

THE INTERACTION OF SENSORY DISABLED PEOPLE WITH COLORS WITHIN THE ARCHITECTURAL SPACES**Alaa Firas Alaulddin AL-HESHMA**

ORCID 0000-0002-1115-5011

Faculty of Art, Design and Architecture, Department of Architecture, Istanbul Okan University, Istanbul, Turkey

Abstract: Architects design for humans, and for the sake of humanity the stages of his life and the circumstances they may go through. Various studies have shown that the design of home can have a profound impact on its occupants. One of the most important factors affecting the disabled is the colors inside the architectural spaces, which is one of the most important guiding tools inside the buildings. This study investigated color and how it contributes to the feel of a home and how it can be implemented into design guidelines. Questionnaires and interviews were used, combining articles, books and Real experiences. The analyzes led to obtaining a relationship linking colors to functions and concluded with a practice checklist, where the design guidelines were formulated.

Keyword: (Sensory disabilities, architectural spaces, colors, sensory, guiding)

Introduction

One of the most important factors affecting the disabled is the colors inside the architectural spaces, which is one of the most important guiding tools inside the buildings in terms of function and direction.

The objective of the experiment is to find out the effect of colors in their degrees and different brightness on the disabled. By conducting a set of questionnaires and interviews with the disabled, and based on previous studies of architects and doctors in this field, a set of results and recommendations will be reached that link each color and its degrees with reactions to it by the disabled.

The problem appears in the architecture and its standard, where most of these standards are fixed and have not changed for a long time and they are considered as a fixed architectural heritage that cannot be manipulated, but the problem is that most of these standards were made by people who did not experience the place after designing it based on their standard. Different types of sensory disabilities affect one or more senses; sight, hearing, smell, touch, taste or spatial awareness.

Types of sensory disabilities**1-autism spectrum disorder (ASD)**

Autism spectrum disorders are a lifelong developmental disability. They affect the way someone interacts with the world around them, as well as with other people. The effects of autism are wide ranging and can include difficulties in social interaction and communication, restricted and repetitive interests and behaviors, and sensitivity to sensory experiences – noise, light, touch etc. As autism can be very variable, the word ‘spectrum’ describes the range of difficulties that someone with autism may experience. Autism is a complex disability and cause is not well understood. As far as we know there’s no single cause. Instead, it’s likely to be due to a combination of environmental and genetic.

2- Blindness and low vision

A person is considered legally blind if they cannot see at six meters what someone with normal vision can see at 60 meters or if their field of vision is less than 20 degrees in diameter. A person is said to have low vision when they have permanent vision loss which affects their day to day and cannot be corrected with glasses.

Blindness and low vision can occur as a result of a number of different diseases, conditions, or accidents. Some eye conditions are congenital (present at or near birth), while others are caused later in life. Some specific causes of vision

loss can include an injury to the eye, eye defects, albinism, macular degeneration, diabetes, glaucoma, cataracts, and tumors.

3- Hearing loss and deafness

Hearing loss, also known as a hearing impairment, is the partial or total inability to hear. If someone has very little or no hearing, the term 'deaf' may be used. Damage to any part of the external, middle, or inner ear can cause hearing loss which can range from being mild to profound.

Causes of hearing loss can be quite varied and can include problems with the bones within the ear, damage to the cochlear nerve, exposure to noise, genetic disorders, exposure to diseases in utero, age, trauma, and other diseases.

4- Sensory processing disorder

Sensory processing disorder is a condition where a person has trouble receiving and responding to information that comes in through the senses. This may mean they misinterpret everyday sensory information, such as touch, sound, and movement.

When someone has sensory processing disorder, they are able to sense the information, however, the brain perceives and analyses the information in an unusual way. It may affect one sense only or it may affect multiple senses. Some people with sensory processing disorder are oversensitive to things in their environment. Common sounds may be painful or overwhelming, and the feel of certain textures on the skin may be very uncomfortable.

5- Touch

Touch is an extremely important sense for a child who has a visual impairment. Many children with visual impairments and additional disabilities use touch as one of their primary means for gathering information. Therefore, it's a good idea to encourage your child to touch objects as a way of exploring the world, beginning in infancy. You can use the hand-under-hand technique to help her reach out to touch things in the environment.

