.1’ reported that autistics prefer to go to corners, underneath spaces, small scale spaces, etc. to be alone, they escape from intimate relationships with others. Similarly four families in ‘G.2’ group mentioned the same thing.



Graph 23: Privacy and owning spaces, answered by: G.1

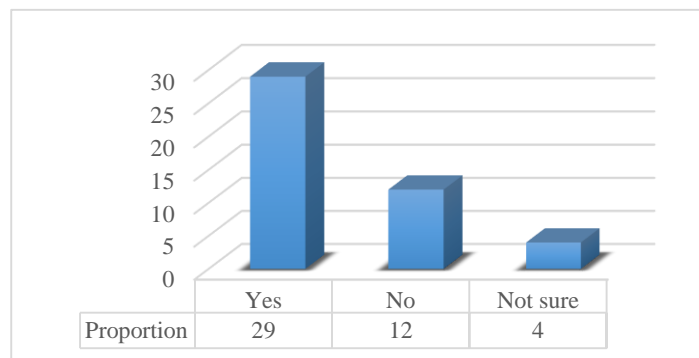
- Also, tantrums and sever anger are mostly observed in autistics, and it is not easy to calm them down. For that, the respondents were asked this question **“Is it true that autistics may desire going to a small space containing soothing objects during their anger?”** as a result 64% of respondents in ‘G.1’ answered ‘yes’, 29% disagreed with the idea and the rest did not have any ideas. Only two families (G.2) answered this question and they stated that their autistic children have a specific space when they may get angry.



Graph 24: Necessity of calm spaces during autistics' anger, answered by: G.1

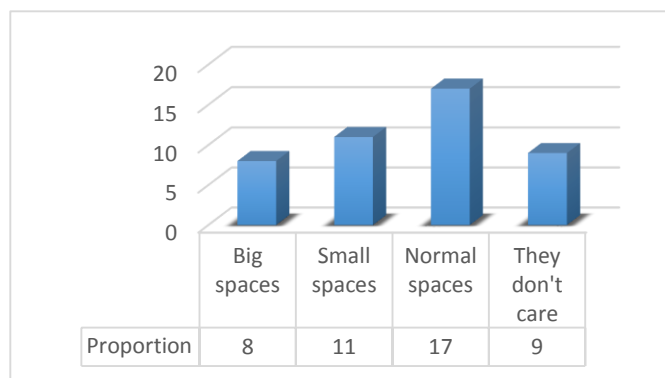
➤ **Space Organization, Way Finding and Proportions etc.**

- Another problem in autistics routine is difficulty in way findings, due to the lack of mental mapping. The research provided this question **“Do autistics have problems related to way finding in the spaces? If yes, how the space design can help it?”** and 65% of the respondents of ‘G.1’ agreed with existing this shortage in autistics. For the second part of the question, some of the respondents, especially therapists mentioned to the visual guidance. For instance, marking pictures of each activity on the doors can help in this issue. Furthermore, painting colour strips on the walls in a way that they can touch it and follow it to the specified activity room. This question did not answer by ‘G.2’.



Graph 25: Wayfinding problems by autistics, answered by: G.1

- **“In which kinds of spaces autistics generally feel themselves more comfortable? Big spaces or smaller ones?”** was another question in the questionnaire. The responds by ‘G.1’ was as follows: 38% of the respondents mentioned that autistics may feel comfortable in normal spaces so as not to be confusing. 24% supposed that autistics because of their deficiencies in social relationships may prefer small spaces, while 18% believed that they like big spaces. And last 20% felt that autistics are apathetic about proportions of the spaces. For this question three of ‘G.2’ participated and illustrated that their kids like small spaces.



Graph 26: Preferred space proportions by autistics, answered by: G.1

- **“Are there any considerations to be noticed in design of the other elements of space such as doors, windows or furniture for autistics?”** for this question, only the respondents of ‘G.1’ answered and they pointed to many things like, design of window openings which should be a special design and not open from sides, instead the opening parts should be in a high level and they should be opened downward with fixing handles. Also they believed that doors should be made of wood and should have usable handles with proper height, also they should not have any lock in any side.

For the furniture, they thought that it should be specifically designed for autistics. Considering heights, non-reflective surfaces, less fragile, material of furniture should not be chemically treated.

- Another question was about the shape of the spaces which was only answered by ‘G.1’. **“Is the shape of space important in design of spaces for autistics? Which one is more suitable according to your experiences, spaces with soft lines or angular ones?”** in respect to this question majorities believed that square and rectangular shapes seems to be fine for the autistics, due to their inclination to the corners, and also because of the homes situation where almost all rooms normally are angular.

Similarly, most of the therapists explained that circular spaces are the worst shapes which could be used for autistics, because they would be always walking and running around which lessen their attention to learning programs.

- A question was asked about proxemics regarding to autistics **“In relation to the others how autistics generally arrange their distances? Do they like to be close to the others (in the class, while working, etc.) or do they need some space in between? Can you please explain?”** The respondents of ‘G.1’ who had knowledge about these behaviors in classes and in other activity areas. They stated that autistics do not want to touch or be touched by others, for that they always keep a wide distance around themselves. One of the therapists believed that this distance at least should be as wide as the circle an autistic may create by his/her hands around their statue.

➤ **Safety**

- **“Are there special safety measurements to be taken in design of spaces for autistic children? What are the most important things to be considered?”** this question was conducted related to safety issues. The respondents of ‘G.1’ curiously described this subject. They stated that autistics are vulnerable and will have problem in unsafe environments, and because of their impairment in brain they cannot recognize dangers. For that, the design should make them a safe environment. The respondents pointed out to the electricity installation in a way that they cannot reach switches and sockets. Also the whole system should be hidden and untouchable.

