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Design Criteria Affecting Behavioral Problems of Autistic Children in Special Schools*

Abolfazl Karbalai Hosseini Ghiasvand[a]- Jamaleddin Soheili[b]- Mehrdad Matin[c]**

[a] Ph.D. in Architecture, Department of Architecture, Qazvin Branch, Islamic Azad University, Qazvin, Iran.

[b] Associate Professor of Department of Architecture, Qazvin Branch, Islamic Azad University, Qazvin, Iran (Corresponding Author).

[c] Assistant Professor of Department of Architecture, Central Tehran Branch, Islamic Azad University, Tehran, Iran.

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ABSTRACT

Autism disorder is a disturbance in the development of the nervous system creating a range of behavioral problems for these people by a defect in thinking, feeling, and excitement. Studies have indicated that the architecture and design of educational schools could cause positive effects on improving their behavioral difficulties. Therefore, recognizing the components of architecture affecting these behavioral problems seems to be prominent for architects. This research aims to identify and prioritize the criteria and sub-criteria of an effective architecture for problems of children with autism. Descriptive-analytic as a research method has been used in this paper. The decision group in this study included 20 architecture and child educators with sufficient experience in the educational environment for autistic children. In this research, the most important architectural criteria were identified using the Delphi method, which recognized the “physical factors of the environment” and “organization of spaces” among the factors derived from the research background. Then, to categorize and evaluate the causes and effects of these criteria, a fuzzy demultiplex technique was used in which the “light,” “texture and materials,” and “acoustic” factors were ranked first to third and MATLAB, and Excel software was also used to analyze the findings.

Keywords: Autism, Behavioral Disorders, Fuzzy Delphi, Fuzzy Dematel.

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** E_mail: soheili@qiau.ac.ir

1. INTRODUCTION

Autism spectrum disorder is a group of growth nervous syndromes that are multiple gene inheritance In terms of phenomenology. Their characteristics are a wide range of social communication traumas and limited and repetitive behaviors. Autism spectrum disorder is divided into five distinct disorders: Autism Disorder, Asperger Disorder, Childhood Disruptive Disorder (CDD), Rett Syndrome and Indeterminate Growth Penetrating Disorder (Sadock et al. 2015 ،417). People with ASD have problems with social interaction, communication skills, and a small range of limited interests. The Intelligence Quotient (IQ) level in Autism Spectrum can range from various disabilities. ASD may almost be indistinguishable for all people at low spectrum levels. These people are commonly known as high-functioning autism. Other people with ASD have severe or life-threatening behaviors (Scott et al. 2000).

According to recent studies, the incidence of autism spectrum disorders is increasing. The latest statistics from the National Institute of Mental Health (NIH) show 8 out of 10,000 live births. It is reported that the prevalence rate in boys is 4 times more than in girls (Sadock et al. 2015, 418). At the same time, this number reached about 3 out of 10,000 children in the 1990s (translation 12). According to Samadi and his colleagues (2012), the prevalence of autism in Iran is 6.25 out of 10000 live births (Samadi, Mahmoodizadeh, and Mc Conkey, 2012). The increasing number and the lack of attention to the educational environment of these children, regardless of the appropriate design criteria for designing the educational environment for them, led us to identify and prioritize these criteria based on scientific methods.

Due to sensory processing defects, patients with autism are sensitive to the surrounding environment. People who cannot understand or adapt to their environment usually show negative behaviors. Many Sensory processing defects, such as visual and auditory sensations, can turn the environment into a marvelous and frightening place for these children. Autistic people often show particular behaviors against these environmental sensitivities and stimuli that may seem scary or inappropriate to others. These behaviors result from an imbalance between the environment and the individual's adaptation ability (P Arnaiz et al. 2011). Recent studies have shown that architecture and internal spaces can positively influence the behavior of ASD people. Therefore, this study aims to identify and prioritize effective design criteria for controlling these sensory stimuli and, as a consequence, behavioral disorders in Autistic children in educational settings. This research seeks to answer this question: what are the design criteria affecting the behavioral disorders in Autistic children in educational spaces, and what are the priorities? The first step is to examine the background, views, and standards introduced in previous studies to answer this fundamental question. Then the Delphi method will use to identify and screen the most important effective criteria for designing. In order to differentiate the sub-criteria to cause and effect and prioritize them, the fuzzy DEMATEL technique is used in this research.