Some children are resistant to touching; you may hear this referred to as "tactile defensiveness." It can be challenging to cope with a child's avoidance of touching because, on the one hand, it's important for children to explore and gather information, but on the other hand, it's also important to respect their feelings and wishes. For example, rather than asking her to touch an object she has never encountered before, begin with things that are familiar to her and introduce unfamiliar objects gradually over time. The use of the hand-under-hand technique is often effective in helping children become more comfortable with touch.

Color definition

he aspect of any object that may be described in terms of hue, lightness, and saturation. In physics, color is associated specifically with electromagnetic radiation of a certain range of wavelengths visible to the human eye.

Color is determined first by frequency and then by how those frequencies are combined or mixed when they reach, they eye. Low frequency radiation is invisible. With an adequately bright source, starting somewhere around 400 THz (1 THz = 10^{12} Hz) most humans begin to perceive a dull red. As the frequency is increased, the perceived color gradually changes from red to orange to yellow to green to blue to violet. The eye doesn't perceive violet so well. It always seems to look dark compared to other sources at equal intensity. Somewhere between 700 THz and 800 THz the world goes dark again.



Fig. 1 color Frequency

Frequency determines color, but when it comes to light, wavelength is the easier thing to measure. A good approximate range of wavelengths for the visible spectrum is 400 nm to 700 nm (1 nm = 10^{-9} m) although most humans can detect light just outside that range. Since wavelength is inversely proportional to frequency the color sequence gets reversed. 400 nm is a dull violet (but violet always appears dull). 700 nm is a dull red.

Wavelength varies with the speed of light, which varies with medium. The speed of light is about 0.03% slower in air than in vacuum. If you're trying to understand color, wavelength is just as good as frequency.

color	1	2	3	4
red	647-700	647-760	630-700	620-600
orange	565-647	585-647	590-630	590-620
yellow	575-585	575-585	570-590	560-590
green	491-575	491-575	500-570	480-560
blue	424-491	424-491	450-500	450-480
violet	400-424	380-424	400-450	400-450

Fig. 2 color Frequency

white & black

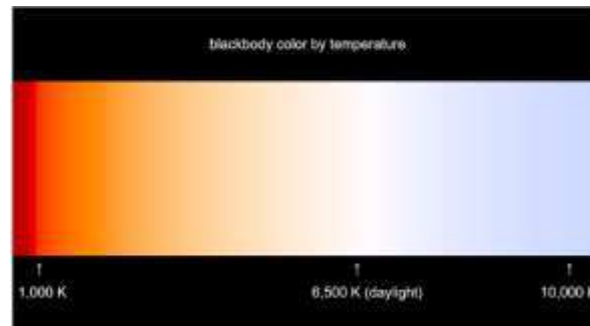


Fig. 3 color temperature

The theory of colors, in particular, has suffered much, and its progress has been incalculably retarded by having been mixed up with optics generally, a science which cannot dispense with mathematics; whereas the theory of colors, in strictness, may be investigated quite independently of optics.

Types of Colors

Neutral Colors Neutral colors do not generally show up on the color wheel. Neutral colors include black, white, grayish, and occasionally brown and faceless. They're occasionally called "earth tones".



Fig. 4 neutral color



Fig. 5 neutral color wall decor

Warm Colors: Warm colors are made with red, orange, yellow, or some combination of these. Warm colors tend to make you think of sunlight and warmth.



Fig. 6 warm color



Fig. 7 warm color wall décor

Cool Colors: Cool colors are made with blue, green, purple, or some combination of these. Cool colors might make you think of cool and peaceful things, like winter skies and still ponds.



Fig. 8 cool color



Fig. 9 cool color wall décor

Bright colors: are colors that command attention due to their hue, brightness or both.



Fig. 10 bright color wall décor



Fig. 11 bright color wall décor

Industrial colors: are colors based on industrial landscapes such as factories infrastructure and stark urban areas.



Fig. 12 Industrial color



Fig. 13 Industrial color wall décor

What is color psychology and how does it work?