They mentioned window glasses as a danger, because of the possibility of breaking when autistics may hit them, it is better to replace them by another less-fragile panel. Also doors may be safer if they are designed as slide door and the edges should be covered with something soft.

Slippery surfaces in floors should be avoided because some of the autistics have body-balancing problems and they may fall. Also wall edges should be designed chamfered so as not to be hazardous to their head and body during collisions. Having steps may be dangerous to autistics and they may fall down.

All toys and play materials must be soft and untorn at the same time. So that they do not hurt themselves and cannot eat its pieces.

Wall painting should be done with non-chemical paints so as when tasted by autistics, do not make problems.

The only point which is concerned related to safety, described by four families was door locking problems, they pointed the problem of locking doors inside when they are alone and they cannot open after that.

4.3 Discussion

This research is not the first endeavor to the field of design and architecture regarding to autism, however, it has its own contribution to the literature based on the data collected from the above mentioned people (G.1 & G.2), in case studies and observations. Which can be summarized as below:

- Sight: the sight sense of autistics is the utmost vulnerable sense to have shortages due to its various related subjects such as: light, colour, shade, glare, proportions and visual character, proxemics and calm spaces. All these sight-related design elements are asked to the respondents in a way to obtain most possible outcomes which are briefly classified:
 - Light: natural and artificial light should be applied indirectly, also natural lighting has many benefits to autistics perception in the spaces. Fluorescents should be avoided instead of it incandescent, and LED lights are preferable.
 - Colour: cool colours like green, blue, white are constructive, while warm colours as red, orange, yellow are destructive to autistics' perception. Similarly, black is among colours to be avoided in their spaces. All preferred colours should be used in a mute and subdued tones, because bright tones have negative influences to them. Moreover, neutral colours like Ivory, beige, light mocha, muted teal and soft gray are accepted to be used. Meanwhile, violet, brown, and grey are unknown to have positive or negative impact to autistics' senses. Some of the respondents

(Therapists) described another role of colours in way findings as autistics have deficiencies related to it. They proposed to use colours along the walls like parallel strips each colour to be continued to a specified room which is painted by the same colour. So autistics especially whom they have a severe degree of autism and have difficulties in finding rooms, can follow the lines to the destination room, (e.g. blue goes to kitchen).

- Shade: design of spaces, openings, and light distribution should be arranged in a way producing the least of shade. It affects autistics to see unreal substances and colours. The therapists explained that for having a critical positive time with autistics during learning process, a well-lightened environment with an adequate degree of homogeneity without shaded areas is required.
- Glare: shiny and bright materials and paintings together with size of openings and inadequate light distribution produce glare. It does not let autistics to see physical features of the surroundings as they are. Glare also creates difficulty to autistics to open their eyes normally that is why glare encourages unusual body movements as rocking, hand flapping and bouncing.
- In the same way, all movable objects as fans, exhaust fans...etc. should be away from their sight.
- Proportion and visual character: huge spaces give autistics the sense of lost and they cannot find their way in it, they need a visual boundary to define the spaces. While most of them accept small spaces to have rest and sleep, accept the transitional spaces like corridors they need more free space around to avoid

touching each other. They feel comfortable in four sided spaces as square or rectangular rooms especially corners. Also compartmentalization is a good concept to have in autistics' spaces. Autistics mostly accept the square and rectangular shapes. For that corners of the rooms are the best places preferred by autistics. Inside the centres many corners are created by placing partitions so as to settle each of the autistics in a corner. On the other hand the therapists showed their disagreement about designing circular spaces. Because they experienced during their time with autistics that they are always turning along the circular walls, which it takes their energy and attention.

In the group activity spaces they need more space, so that they do not touch each other in around. During the data collection some of the experts of autism especially therapists, addressed that autistics should have a free space around when they stretch their hands nearby should not hit anything, for the reason of autistics' sensitivity to touch. This free space could be considered approximately 1 square meter for each single autistic in their sitting places.

- Calm spaces: it is essential to have calm spaces in autism centers for the critical tantrum moments of autistics. These spaces can be available in two types; temporary calm spaces inside class rooms which may be a corner of the room and being modified to give them the sense of mental rest for a while. And main calm room where should be designed for longer use and many considerations have to be taken during design such as: colour, texture, space definitions, sound proof quality, suitable light and so on. As it was observed by the researcher in both of the centres, dark rooms were supplied. These rooms were mainly used when autistics might have a tantrum to calm down them in. These dark rooms were only used in

these centres and they could not be found in the literature which was surveyed in this research. Instead of the dark rooms, calm rooms were mentioned in the literature as soothing spaces for autistics during their anger and anxiety. Nevertheless, these calm rooms are quite different from these dark rooms. In the calm rooms autistics could find what make them relax, such as: a favoured colour, texture, sound and small proportion. At the same time, the respondents mentioned another point which was clutter-free spaces. Since autistics confuse about having disorganized surroundings. For that, every furniture should be arranged.

- Auditory: according to the respondents answers acoustical quality of spaces has a great role in their life, especially during learning process and therapies as 95% of the respondents reported that autistics have a huge sensitivity towards sound.

Good sound proofing and sound absorbing materials have to be used in spaces. Also zonings should be separated from each other according to activities. For example, classrooms should be far from music halls ...etc. the site selection of the building is also important, a secluded and free sound environment of the city is most appropriate to autism centers.

- Touch: textures are effective in autistics' spaces. Autistics (hypersensitive individuals) mostly desire to touch soft surfaces and they averse to touch rough and smooth surfaces.
- Smell: autistics are different in this sense, some of them run from odors, and the others addict to it. In both cases, it is logical to hinder spreading smells into their

spaces. It can be achieved by considering zoning in design of the spaces. Kitchen, toilets, and any smell producers to be separated with other spaces.