2. LITERATURE

In the last few decades, contemporary architecture has considered the needs of people with various visual, auditory, and moving disorders. In this process, criteria and standards have been created to ensure that these people with special needs can use internal and external spaces. In these studies, the main keyword is “accessibility,” which is a physical concept and implies that people with disabilities can access public buildings and spaces. However, studies on architectural design for people with cognitive and sensory disorders show that Autistic children in this group are less likely to see. A summary of the research is presented as follows:

- Mostafa (2008) has tried to measure the impact of the environment on autistic children by doing experimental work. An interventional study was conducted to evaluate the effect of increasing two enhancing functions on the performance of autistic children in the Cairo Special Education Center. Acoustic changes included audio controls to reduce noise. The arrangement of spaces for various activities has also been changed. This study was conducted through a control and test group, a pre-test and a post-test design, and produced positive results in increasing attention, reducing response time, and improving the behavioral mood of autistic students. Mostafa expanded his studies in 2014 and 2016 and introduced the “environmental sensory design” model.
- Brooke (2010), the purpose of this study is to study the impact of the environment and furniture on the learning of autistic children and emphasize their social and sensory disorders that affect their situations in the educational environment. This study tries to use evidence of a learning environment as a deep connection between autistic students and their learning environment. This research was conducted at the Institute for Children with Severe Learning Needs; the first step is to record children's behavior in a normal environment. Then, through environmental interventions in lighting, furniture and spaces, the impact of these interventions and children's learning was measured by observing and recording behavior.
- Kanakeri (2014), Kanakeri has been particularly focused on the impact of sound on autistic children's behavioral problems and examines two schools to prove his hypothesis. The results of the study showed that in the third class in the neighborhood of a crowded

place, with increasing noise, the number of behavioral disorders that children show also increased.

2.1. Theoretical Framework

In this section, definitions and theories related to sensory processing disorder, behavioral problems in children with autism and finally the relationship between architecture and autism will be discussed.

2.1.1. Sensory Processing Disorder in Autistic Children

Sensory processing refers to how peripheral and central nervous systems manage sensory information. In some people, sensory processing is not done correctly in the brain, and everyday sensory information such as calls, voices and movements are misinterpreted. These mistakes in interpreting information cause behavioral problems and difficulties in adapting and responding to environmental stimuli in a person (Nazari and Karami Nejad 2015, 39). When processing problems occur in one or more sensory systems, it will cause problems such as behavioral problems, jumping action, verbal problems, delays in eye and hand coordination, high or low sensitivity to foods, sounds, touch, and eventually lead to participatory problems (Parham and Mailloux 2010). Sensory processing disturbances can lead to problems in many areas, such as everyday life, confidence, exposure skills, playing and social contributions (Cosby, Johnston, and Duun 2010).

People usually get information about the space they are in based on all their senses: Smell, vision, taste, hearing and touch. This ability is recognized as sensory integrity and is essential for understanding a situation completely and deciding how to respond to the environment (Grace and M.C. Donald 2006). However, people with ASD have a defect in sensory integrity due to the inability to simultaneously process information from several areas. It may appear through a high sensitivity to stimuli or low sensitivity (low reaction). Fast attention transmission between two stimuli is difficult for these people, and abnormal sensory processing may cause ASD people to show unusual behaviors. In addition, disturbance in this sensory integrity may lead to language delays and academic progress (Jeffrey and Parsons 1998; Temple 2006; Cindy 1995).

Generally, ASDs have high or low sensitivity to specific sensory stimuli associated with smell, vision, taste, hearing, or touch. Also, some highly sensitive ones have difficulty understanding the position of their body in space. Children who were later identified with ASDs generally had sensitive hearing tendencies and were often considered deaf (Scott and Dunn 2007). ASDs with low sensitivity often create or produce their own sensory experiences. Conversely, people with high sensitivity respond to sensory stimuli. Children with excessive sensitivity can be easily stimulated by sensory information. Sometimes the environment can scare them because loud or sudden sounds are painful for people with high sensitivity (Robert et al. 2003). Some experts believe this kind of Sensory overcharge has been more experienced among people with Asperger syndrome than other people in the spectrum. A common thread between ASD people is the inability to use all the senses together and trying to use more than one sense. ASD people often act slowly in changing the focus between visual and auditory stimuli (Gaines et al. 2016).

2.1.2. Behavioral Problems in Autistic Children

ASDs show repetitive and limited behaviors. These behaviors are repetitive, limited and almost obsessive movements (Pan et al. 2008). Harmful behaviors, such as head-banging, are also seen in these people. These behaviors can be dangerous for them and those around them (Vogel 2008; Carissa et al. 2008). Other examples of this type of repetitive behavior are the repetition of finger and hand movements and shaking or knocking objects. Many children with high-performance autism or Asperger syndrome show more repetitive behaviors than others on the autism spectrum. One study showed that children with unusual sensory responses are more likely to have repeated behaviors. These behaviors can be a child's attempt to create a sensory experience or maintain control over the environment after sensory overload. Often, these behaviors are relaxing for these children when the environment is designed suitably (Ashburner et al. 2008).