Color psychology is simply the effect that color can have on the psychological and emotional state of the mortal brain. Colors beget perception that we must understand each color has a triadic effect on person

1. Impress, attracts, attention.
2. Triggers an emotion or response as each color has a suggestive range.
3. Builds, because every color has a distinct meaning and takes on emblematic significance.

Questionnaire:

A questionnaire was conducted for the sensory disabled people to know their interaction with colors.

The target category of the questionnaire (autism spectrum disorder, color blindness and low vision, hearing loss and deafness, Sensory processing disorder, Touch). The questionnaire aims to know the reactions of the sensory disabled people to the main types of colors and with the degrees of color brightness.

Through a set of direct and indirect questions that were developed based on a prior study of the types of questions related to the psychological aspect of the sensory disabled people, and after reviewing them by more than one engineer and specialists in the field of writing architectural and psychological questionnaires.

after submitting about 200 people, the questionnaire was analyzed and the results were as follows:

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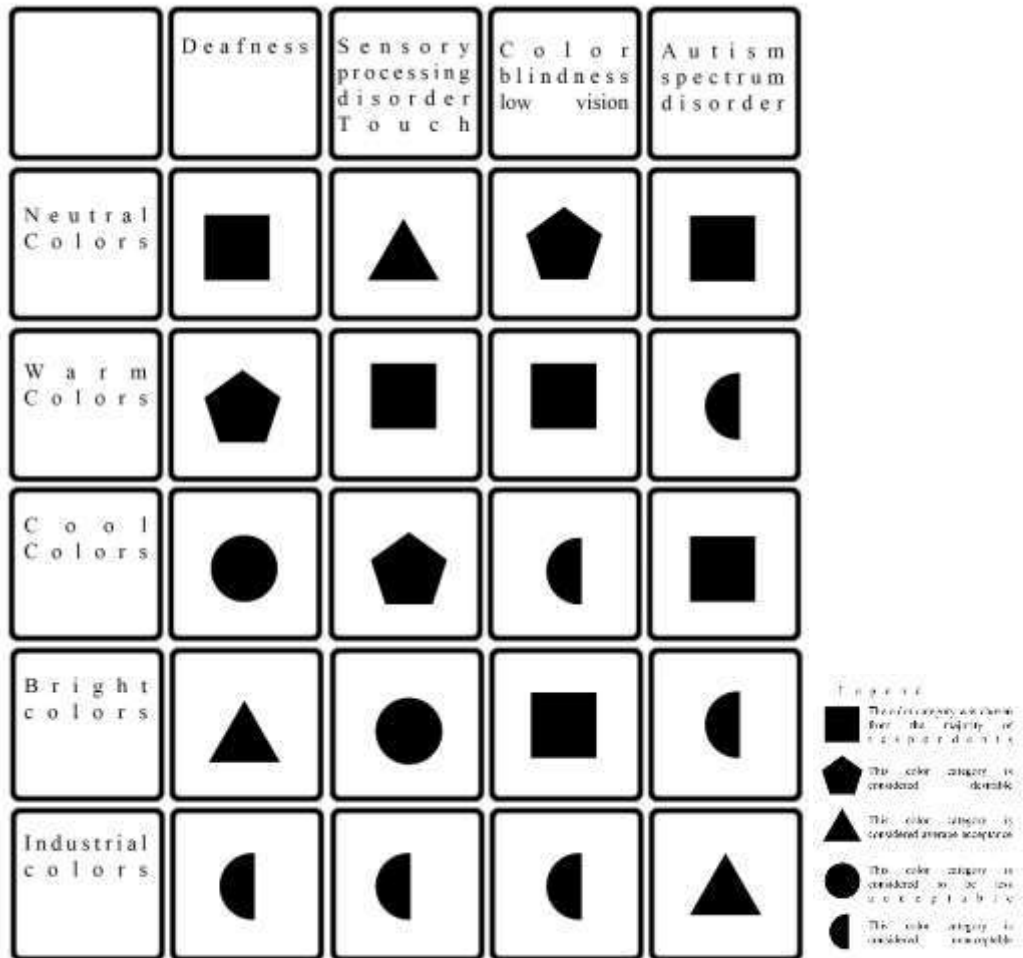


Fig. 14 color category

Design decisions

Before starting design decisions, the foundations and rules that were followed in the case of color blindness should be discussed.

color blindness

Color blindness is a reduced capability to distinguish between colors when compared to the standard for normal mortal color vision. When a person is color eyeless, also called color vision insufficiency (CVD), they generally have difficulty distinguishing between certain colors. There are colorful kinds of color blindness, and while it may be on occasion, utmost color eyeless persons are only incompletely suitable to " see" red, green, or blue light.