- Taste: in design for autistics it should be considered that they are about taste everything around, for that chemical substances like paintings, toys and any other things that may cause danger to them have to be avoided.
- Vestibular: body balancing is another impairment of autistics. Hypersensitive individuals cannot keep their posture naturally. Nonetheless, hyposensitive individuals are different as they are too active. They can easily jump over handrails and high steps that is why it is necessary to consider a free risk environment. For that, along the corridors and transitional areas a handrail tool fixing to the walls is essential to have. Any kind of steps between the spaces or between entrance and outside should be avoided. The possibility of colliding their body to the objects around is high. It is necessary to cover the columns or any other obstacles which they may hit their body and head with a soft material. Proactive of this sense gives them fear of high surfaces from the ground and they become dizzy. Manipulation with volumes inside the buildings make them confusing, so a homogeneous high slab with no difference in height seems to be convenient for them as it was observed and asked to autism experts but was not put in the questionnaire.
- Proprioceptive: Autistics' body is not in tune with the brain, so they have unexpected movements. Thus, having steps and unexpected elements like columns in spaces will affect them. They need some play tools to rectify their shortage.

- Safety: The height of electric installation such as switches and sockets, cable and wire extensions which can be touched by autistics should be considered. Slippery floor surfaces such as ceramic, marble and mosaic fine surfaces are risky. Glasses of windows should be replaced by an infrangible material like clear plastic, also movable parts of windows should be placed high and opening upside down. Sharp edges of walls, furniture, and doors should be thought. Hot water installation, also needs caution.

The results are summarized in the table which is shown below concisely for this research, which includes considerations in designed spaces for autistics' according to their seven senses and safety.

As an overall summery for the findings of the results, briefly these points can be visualized:

- Both of academic experienced people (Psychologists, sociologists, and therapists) (G.1) and families with autistic children (Parents, and siblings) (G.2) have contributions to this research which is significant to get some flagship results, supported by their experiences of living with autistics.
- The research mainly considers the outputs by 'G.1' due to their reliable experience with autistics, once as an academic background knowledge which is mostly research based and later their observation during working in the autism centers with multiple cases. For the 'G.2' some of them have a long living experience, however, their knowledge on autistics' sensory needs is limited, because of complexity of the disorder which is dissimilar in any autistic individual in one hand, and many parents do not have any external information on autism as a whole.

- In ‘G.1’ it is observed that therapists have more accurate knowledge on autistics, they have lived with numerous autistics and in a very intricate way. They are responsible to change autistics behaviors and practicing them to learn language, and rectifying their postures. For that, this research gives the therapists’ opinions in to a serious consideration.
- The research also shows that in many cases (like light and color) even therapists do not have clear idea.
- In most cases the families are completely unaware of what is good for autistics. These show the importance of this research and need for a comprehensive guide both for centers as well as parents.

As a summary of the whole data coming from the literature survey, case studies, observations in therapy and autism centers, and interviews. The below table has prepared to serve as a design guideline for interior architects and interior designers who intend to design spaces for autistics. The table contains design elements to be used in interior spaces regarding to autistics’ seven senses. So it is divided into columns of ‘positive, negative, and controversial’ effects. Controversial part is provided in case of having the ambiguous results which are not paralleling or having different results. Finally, the ‘notes’ column is provided if there is a need for further illustrations on the results.

Table 4: Design checklist for autism spaces (prepared by author)

Senses Safety &	Elaborations	Positive impact	Negative impact	Controversial	Notes
- Sight					
a. Light	Indirect natural lighting	■			
	Direct sun light		■		
	Fluorescent		■		
	Incandescent	■			
	Coloured lighting			■	-Some sources of literature accept it. -Majority of respondents rejected.
	Homogeneous lighting	■			
b. Colour	Basic colours	■			
	Calm and mute colours	■			
	Tranquil hues as pale blue, soft green and muted purple	■			
	Neutral colours like Ivory, beige, light mocha, muted teal and soft gray	■			
	Bright colours		■		
	Red		■		
	Yellow		■		
	Green	■			
	Blue	■			
	Violet			■	-Accepted by few sources of the literature. -The result was 'not sure' for by the respondents.

Senses & Safety	Elaborations		Positive impact	Negative impact	Controversial	Notes
b. Colour	Brown				■	-Few sources accept it. -Not sure by the respondents.
	Grey				■	-Few sources accept it. -Not sure by the respondents.
	Pink		■			
	Black			■		
	White				■	-Some sources reject it and some accept it. -Highly accepted by the respondents.
	Purple		■			
	Orange			■		
Shade	Shade			■		
Glare	Glare			■		
Proportion and visual character	Compartmentalization		■			
	Open plan system			■		
	High ceilings			■		
	Circular spaces			■		
	Movable objects like 'Fans, exhaust fans,...etc'			■		
Proxemics	Privacy	Wider space	When they are not alone (Class rooms, corridors...etc)			Autistics prefer to go to corners, underneath spaces, small scale spaces, etc. they are running from intimate relationships with others.
		Closer space	When they are alone (Bedrooms, calm spaces..etc)			

Senses & Safety	Elaborations		Positive impact	Negative impact	Controversial	Notes
Calm spaces	Simplicity (using least details in spaces)		■			clam down them
	Calm rooms		■			
	Dark rooms				■	Based on the case studies in literature there is nothing like this.
Touch	Textural materials	Rough		■		
		Soft	■			
		Smooth		■		
Smell				■		Smell should be thought, zoning should be considered to put all smell producing spaces far from other activities. Wind direction
Taste	Soluble, fine particles, and chemical materials are negative to have in spaces.			■		Autistics are sensitive to taste materials, it should be considered in design.
Vestibular	Hyper-sensitive autistics are afraid of movable things, stairs, ramps.			■		Supportive elements like handrails are essential.
Proprioception	Ambiguity in space coordination, unexpected elements in spaces, and rough surfaces make them hurt and confusion.			■		Barrier free moving space, step-less surface, real scale of learning tools is required.
Safety considerations	High safety consideration in spaces are required.		■			Suitable height of electric installation. Non-slippery roofing surfaces. Using clear plastic instead of window glasses. Free sharp-edge elements. Considerable hot water installation.