If the routines of these children get disturbed, they will be completely upset. Like communication problems, these strong preferences for having a particular routine and not changing it may be due to sensory processing abnormalities. People in this spectrum may hate touching or trying new foods because they are uncertain or unreliable, but they may enjoy touching others or eating foods with a special texture. An explanation for this insistence on uniformity and other limited thinking is Executive Performance Theory. Executable functions should be done with cognitive processes such as focusing, planning and attention, but most ASDs lack control over their performance (Sanchez et al. 2011). Poor executive function results in poor motivational control, irregular and inflexible thoughts, or inappropriate behaviors (Davies and Claton 2008). When children start to communicate with their parents, the problems with social interactions are another problem that occurs in ASD people. Signs of ASD in infants may be a delay in talking, talking too much, lack of basic use of gestures and failure to respond to their names (Jordan 2003). Some people with ASD feel lonely and have lower quality relationships with others because they are more aware of their social constraints and thus avoid social communication (Frankel et al. 2011).

In high-performance children, social interaction is highly affected by sensory processing and recording problems (Hilton et al. 2007). Matsushima and colleagues used the Japanese revised sensory log (JSI-R) and the social response scale to examine the impact of hearing impairment on the social interaction of children aged 4 to 6 years old. The results showed that the social interaction of these children was lower than their normal counterparts and had a significant relationship with hearing impairment (Matsushima et al. 2013). Sensory processing status in autistic children can also affect their involvement in leisure activities and participation patterns. These children are more involved with activities at home, and they choose activities and games that are more sensory comfortable for them (Hochhauser and Engel-Yeger 2010). In the population of autistic children, there is a wide variety of sensory responses; it is stated that the severe condition of more or less responding is related to negative emotions, anxiety and depression (Ben-Sasson et al. 2008).

2.1.3. Architecture and Autism

In recent years, architects have been trying to design using new attitudes toward the relationship between human and their surrounding environment, with the help of Human Sciences Specialists, especially environment psychologists. Generally, the study of research conducted in recent years has shown that designing an appropriate environment concerning their sensory problems can affect their recovery and health. According to Mostafa's (2003; 2008; 2014) studies and other researchers (Paron-Wildes 2013; Beaver 2010), control of environmental stimuli plays an important role in maintaining the level of attention and concentration of autistic children. If architectural spaces were designed accordingly, autistic children do not need to adapt themselves to create focus and personal space. Designing the educational environment for these children, based on controlling environment sensory stimuli, can influence their behavioral disorders improvement and their interactions and interactions participation. In order to have a better understanding of this disorder, many definitions and theories have been presented in the past, considering the mechanisms of autism. The hypothesis of this research is based on sensory integrity disorder in autistic children and the role of environment and architectural spaces in improving these disorders, emphasized by researchers such as Rimland (1964), Delacato (1974), Anderson (1998), Mostafa (2014) and Kanakeri (2016). In these theories, the behavioral disorders of autistic children occur when they process the stimulant information from the surrounding physical environment. The conceptual aspect of the present study is that the architect, with the sensory design of the physical environment, can control the nature and amount of sensory inputs. By understanding the mechanisms of these sensory impairments and the following needs of the autistic user, the environment can be optimally used to regulate sensory inputs and thereby improve the behavioral disorders of autistic children and promote social participation in them. In the following, a summary of the researches carried out by various researchers to determine the criteria and sub-criteria of the study is presented in Table 1.

Table 1. Studies on the Design of Spaces for Autistic Children

Row	The Title of the Conducted Study	Source	Findings
1	Specific Needs	(Young 2004)	Provide appropriate architectural conditions of educational spaces for autistic children: having more control over users on environmental conditions, the simplicity of decorations, and the ability to combine small and large spaces.
2	The Effects of Buildings' Design on Autistic Children	(Whitehurst 2004)	Description of educational spaces architecture for autistic children: designing one one-floor buildings, multi-functional use of spatial spaces for the optimal use of space, using open spaces, curved walls, high windows, etc.
3	Designing Environments for Children and Adults with Autism	(Beaver 2006)	The acoustics spaces, having suitable light, ventilation and colors, having have suitable light, ventilation and colors, open spaces, etc.
4	A Design for Autism	(Mostafa 2007; 2014)	Propose architectural approaches for designing appropriate educational spaces for autistic people, such as: Being enclosed, having proportions height, private spaces and open spaces, the orientation of exterior landscapes and absorbing elements, using Harmonious spatial and visual environments, using sound insulation and more.
5	A Design for Autism	(Khare and Mullick 2008)	Physical structure: Organizing an environment with specific physical and visual boundaries. Maximizing visual structure and visual assistance. Designing quiet spaces. Correct arrangement of spaces, direct paths between spaces, regular zoning, and using simple shapes. Maximizing access to all spaces.