The term " red/ green color blindness" refers to the most current types of color blindness. Although the term " red/ green color blindness".

Types of Color Blindness



Fig. 15 normal color



Fig. 16 normal color

Protanopia

Protanopes are more likely to confuse: -

1. Black with many shades of red
2. Dark brown with dark green, dark orange, dark red, dark blue/purple and black



Fig. 17 Protanopia color



Fig. 18 Protanopia color

- 3. Some blues with some reds, purples and pinks
- 4. Mid-greens with some oranges

Deuteranopes



Fig. 19 Deuteranopes color



Fig. 20 Deuteranopes color

Deuteranopes are more likely to confuse: -

1. Mid-reds with mid-greens
2. Blue-greens with grey and mid-pinks
3. Bright greens with yellows
4. Pale pinks with light grey/white
5. Mid-reds with mid-brown
6. Light blues with lilac

Tritanopes



Fig. 21 Tritanopes color



Fig. 22 Tritanopes color

The most common color confusions for tritanopes are light blues with greys, dark purples with black, mid-greens with blues and oranges with reds.

Key for color blind

It's crucial to make your infographics and charts accessible and inclusive for persons who are color blind.

Additionally, it is feasible to do so without sacrificing the final product's aesthetic appeal.

Make sure color-blind users can interact with your designs by taking the following precautions:

- choosing color schemes that are accessible to color-blind people
- Keeping bad color combinations out
- using diverse patterns and textures rather than just color to draw attention to critical details
- adding icons and symbols to color-coded messages, alerts, and warnings
- Using color combinations that are starkly contrasting
- adopting a minimalist style to help prevent needless confusion.

Making use of all these components can enable color-blind individuals have easier access to your designs. The more people you can interact with, the greater the influence of your effort.

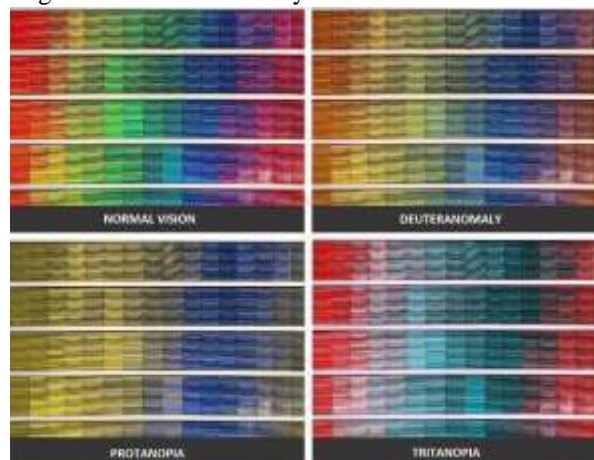


Fig. 23 Comparison of the types of color blindness

Recommendations

After identifying the samples and knowing the results of their selection of the desired and undesirable colors from the color groups, the type of condition will be chosen, and then what is the desired feeling within this space (calm, warning...etc.) based on the desired situation and feeling, select the appropriate color from the color groups. for example:



Fig. 24 example

Color is a powerful form of communication and plays a vital role in your daily life. It's used in industrial, mechanical, commercial, medical, political, cultural, athletic and educational purposes to name a few. It can sway thinking, change actions and cause reactions.

Examples:

1-Deafness color The color was determined based on the matrix obtained from the questionnaire



Graphic Green: cuts of wood edging into the green tile floor at the transition to the dining area. The green tiles with white lines look a bit like palm leaves and complement the natural look of the wood floors. The color provides a feeling of comfort and calm with complete freedom for the user within the boundaries of the color.