Chapter 5

CONCLUSION

Considerations in design for autistics has become an important issue nowadays due to the incredible rising of autism, which is expected to be one of the major issues in upcoming years. Increasing autism affects whole human community as autistic individuals have to be taken care, to be productive and independent individuals. Autistics need a special care because of having problems in their minds, which causes sensitivities towards things. Autistics' are divided into two groups according to the sensitivities; hyposensitive individuals and hypersensitive ones, who they are opposite in perceiving the surrounding environment. Hyposensitive individuals are mostly dormant, so they need to be stimulated so as to activate their senses, while hypersensitive autistics are highly stimulated by everything around related to their seven senses. In addition to sensitivity, autistics have impairments in social interaction, communication, and imagination, which are considered as major reasons hindering them from becoming a part of society. Despite all these problems if autistics have a suitable care and environment they may show many outstanding talents, and may do inventions and innovations which benefit the human society. For that reason, autistics need places to have mood relaxation so as to have rest, learn, and socialize with the other people in a very delicate way which cannot be achieved in a common design scheme. Since any inconvenience or change may affect them oppositely, all of their sensitivity points and other impairments should be considered in design of these spaces. The findings of this study have classified what is necessary

to have in a space for autistics, and what is to be avoided. For this purpose, the study concentrated on the seven senses and some other significant considerations which autistics have sensitivities with on one hand, and safety attentions on the other. Moreover, depending on the findings from literature survey, questionnaires with autism experts, interviews, and observations, a checklist has been prepared which contains physical environment and indoor space qualities suited to autistics. The important role of architecture and interior design on autistics' life is also emphasized by the autism experts and families of autistics in their answers. For this reason the research recommends all architects and interior designers to be aware of autistics' sensitivities and safety issues in physical environment. The provided checklist attempts to be a guide and a tool for designers to be used in design of proper spaces for autistics.

In Iraqi-Kurdistan and many other countries the authorities are not aware of the effects of design and interior design elements on autistics' perception, that is why most of the autism centers are placed in common buildings with no alternations and modifications. Also there is no attention to the location of the centers' buildings and most of them are placed in crowded areas without any acoustical solutions. Instead, the focus is only on the psychological and therapeutic programs without proper concern about the quality of the environment where autistics spend most of their times in it. However, autism is a mental disorder, and autistics react to the surroundings. From this point of view, the significance of physical environment has to be considered. For autistics to be comfortable, a good noise or echo proof space is required. Also, focusing on visual comfort is significant which includes considerations related to light, color etc. Autistics lose their concentration in case of having some sorts of smell who some of them may suffer from it. That's why choice

of materials and organization of space become very important. In addition, all poisonous substances such as some kind of paints, furniture materials, cleaning liquids, and everything harmful to taste should be eliminated from their spaces. Texture of surfaces has a great role in design for autistics, as they are picky in touching some types of textures. Mostly they prefer soft surfaces rather than the others. Autistics can have problem in their body balancing, that is why they walk irregularly as if bouncing, swinging, and flapping their limbs. For that, they need more space and suitable coverings on the surfaces which they may collide. Discontinuity between autistics mind orders and body parts is another impairment, for that they have unexpected movements or showing no conscious when something moves towards them. That's why everything should be clear to understand around them, no members like columns or other physical elements should be put in their spaces.

This research can be assistive to the designers and architects who may design spaces for autistics as well as those who are interested in similar fields of research. Some other potential areas for further researches relate to this subject, are:

- The importance of integrating nature to spaces in autism centers and finding out landscape role on autistics life.
- Every stage of autism has specific space requirements which can be studied, for instance, this study focused on the stage of 3-7 years when they spend their time in kindergarten or similar environments. Nonetheless, it is possible to research autistics needs when they go to elementary schools, whether in special schools or in normal ones with other neurotypical pupils.
- Criteria in design of homes for families with autistic children may be another suggestion.

- Cultural issues may create differences in design of spaces for autistics; this subject also deserves being studied.

REFERENCES

- Akshoonoff, N., Pierce, K., & Courchesne, E. (2002). The neurological basis of autism from a developmental perspective. *Developmental Psychopathology* 14(3):613-634.
- Al-Saad, S. (1998). *The design, implementation and evaluation of an educational programme for children with autism in oil-rich countries: The case of Kuwait* (Doctoral Dissertation, University of Leicester, England).
- Araghi, N. M., & Soltanzadeh, M. (2014). A study on architectural spaces from psychological perspective emphasizing the autism rehabilitation clinic. *International Journal of Scientific & Engineering Research*, 5 (1), 1449-1464. Retrieved in: <http://www.ijser.org/researchpaper%5CA-study-on-architectural-spaces-from-psychological-perspective.pdf>
- Attwood, T. (2006). *The pattern of abilities and development for girls with Asperger's Syndrome. In Asperger's and Girls*. Eds. Arlington, TX: Future Horizons Inc.
- Augustin, S. (2009). *Place advantage: applied psychology for interior architecture*. Canada: John Wiley & Sons.
- Autism classroom (2013). *Colour*. Retrieved in: <http://www.autismclassroom.com/index.php/home-space-design/colour/>. Accessed on (October, 20, 2015).