Row	The Title of the Conducted Study	Source	Findings
6	Open Space and Autism	(Linehan 2008)	Emphasize the natural environment and natural elements in stimulating the sensory receptors of autistic children.
7	Designing Houses for Autism Patients	(Ahrentzen and Steele 2009)	Existence of safety and security, maximizing familiarity with spaces, minimizing spatial stimulation, and opportunities for controlling social relationships.
8	Preparation of a Class For Autistic Children	(Kabot and Reeve 2010)	The impact of physical space on the learning of autistic children, Providing school experiences of other countries in the field of different type of educational facilities for children with autism spectrum disorders.
9	Design and Architecture	(Humphreys 2011)	Providing the necessary conditions for designing appropriate educational spaces for autistic people: using natural light, the ability to restrain space, the acoustic space, the minimum detail and decorations.
10	Architecture and Autism	(Ghasemi Sichani et al.)	Reviewing global studies on the educational spaces necessary for autistic children and the characteristics of suitable spaces.
11	Autism-Friendly Environment at Home	(Nagib 2014)	Interior design of residential space for children with autism: Considering appropriate furniture, bright walls, safety and security in interior design, using appropriate natural light.
12	Designing an Acoustic Environment For Autistic Children	(Kanakri 2014; 2016; 2017)	Acoustic effect on behavioral problems of autistic children: In spaces with high noise and high decibel (Db), children experience more behavioral problems. The need for insulation of walls and floors, using wooden furniture.
13	Effect Of Interior Design on Autistic Children	(Ibrahim Anous 2015)	A good educational environment for autistic children: using bright colors and simple textures, readability in space, acoustic environment, using controlled natural light, and the lack of fluorescent lamps. Designing flexible spaces.

Considering the studies carried out in order to provide appropriate design solutions for behavioral problems and promote the level of social interaction among autistic children, and examine case studies, the main indicators for designing these spaces (due to emphases that have been made in previous studies), can be divided into four main categories as Table 3.

Table 2. Studies on the Design of Spaces for Autistic Children

Criteria	Sub Criteria	Sources
Space Organization	Privacy and Personal Space; Flexibility of Spaces; Predictable Spaces	(Sanchez et al. 2011; Beaver 2006; Beaver 2010; Woodcock 2013; McAllister 2010)
Physical Factors of the Environment	Color; Light; Acoustic; Texture and Materials	(Anous 2015; Tucher 2014; White and White 1989; Mostafa 2007; Mostafa 2014)
Control and Security	Limitations; Supervision; Having No Risk	(Kanakri 2016; Humphreys 2002; Nagib 2014)
Natural Elements of the Environment	Natural Elements Ability of Beingto be Played; Provocative Natural Elements	(Mccoy and Evans 2002; Shibata and Suzuki 2004; Linehan 2008)

3. METHOD

As stated in this research, based on the literature and research background, the criteria and sub-criteria of the architecture affecting the behavioral disorders of autistic children were extracted and, after aggregation, with the help of experts' opinions, were presented in Table 2. In this study, Fuzzy Delphi and Fuzzy DEMATEL techniques were used. A questionnaire was distributed among 20 people, including 10 architects with sufficient information about the design of autistic children's spaces and 10 others, including autistic children's mentors, with sufficient experience teaching these children. The demographic profile of the decision group is given in Table 3.

Table 3. Introduction of the Statistical Society

Variable	Group	Quantity
Expertise in	Architecture	10
	Coaching	10
Education Level	M. A	14
	P.H.D	6
Work Experience	1 to 5 Years	12
	More than 5 Years	8

Fuzzy Delphi analysis was used to identify and screen the most important criteria. For this purpose, a researcher-made questionnaire consisting of four effective measures with a seven-range Likert scale and a free-form question to express any other ideas. After identifying the more important criteria, Fuzzy DEMATEL techniques have been used to differentiate sub- criteria to cause and effect and prioritize them pairwise compared by the same experts with the help of the 0 to 4 range of a questionnaire. The fuzzy DEMATEL technique is suitable when the relationships between feedback, network and non-linear variables and determining the intensity of the effect between them. The validity of the questionnaires was formal, so after designing the questionnaires, they were confirmed by the architects and autistic children's teachers in terms of appearance and ease of response, and for analyzing the results, Excel and Matlab (matrix laboratory) software were used (Fig. 1).