Fig. 25 cuts of wood edging into the green tile floor

2- color blindness and low vision colors The color was determined based on the matrix obtained from the questionnaire



Fig. 26 amber color door

One of the colors that a person with color blindness can see, Amber Color and by using this color we can identify the important places or the desired roads, as this color is considered attractive. As a warm and inviting color, amber is revered as a protector. Some people wear amber jewelry to guarantee optimal safety. Equally effective is surrounding yourself with amber gems. Those who swear by holistic medicine generally honor this school of thought. While there's no proof to support this claim, there's also no harm in measures against taking extra to safeguard danger.

There's not much about amber that disappoints. It's upbeat, helpful, and supportive. Moreover, it welcomes all with open arms. However, it can sometimes ruffle feathers. Amber boasts such positive qualities that you hardly notice its flaws.

3- Sensory processing disorder and Color blindness The color was determined based on the matrix obtained from the questionnaire



One of the colors that a person with color blindness can see, and by using this color we can identify unwanted places. The injured person can also see this color as a warning, as it is annoying to him.

Due to its green undertones, chartreuse is prone to jealousy.

Try as it might, chartreuse can't help but feel inferior to most. From its dwindling confidence to its incessant self-doubt, many find it frustrating to be around chartreuse.

If you'd describe yourself as an envious person, keep your interactions chartreuse with to a minimum.

While this color relishes its uniqueness, it can sometimes feel like an outsider, which gives rise to feelings of uncertainty.



Fig. 27 chartreuse color line on the floor

4- autism spectrum disorder The color was determined based on the matrix obtained from the questionnaire.



This color is used to indicate the places to walk, and mixed with the orange color, it has become a symbol of a dangerous place. Best described as a mix between red and purple, burgundy is a deep hue that's often mistaken for maroon.



Fig. 28 burgundy color line on the floor

Unlike maroon, burgundy has a hint of purple where maroon has more brown to it. Burgundy gets its name from a drink that boasts a similar shade. More specifically, a red wine that comes from France. Burgundy made its ultimate claim to fame about three decades ago. During this era, burgundy lipstick was all the rage. It was the beauty industry that essentially put this hue on the map.

5- Aquarius color



Color is a powerful form of communication and plays a vital role in your daily life. One of the colors that a person with color blindness can see, and by using this color we can Aquarius color identify unwanted places. The injured person can also see this color as a warning, as it is annoying to him.



Fig. 29 Aquarius color

6- Neutral color



Fig. 30 Neutral color

The use of earthy and natural colors in the interior design symbolizes comfort in the place and to define a special area in which interaction is allowed with the presence of lines in another color expressing that this place is the place of important interaction within the place. The colors used are also considered comfortable and visible colors for all types of sensory disabled

conclusions

In the end, we, as architects, must design for a better life for people and abandon the idea of traditional design based on pure numbers, which does not have human values within it, but rather its greater goal is financial gain by following

economic methods in design without taking into account the human’s psychological and health needs, which are the basis.

Today, unfortunately, we fall under the principle of (the sick house), which today considers modernity and the best design for humanity, or so it is said. In fact, most of the diseases that people suffer from at the present time due to the bad designs of the architectural environment inside modern homes, the lack of space, the overcrowding and the distance of people with towers off the earth’s surface.

We should design for the disabled from their point of view, not ours. They are the ones who will live in the house we must ask them about what they prefer and what they do not prefer inside their homes in all aspects in a humane manner without seeking material gains from people who have no fault.

Every architect has a story that he writes with his designs, so write your story as if you were a poet.

APPENDIX

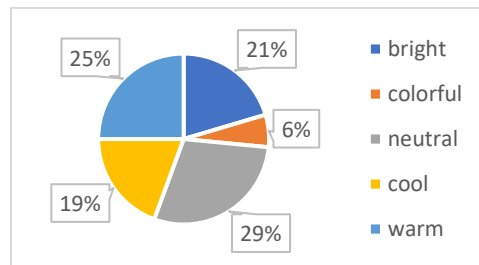
Appendix A

Questionnaire and results: A questionnaire was conducted for the sensory disabled people to know their interaction with colors. The target category of the questionnaire (autism spectrum disorder, color blindness and low vision, hearing loss and deafness, Sensory processing disorder, Touch). The questionnaire aims to know the reactions of the sensory disabled people to the main types of colors and with the degrees of color brightness.