Autism discussion page (2014). Retrieved in : <https://www.facebook.com/autismdiscussionpage/posts/627653807314123>. Accessed on (20, May, 2015).

Autism speaks (2016). *Sensory Room at Brooklyn Children's Museum?* Retrieved in: <https://www.autismspeaks.org/resource/sensory-room-brooklyn-childrens-museum>. Accessed on (January, 01, 2016).

Autism Spectrum Australia (2015) *Characteristics*. Retrieved in: <http://www.autismspectrum.org.au/content/characteristics>. Accessed on (17, May, 2015).

Autism Victoria (2011). *What is autism spectrum disorder?* Retrieved in: <http://www.amaze.org.au/discover/about-autism-spectrum-disorder/what-is-an-autism-spectrum-disorder/>. Accessed on (29, April, 2015).

Backner, W. (2010). *Autism and Early Intensive Behavioral Interventions*: University of Utah, USA.

Baron-Cohen, S., Lombardo, M. V., Auyeung, B., Ashwin, E., Chakrabarti, B. & Knickmeyer, R. (2011) *Why are autism spectrum conditions more prevalent in males?* PLoS Biol. 2011 Jun; 9 (6):e1001081.

Bear, M. F., Connors B. W., & Paradiso M. A. (2007). *Neuroscience: Exploring the Brain*. Baltimore: Lippincott, Williams & Wilkins.

- Bernier, R. (2012). How do we measure autism severity. *Simons Foundation Autism Research Initiative*. Retrieved in: <https://sfari.org/news-and-opinion/viewpoint/2012/how-do-we-measure-autism-severity>. Accessed on (12, May, 2015).
- Bhandari, S. (2015). *Autism Spectrum Disorders Health Center* Retrieved in: <http://www.webmd.com/brain/autism/understanding-autism-basics?page=2>. Accessed on (29, April, 2015).
- Brugha, T. S., McManus, S., Bankart, J., Scott, F., Purdon, S., Smith, J.,..., Meltzer, H. (2011). Epidemiology of autism spectrum disorders in adults in the community in England. *Archives of General Psychiatry*, 68(5), 459-465. doi: 10.1001/archgenpsychiatry.2011.38
- Burleigh, J. (2015). *Was Michelangelo's artistic genius a symptom of autism?* Retrieved in: <http://www.independent.co.uk/news/uk/this-britain/was-michelangelos-artistic-genius-a-symptom-of-autism-6168716.html>. Accessed on (12, May, 2015).
- Carper, R. A., Moses, P., Tigue, Z. D., & Courchesne, E. (2002). Cerebral lobes in autism: Early hyperplasia and abnormal age effects. *Neuroimage* 16(4):1038-1051.
- Cherry, C. P. (2012). The ideal home for the autistic child: physiological rationale for design strategies, *autism science digest*: retrieved in: <http://purposefularchitecture.com/the-ideal-home-for-the-autistic-child->

physiological-rationale-for-design-strategies/ accessed on (November, 11, 2014).

Cherry, K. (2015) *Perception and the perceptual process*. Retrieved in: <http://psychology.about.com/od/sensationandperception/ss/perceptproc.htm>. Accessed on (25, May, 2015).

Coen, A. (2012). *Learning Spring School for Autistic Students in NYC Earns LEED Gold Certification*. Retrieved in: <http://inhabitat.com/nyc/learningspring-school-for-students-with-autism-in-nyc-earns-leed-gold-certification/>. Accessed on (28, May, 2015).

Constantino, J. N., & Charman, T. (2012). Gender bias, female resilience, and the sex ratio in autism. *J Am Acad Child Adolesc Psychiatry*. 2012 Aug;51(8):756-8.

Downs, M. (2015). Autism-Vaccine Link: Evidence Doesn't Dispel Doubts. *WebMD* Feature. Retrieved in: <http://www.webmd.com/brain/autism/searching-for-answers/vaccines-autism>. Accessed on (27, April, 2015).

Fullerton, A., Stratton, J., Coyne, P. & Gray, C. (1996). *Adolescence and young adulthood: higher functioning adolescents and young adults with Autism*: Austin, TX: Pr Ed. Used with permission.

Gerdes, M. (n.d). *Interior architect now 'autism innovator'*. Retrieved in: <http://aaa.uoregon.edu/100stories/alumni/kijeong-jeon>. Accessed on (27, May, 2015).

- Golembiewski, J. (2014). *Building a better world: can architecture shape behavior?*
Retrieved in: <http://theconversation.com/building-a-better-world-can-architecture-shape-behaviour-21541>. Accessed on (29, May, 2015).
- Grandin, T. (1992). Calming Effects of Deep Touch Pressure in Patients with Autistic Disorder, College Students, and Animals. *Journal of child and adolescent psychopharmacology*, 2 (1). Mary Ann Liebert, Inc., Publishers.
- Grandin, T. (2010, February 24). *The world needs all kinds of minds*. [Video file].
Retrieved in: http://www.youtube.com/watch?v=fn_9f5x0f1Q.
- Harden, A. Y., Minshew, N. J., Mallidarjuhn, M., & Keshavan, M. S. (2001). Brain volume in autism. *Journal of Child Neurology* 16(6):421-424.
- Hatch-Rasmussen, C. (2015). *Sensory Integration*. Retrieved in: http://www.autism.com/symptoms_sensory_overview. Accessed on (4, June, 2015).
- Henry, C. N. (2011). *Designing for Autism: Lighting*. Retrieved in: <http://www.archdaily.com/177293/designing-for-autism-lighting/>. Accessed on (28, May, 2015).
- Howard, M. A., Cowell, P. E., Boucher, J., Broks, P., Mayes, A, & Farrant, A. (2000). Convergent neuroanatomical and behavioral evidence of an amygdala. *Neuroreport* 1(13):2931-2935.