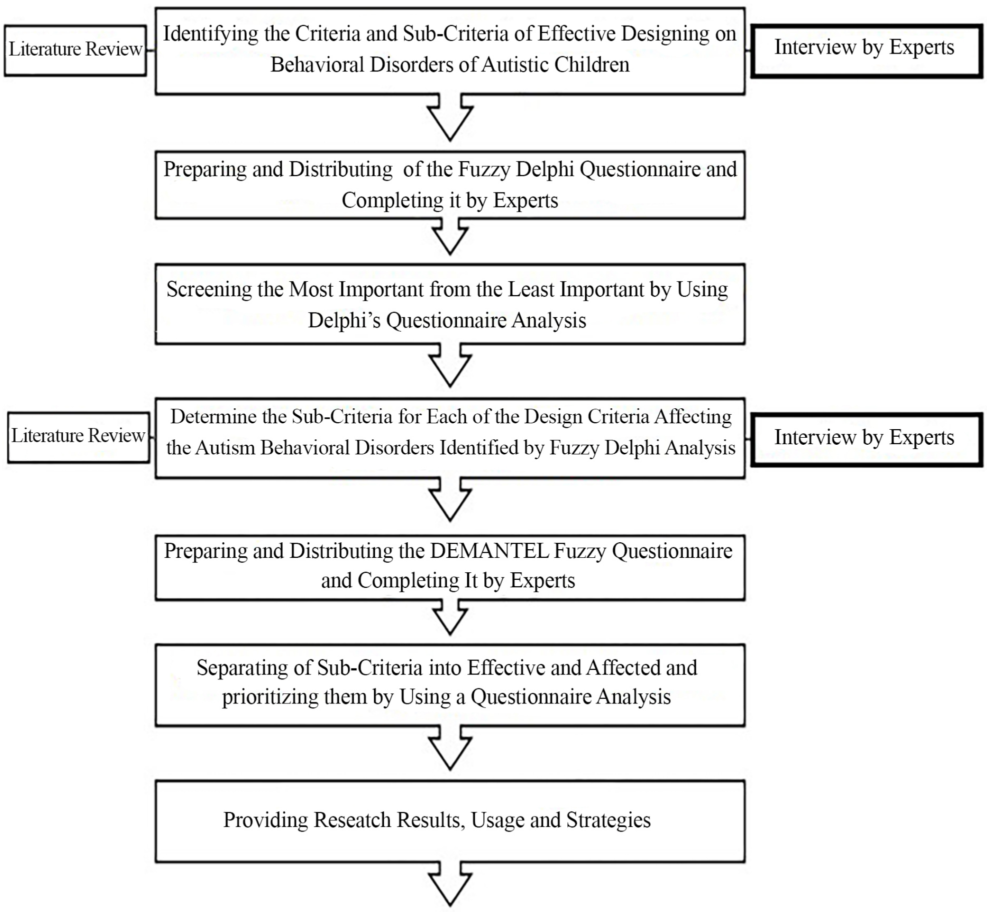

Fig. 1. The Process of Research Implementation

(Habibzadeh et al. 2016, 19)

4. FINDINGS

In this part of the research, we will refer to the findings obtained from two fuzzy Delphi and fuzzy Dimantel methods.

4.1. Findings of the Fuzzy Delphi Method

The Fuzzy Delphi method was to determine the effective architectural criteria in behavioral problems of autistic children from the point of view of architects and occupational therapists. The obtained criteria are based on previous studies, which are categorized in Table 2. The results of this method are presented in Table 4, in which, according to the information, 2 criteria out of 4 were determined as the basic criteria.

Table 4. Experts' Opinions and the Important Factor of Evaluated Criteria

Criteria (Architectural Components Affecting Behavioral Problems)	Number of Responses According to Importance					Final Numbers Related to Each criterion	Choosing Criteria Above 0.80
	Very Much	Much	Medium	Low	Very Low		
space organization	21	3	4	-	-	0.863	*
Physical Factors of Space	28	2	-	-	-	0.940	*
Control and Security	6	10	7	5	1	0.621	Not Essential
Natural Elements of The Environment	12	14	7	-	-	0.771	Not Essential

As shown in Table 6, two criteria for physical factors of space with a weight of 0.940 and space organization with a weight of 0.836 were selected as components of the main criteria. In the following, the method of calculating the definite numerical value of the factor of the importance of space organization is computed (as an example):
21*(0.75, 1, 1) = (15.75, 21, 21)
Aaverage= (15+1.15+1)/28, (21+2.25+2)/28, (21+3+2.25)
3(0.5, 0.75, 1) = (1.15, 2.25, 3) = (0.65, 0.90, 0.3)
4(0.25, 0.5, 0.75) = (1, 2, 2.25)
A1= (0.65+0.90+0.93)/3=0.83
A2= (0.65+2(0.90) +0.93)/4=0/845
A3= (0.65+4(0.90) +0.93)/6=0.863
Z*max {0.83, 0.845, 0.864}

4.2. Findings from the Fuzzy DEMATEL Method

Excel software has been used to analyze the fuzzy DEMATEL questionnaire. At first, the average responses for each sub-criterion were calculated to sum up expert responses. Then, according to the fuzzy values, direct relations were obtained as fuzzy numbers (imu) (Table 5).

Table 5. The Summation of Experts' Views

Total Ideas of Experts	Privacy and Personal Space			Flexibility of the Spaces			Predictable Spaces			Color			Light			Acoustic			Texture and Materials		
Privacy and Personal Space	0	0	0	7	8	8.5	8	9	9	3	4	5	1	1	1	3	4	5	3	4	5
Flexibility of Spaces	7	8	8.5	0	0	0	5	6	7	1	1	1	2	3	4	3	4	6.5	2	3	4
Predictable Spaces	8	9	9	7	8	8.5	0	0	0	4	5	6	1.5	2	2.5	1	1	1	3	4	5
Color	5	6	7	1.5	2	2.5	8	9	9	0	0	0	5	6	7	1	1	1	4	5	6
Light	4	5	6	3	4	5	7	8	8.5	6	7	8	0	0	0	3	4	6.5	8	9	9
Acoustic	5	6	7	4	5	6	5	6	7	1.5	2	2.5	1	1	1	0	0	0	4	5	6
Texture and Materials	7	8	8.5	5	6	7	5	6	7	8	9	9	6	7	8	3	4	5	0	0	0

Then, to normalize the data, according to the fourth step of table 3, the sum of each row was calculated, and then each data was divided by its maximum value. Table 6 shows the normalized matrix.

Table 6. Normalized Matrix

Normalized Matrix	Privacy and Personal Space			Flexibility of the Spaces			Predictable Spaces			Color			light			Acoustic			Texture and Materials		
Privacy and Personal Space	0	0	0	0.157	0.179	0.191	0.179	0.202	0.202	0.067	0.089	0.112	0.022	0.022	0.022	0.067	0.089	0.112	0.067	0.089	0.112
Flexibility of Spaces	0.157	0.179	0.191	0	0	0	0.112	0.134	0.157	0.022	0.022	0.022	0.044	0.067	0.089	0.067	0.089	0.146	0.044	0.067	0.089
Predictable Spaces	0.179	0.202	0.202	0.157	0.179	0.191	0	0	0	0.089	0.112	0.134	0.033	0.044	0.056	0.022	0.022	0.022	0.067	0.089	0.112
Color	0.112	0.134	0.157	0.033	0.044	0.056	0.179	0.202	0.202	0	0	0	0.112	0.134	0.157	0.022	0.022	0.022	0.089	0.112	0.134
Light	0.089	0.112	0.134	0.067	0.089	0.112	0.157	0.179	0.191	0.134	0.157	0.179	0	0	0	0.067	0.089	0.146	0.179	0.202	0.202
Acoustic	0.112	0.134	0.157	0.089	0.112	0.134	0.112	0.134	0.157	0.033	0.044	0.056	0.022	0.022	0.022	0	0	0	0.089	0.112	0.134
Texture and Materials	0.157	0.179	0.191	0.112	0.134	0.157	0.112	0.134	0.157	0.179	0.202	0.202	0.134	0.457	0.179	0.067	0.089	0.112	0	0	0

Subsequently, the total matrix was calculated according to the equation of the seventh step of Table 4, which is shown in Table 7. After this step, the de-fuzzy matrix of complete relation was obtained (Table 8).