- Humphreys, S. (2008). *Architecture and autism*. URL: http://www.autismsocietycanada.ca/images/dox/Autism_and_Architecture_08_Humphrey.pdf.
- Jeffrey, P., & Baker M. D. (2013). *Autism at 70 — Redrawing the Boundaries*, retrieved in <http://www.autismspeaks.org/science/science-news/autism-70-%E2%80%93-kanner-dsm-5> accessed on (November, 1, 2014).
- Kennedy, C. (2010). *The vestibular & proprioceptive sensory systems*. Retrieved in: http://www.odellengineering.com/informer/L_PA-Oct_10.htm. Accessed on (12, June, 2015).
- Koegel, R. L., & Koegel, L. K. (1995). *Strategies for Initiating Positive Interactions and Improving Learning Opportunities*, Paul H. Brookes Publishing Co., Baltimore, Maryland.
- Lock, R., Sancibrian, S., & Gaines, K. S. (2011). The Impact of Classroom Design on Students with Autism Spectrum Disorders. *Autism Society 42nd National Conference and Exposition*. Orlando: Autism Society.
- Long, E. A. (2010). *Classroom Lighting Design For Students with Autism Spectrum Disorders*. (Master Thesis, Kansas State University, Manhattan, Kansas).
- Mandal, A. (2015). Autism History. Retrived In : <http://www.news-medical.net/health/Autism-History.aspx>. Accessed on (2, May, 2015).
- Mata, L. (n.d). *How to Design Your Autistic Child's Room*. Retrieved in:

[http://www.ehow.com/how_5331078_ design-autistic-childs-room.html](http://www.ehow.com/how_5331078_design-autistic-childs-room.html).

Accessed on (December, 1, 2015).

Mathew, V. G. (2012). *Environmental Psychology*. Retrieved in:
<http://www.psychology4all.com/environmentalpsychology.htm>. accessed on
(December, 13, 2015).

McCarthy, J., & Carrey, J. (2008). *My son's recovery from autism*. Retrieved in:
<http://edition.cnn.com/2008/US/04/02/mccarthy.autisimtreatment/>. Accessed
on (1, May, 2015).

McGuinness, S. (n.d). *History of Autism . Colour-se7en Website*. Retrieved in:
http://www.autismuk.com/?page_id=1043. Accessed on (1, May, 2015).

Mostafa, M. (2003). *Accommodating autistic behavior in design through
modification of the architectural environment* (Doctoral Dissertation,
American University in Cairo, Egypt).

Moreno, S. J., & O'Neal, C. (2000). Tips for teaching high functioning people with
autism. *Crown Point, IN: MAAP Services, Inc.*

Mostafa, M. (2008). *An architecture for autism: concepts of design intervention for
the autistic user*, Archnet-IJAR, International Journal of Architectural
Research, retrived in [http://archnet.org/system/publications/contents
/5107/original/DPC1837.pdf?1384788342](http://archnet.org/system/publications/contents/5107/original/DPC1837.pdf?1384788342), accessed on (March, 1, 2008).

- Mostafa, M. (2014). *Architecture for Autism: Autism Aspects in School Design* , Archnet-IJAR, 8 (1), March 2014, retrieved from <http://archnet.org/system/publications/contents/5107/original/DPC1837.pdf?1384788342> accessed on (November, 3, 2014)
- Muir, H. (2003). *Einstein and Newton showed signs of autism*. Retrieved in: <http://www.newscientist.com/article/dn3676-einstein-and-newton-showed-signs-of-autism.html#.VVOOrLvmqqko>. Accessed on (12, May, 2015).
- National Institute on Deafness and other communication Disorder (NIDCD) (2014). *Communication Problems in Children with Autism Spectrum Disorder*. Retrieved in: <http://www.nidcd.nih.gov/health/voice/pages/communication-problems-in-children-with-autism-spectrum-disorder.aspx>. Accessed on (12, May, 2015).
- Niederhofer, H. (2005). *The autistic vision problem with light from fluorescent lamps explained in terms of coherence and phase shift*. Retrieved in: <http://www.ee.bgu.ac.il/~gluskin/files/AutisticVVV.pdf>. Accessed on (9, June, 2015).
- Nguyen, A. (n.d). Environment and Surroundings How to make them autism friendly, *The 17 national autistic society*. Retrieved in: <http://www.aut2know.co.za/library/enviro%20&%20surroundings2.pdf> accessed on (November, 18, 2014).

- North Carolina State University (1997). *The Principles of Universal Design*. Retrieved in: http://www.ncsu.edu/ncsu/design/cud/about_ud/udprinciplestext.htm. Accessed on (October, 6, 2015).
- Null, G. (2013, February, 16). *Autism-made in the USA, Gary Null's remarkable documentary*. [Video file]. Retrieved in: <https://www.youtube.com/watch?v=fwuyxyBUmwY>.
- Office of the Deputy Prime Minister ODPM (2003). *Planning and Access for Disabled People: A Good Practice Guide*. Retrieved in: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/7776/156681.pdf
- Paron-Wildes, A. (2013). *Interior design for autism from childhood to adolescence*. Hoboken, NJ: Wiley.
- Puckette, M. (2013). Calming room ideas to prevent tantrums for kids with autism or other disorders. *Raising Troubled Kids*. Retrieved in: <http://www.raisingtroubledkids.com/calming-room-ideas-to-prevent-tantrums-for-kids-with-autism/>. Accessed on (October,22, 2015).
- Rains, S. (2009). *Design & disabilities group*. Retrieved in: <https://www.changemakers.com/groups/design-disabilities-group/discussion-7>. Accessed on (October, 6, 2015).
- Retvo, A. (2013). *Vestibular System in Autism*. Retrieved in: <http://link.springer.com/>

referenceworkentry/10.1007%2F978-1-4419-1698-3_211. Accessed on (9, June, 2015).