Table 7. Complete Relationship Matrix

Complete Relationship Matrix	Privacy and Personal Space			Flexibility of the Spaces			Predictable Spaces			Color			light			Acoustic			Texture and Materials		
Privacy and Personal Space	0.162	0.297	0.507	0.271	0.403	0.598	0.312	0.464	0.676	0.156	0.267	0.441	0.089	0.160	0.287	0.123	0.208	0.376	0.153	0.271	0.467
Flexibility of Spaces	0.268	0.407	0.638	0.112	0.217	0.416	0.232	0.373	0.614	0.102	0.188	0.353	0.094	0.174	0.318	0.115	0.195	0.395	0.120	0.230	0.433
Predictable Spaces	0.313	0.461	0.665	0.269	0.398	0.588	0.161	0.294	0.499	0.175	0.285	0.457	0.100	0.179	0.313	0.086	0.153	0.302	0.153	0.270	0.462
Color	0.265	0.420	0.655	0.170	0.298	0.503	0.325	0.480	0.697	0.111	0.209	0.373	0.176	0.266	0.413	0.086	0.154	0.311	0.186	0.308	0.508
Light	0.286	0.474	0.775	0.227	0.390	0.661	0.344	0.533	0.824	0.259	0.395	0.616	0.099	0.187	0.350	0.141	0.243	0.487	0.286	0.428	0.661
Acoustic	0.236	0373	0.594	0.196	0.316	0.516	0.234	0.371	0.593	0.116	0.208	0.366	0.080	0.141	0.259	0.053	0.111	0.252	0.160	0.265	0.450
Texture and Materials	0.350	0.543	0.831	0.272	0.440	0.708	0.326	0.522	0.817	0.298	0.437	0.641	0.221	0.329	0.510	0.147	0.253	0.473	0.137	0.269	0.502

Table 8. De-Fuzzy Matrix of Complete Relation

De-Fuzzy Matrix of Complete Relation	Privacy and Personal Space			Flexibility of the Spaces			Predictable Spaces			Color			light			Acoustic			Texture and Materials		
Privacy and Personal Space	0.316	0.419	0.479	0.283	0.174	0.229	0.290	0.316	0.419	0.479	0.283	0.174	0.229	0.290	0.316	0.419	0.479	0.283	0.174	0.229	0.290
Flexibility of Spaces	0.430	0.241	0.398	0.208	0.190	0.225	0.253	0.430	0.241	0.398	0.208	0.190	0.225	0.253	0.430	0.241	0.398	0.208	0.190	0.225	0.253

De-Fuzzy Matrix of Complete Relation	Privacy and Personal Space			Flexibility of the Spaces			Predictable Spaces			Color			light			Acoustic			Texture and Materials		
Predictable Spaces	0.475	0.413	0.312	0.301	0.193	0.173	0.288	0.475	0.413	0.312	0.301	0.193	0.173	0.288	0.475	0.413	0.312	0.301	0.193	0.173	0.288
Color	0.440	0.318	0.495	0.225	0.280	0.176	0.327	0.440	0.318	0.495	0.225	0.280	0.176	0.327	0.440	0.318	0.495	0.225	0.280	0.176	0.327
Light	0.502	0.417	0.558	0.417	0.205	0.279	0.451	0.502	0.417	0.558	0.417	0.205	0.279	0.451	0.502	0.417	0.558	0.417	0.205	0.279	0.451
Acoustic	0.394	0.336	0.392	0.224	0.155	0.132	0.285	0.394	0.336	0.392	0.224	0.155	0.132	0.285	0.394	0.336	0.392	0.224	0.155	0.132	0.285
Texture and Materials	0.567	0.465	0.547	0.453	0.347	0.282	0.295	0.567	0.465	0.547	0.453	0.347	0.282	0.295	0.567	0.465	0.547	0.453	0.347	0.282	0.295

According to the results, the fuzzy values of r, the sum of each row of the complete relation matrix, and c, the sum of each column, as well as the values of d + r and d-r were obtained, and then the equation of step 7 in Table 4 was used to make them de-fuzzy in order to determine the cause and effect and prioritize the criteria which are shown in Table 9. The cause and effect graph is also drawn for factors, shown in figure 2.

Table 9. D + r and D-r Values

D + R	5.320	4.559	5.343	4.379	4.381	3.420	5.152
D - R	-0.934	-0.664	-1.026	0.150	1.284	0.423	0.766

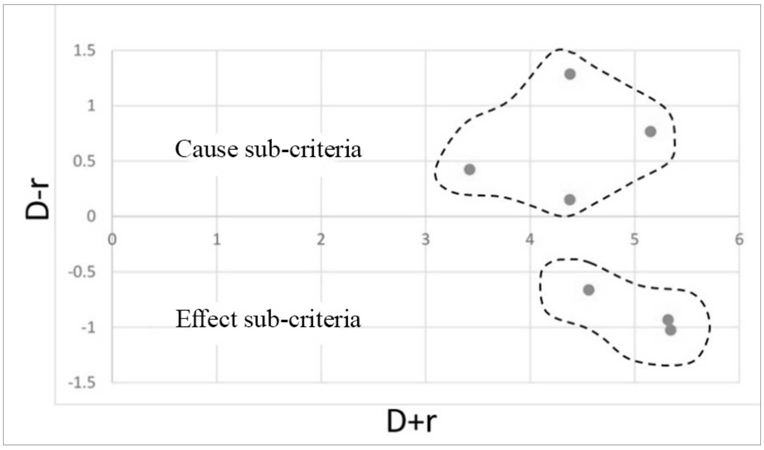

Fig. 2. Causes and Effects Diagram

Therefore, the sub-criteria of causes and effects are identified as shown in Table 10. The de-fuzzy values of D-r also determine the prioritization of the sub-criteria. Thus, the priority and the cause are "light," and the last priority and the effect are "the predictability of spaces." This way, the cause and effect relationship and the prioritization of the factors are determined.

Table 10. Prioritization of Sub-Criteria

	Sub-Criteria	Prioritization
Cause	Light	1
	Texture and Materials	2
	Acoustic	3
	Color	4

	Sub-Criteria	Prioritization
Effect	Flexibility of the Spaces	1
	Privacy and Personal Space	2
	Predictability of Spaces	3

5. CONCLUSION

Various studies on the effects of the environment on autistic children's problems suggest that appropriate architecture and design can greatly affect their behavioral problems. Therefore, it seems necessary for environmental architects and designers to identify the factors affecting their design, prioritization, and relationship.

In the first step, by reviewing the literature, the architectural features affecting the behavioral problems of children with autism were studied and classified into four general factors. The organization of the spaces, the physical characteristics of the environment, the security and the natural elements of the environment were obtained at this research stage. In the next step, the questionnaire was analyzed by the Delphi method consisting of four factors extracted from the first stage; two factors were considered the most important architectural factors affecting the behavioral problems of autistic children, Physical factors of space with weight (0.940) and organization of spaces with weight (0.863). After this stage, the sub-criteria of these factors were classified and prioritized using the Delphi method questionnaire. According to research findings, “light, texture and materials, acoustics and color” as sub-factors are the causative aspects and “flexibility of the spaces, privacy, and personal space and the predictability of spaces” are which are affected by caused factors. According to the results, when the designers -depending on the design matter- are looking for early but superficial results, they could focus on the priority in the influential group. While their goal is to carry out basic interventions focusing on the subject, they can focus on the priorities placed on the influential layer or cause and formulate their design appropriately.

Considering the division of criteria for the design of children's educational aids in children with autism into two effective and effective categories, the suggestions are presented according to these criteria in the following sentences.

In terms of impact criteria, the personal space required for ASD people is different from ordinary people, which means that they need more space for social relationships, and in the design process of spaces such as classrooms, corridors, dining rooms, etc., this issue must be considered. Research has shown that cognitive ability increases significantly when classrooms are divided into different parts, and each part is assigned to specific activities. Restricting the learning environments in physical or visual aspects and adapting them to the physical needs of autistic children over a specific period allows them to remember attention, concentration and activity. When the child enters the divided space, the equipment, furniture and teacher are always in a particular pattern for each activity; this makes everything for the child predictable and, as a result, maximizes his focus. Clear and defined signs in the various spaces are essential for ASD students who often depend on visual signs. Using such signs improves student understanding by creating a more predictable and interactive environment; therefore, using visual aid signs in different spaces is suggested. Visual aid tools can be used in various ways to support the arrangement of the physical environment; for example, It shows children where to sit, where to stand, where to queue

In terms of Effective criteria, the sensitivity and response to artificial light, in contrast to the types of artificial light in autistic patients, sometimes have distinct differences. In the design of lighting, it should be noted that the extreme reactions of autistic children be minimized (especially those who suffer from severe disorders), but the balance and coordination with other things, including the poor vision of some ASD students, should also be considered. Transmissions that work with fluorescent lamps produce an audible sound that is distracting and disappointing for ASDs. The effect of specific colors on ASD children is not always the same, and thus it might be necessary to do trial and error to determine the suitable color for each child. It is believed that autistic children perceive 85% of the colors more than ordinary children. However, autistic children may respond differently to certain colors and patterns from their peers.

Most people with ASD are overly sensitive to sounds, meaning their hearing pain threshold differs from normal people. Observers report that autistic people cover their ears when the noise level increases. Perhaps the most important design aspect for ASD children is suitable acoustic conditions, and the designed space for them should be able to respond appropriately to this particular need of these children. As stated above, the existence of calm and order is not limited to space organization; it also affects the use of materials; therefore, using materials with the least details in buildings is recommended.

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