Rice, K. E. (2011). *The Changing Prevalence of the Autism Spectrum Disorders*. Retrieved in: <http://www.aafp.org/afp/2011/0301/p515.html>. Accessed on (27, May, 2015).

Sarris, M. (2013). *Not Just For Boys: When Autism Spectrum Disorders Affect Girls*. Retrieved in: http://iancommunity.org/cs/simons_simplex_community/autism_in_girls. Accessed on (27, May, 2015).

Schafer C. T. (2014). *A Population Excluded: Interior Design For Autism In University Dining Facilities* (Master Thesis, Savannah College of Art and Design, Georgia).

Schopler, E. & Mesibov, G. (1984). "Professional attitudes toward parents: A Forty -year progress report" in Schopler, E. and Mesibov, G. (eds.) *The Effect of Autism on the Family*, Plenum Press, New York. (1994), *Behavioural Issues in Autism*, Plenum Press, New York.

Sensory Processing Disorder (n.d). *Proprioceptive Dysfunction: The REAL Reason He Keeps Crashing, Jumping, Tripping, Falling, Writing Too Dark, And Breaking Things!* Retrieved in: <http://www.sensory-processing-disorder.com/proprioceptive-dysfunction.html>. Accessed on (4, June, 2015).

Shriber, L. (2010). *Autism: A Neurological and Sensory Based Perspective*. In: JH

Stone, M. Blouin (Ed.), *International Encyclopedia of Rehabilitation*.
Available online: <http://cirrie.buffalo.edu/encyclopedia/en/article/285/>

Smith, R. (2009). *Charles Darwin had autism, leading psychiatrist claims*. Retrieved in: <http://www.telegraph.co.uk/news/health/news/4680971/Charles-Darwin-had-autism-leading-psychiatrist-claims.html>. Accessed on (12, May, 2015).

Smyth, R. D., (2009). What you need to know about children and youth with sensory processing issues information for parents and caregivers. *Cheo*. Ottawa, Ontario, Canada.

The DSM-5 "Severity Levels" of Autism. (2013). Retrieved in: <http://www.myaspergerschild.com/2013/09/the-dsm-5-severity-levels-of-autism.html>. Accessed on (12, May, 2015).

The Hanen Center (2011). *How Autism Affects Communication in Young Children*. Retrieved in: <http://www.hanen.org/Helpful-Info/Autism-Corner/How-Autism-Affects-Communication.aspx>. Accessed on (12, May, 2015).

The National Autistic Society, (2015). *The sensory world of autism*. Retrieved in: <http://www.autism.org.uk/sensory>. Accessed on (20, May, 2015).

Torky, E. A., AbdelRahman, A., & Rashed, A. Y. (2013) Design of educational facilities for autistic children. *Sustainable Building Conference*. Cairo, Egypt. (December, 09, 2013).

Tucker, K. (2015). *The Best Room Colours for Children with Autism*. Retrieved in:
<http://everydaylife.globalpost.com/room-colours-children-autism-10950.html>.
Accessed on (4, June, 2015).

University of Cambridge (2015). What is inclusive design?. *Inclusive design Toolkit*.
Accessed on (October, 6, 2015).

URL 1: <http://autismmythbusters.com/general-public/famous-autistic-people/>

URL 2: <http://www.deism.com/einstein.htm>

URL 3: <http://www.crystalinks.com/newton.html>

URL 4: <http://www.catholicamericanthinker.com/darwinism.html>

URL 5: <http://www.britannica.com/EBchecked/topic/379957/Michelangelo>

URL6: <http://beforeitsnews.com/health/2013/03/autism-rates-1-in-50-kids-are-vaccines-responsible-2478354.html> accessed on (October, 15, 2014).

URL 7: http://www.archlighting.com/daylighting/the-benefits-of-natural-light_o.aspx

URL 8: <http://www.aconversationonautism.com/Coping-with-Autism/Sensory-Integration>.

URL 9: <http://www.fsec.ucf.edu/en/consumer/buildings/basics/windows/how/glare.htm>. Accessed on (October, 4, 2015).

URL 10: <http://www.krgmopdcc.com/dcc/index.jsp?sid=1&id=535&pid=526>.

URL 11: <http://www.lahistoriaconmapas.com/atlas/iraq-map/kurdish-iraq-map.htm>

URL 12: <http://www.momentity.com/its-sensory-processing-disorder-our-story-begins/>.

URL 13: <https://www.pinterest.com/pin/56646907788383168/>.

URL 14: <http://www.designboom.com/architecture/la-sagrada-familia-2026-visualized-in-3d-12-22-2013/> .

URL 15: <http://www.agefotostock.com/age/en/Stock-Images/Rights-Managed/VIW-HAV-NS-0006-A>.

URL 16: <https://www.flickr.com/photos/treehousetrust/6028288247>

URL 17: <http://asumag.com/interior-design/new-manhattan-school-sensitive-needs-autistic-students> .

URL 18: <http://www.dubaiautismcenter.ae/newbuilding.htm>

URL 19: <http://www.penyreprasad.com/projects/the-pears-national-centre-for-autism-education/>.

URL 20: <http://blog.iccadubai.ae/2012/07/24/icca-dubai-supports-the-dubai-autism-center/#.VXU62s-qqko>

URL 21: <http://www.dubaiautismcenter.ae/newbuilding.htm>.

URL 22: <https://www.autismspeaks.org/what-autism>

URL 23: http://www.whale.to/a/autism_diagnosis.html

URL 24: <http://www.autismclassroom.com/index.php/home-space-design/colour>

URL 25: <http://www.autism-society.org/living-with-autism/how-the-autism-society-can-help/safe-and-sound/safety-in-the-home/>.

URL 26: https://www.facebook.com/photo.php?fbid=1042170049150226&set=pb.100000717222438.2207520000.1449712020.&type=3&theater&__mref=message_bubble

URL 27: <https://www.facebook.com/photo.php?fbid=1748998798660699&set=t.100007481054451&type=3&theater>.

WebMD (2015). *Autism Spectrum Disorders Health Center*. Retrieved in: <http://www.webmd.com/brain/autism/autism-topic-overview>. Accessed on (21, May, 2015).

WebMD Medical Reference, Reviewed by Weintraub, A. G., (2013), *History of Autism*, retrieved in <http://www.webmd.com/brain/autism/history-of-autismHistory> . accessed on (May 12, 2013).

Weintraub, A. G. (2013). *History of autism*, retrieved in: <http://www.webmd.com/brain/autism/history-of-autism>. Accessed on (5, May, 2015).

White, J. R. (2009). *Didactic daylight for design education*, master thesis, State University of New York.

Wilson, M. K. (2014). *Different Levels of Autism*. Retrieved in: http://autism.lovetoknow.com/Different_Levels_of_Autism. Accessed on (13, May, 2015).

Wong, C. (2009). *Hypersensitivity and Autism*. Retrieved in: <http://www.newautism.com/hypersensitivity-and-autism/487/>. Accessed on (21, May, 2015).

APPENDIX

Appendix A: Questionnaire

This questionnaire is arranged to collect data from Autism schools in Iraqi-Kurdistan for a research done as a master thesis in the Department of Interior Architecture in Eastern Mediterranean University-Northern Cyprus on Considerations in Design of Interior Spaces for Autistic Children. The questionnaire is prepared as questions for a structured interview with different people who work and live with Autistic children. The information in this questionnaire is only used for academic purposes and are totally confidential.

A-General information:

1. Are you a/an:

Teacher Therapist Psychologist Pediatrician
Autistic's parent Autistics' sibling other

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2. How many years have you been living or working with autistics?

0-5 years: 6-10 years: 11-15 years:

B-Information related to the research topic:

1. Colour

a. Do you believe that colours have any effect on autistic children's behaviors?

Yes: No:

b. Which one do you believe is more suitable to be used in spaces for autistic children: white, neutral colours (greys, etc.) or others?

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c. According to your experiences which colours have more impact on autistic children? Which ones have negative, which ones have positive effect on them?
Please describe.

Positive:

Negative:

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d. Which pattern of colour do you believe could be used for autistic children? Basic colours like (Red, Yellow, Blue.) or secondary colours such as green, violet or orange? How?

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e. Which tones of colour should be used in spaces for autistics? Bright colours or soft, pastel ones? Why?

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f. Which colours are used in interior of this school? Do you think they are suitable?

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1. Lighting

a. What kind of lighting do you prefer to be used in interior of the school?

Natural: artificial: Both:

Why?

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b. According to you which kind of natural light is better to be used in interior spaces for autistic people, direct or indirect? Why?

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c. According to you which kind of artificial light is better to be used in interior of spaces for autistics, florescent, incandescent, etc.? Why? fluorescent

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d. Do you think a coloured light is suitable for being used in spaces for autistics? Why?

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e. Do autistics prefer spaces with a lot of light or more dim or shady spaces?

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f. Do you think that glare caused by light, has any influence on autistics' behaviors?

How?

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g. Which kind of lighting is used in your school? Do you think it is suitable?

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h. Have you ever heard about the effects of Fluorescent lights on autistics' perception?

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2. Acoustic

a. Do you think that the acoustic quality of space may affect autistics' behaviors ? if yes how?

Yes No I do not know

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3. Smell

a. Do you think that smell may have any influence on autistics' perception of space?

Yes No I do not know

b. Do autistics react to different odors such as perfumes, paint colours, etc.? Is there any particular kind of smell that they like or dislike?

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4. Taste

a. Do autistics tend to taste surrounding objects?

Yes No I do not know

5. Texture

a. Do autistics like touching objects around them?

b. Yes No I do not know

c. Which kind of materials they desire to touch?

Soft rough smooth other

d. Do you think that the texture of the walls, etc. in space have any effect on the autistics feeling on that space?

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e. Have you found any indicator that autistics may calm down after they touch something?

Yes No

If Yes; how?

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6. Privacy

a. Do autistics generally like to be alone?

Yes No

b. Do they prefer specific spaces in the buildings, like corners, underneath spaces, small scale spaces, etc.? Please explain.

Yes No

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c. Is it true that autistics may desire going to a small space containing soothing objects during their anger?

Yes No

7. Proportions, etc.

a. Do autistics have problems related to way finding in the spaces? If yes, how the space design can help it?

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b. In which kinds of spaces autistics generally feel themselves more comfortable? Big spaces or smaller ones?

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c. Are there any considerations to be noticed in design of the other elements of space such as doors, windows or furniture for autistics?

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d. Is the shape of space important in design of spaces for autistics? Which one is more suitable according to your experiences, spaces with soft lines or angular ones?

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e. In relation to the others how autistics generally arrange their distances? Do they like to be close to the others (in the class, while working, etc.) or they need some space in between? Can you please explain?

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f. Are there special safety measurements to be taken in design of spaces for autistic children? What are the most important things to be considered?

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