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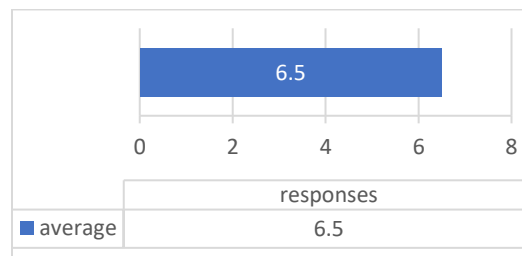
after submitting about 200 people, the questionnaire was analyzed and the results were as follows:

1. Do you have colors that you love? Do you like things bright, colorful, muted, neutral, or earthy?



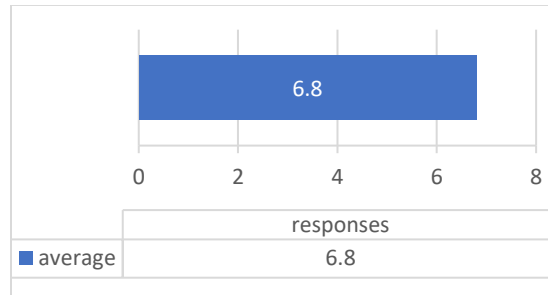
Bright colors (40), colorful (12), neutral (57), cool (38), warm (49).

2. At 1 to 10 scale how much do cool colors affect you?



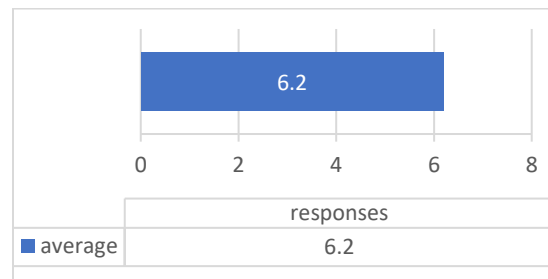
Responses 177, Average Number 6.5.

3. At 1 to 10 scale how much do warm colors affect you?



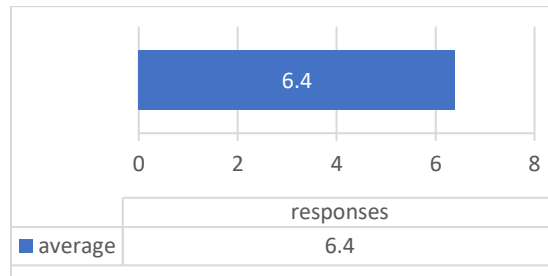
Responses 172, Average Number 6.8.

4. At 1 to 10 scale how much do interactive colors affect you?



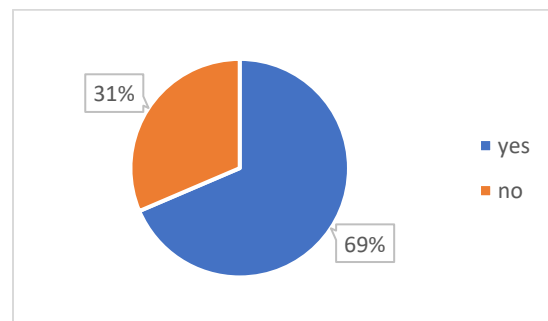
Responses 177, Average Number 6.2.

5. At 1 to 10 scale how much does your daily activities depend on the natural lighting?



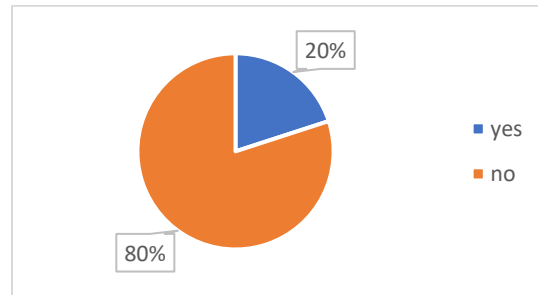
Responses 167, Average Number 6.4.

6. Are the paintings cool colors helping you to feel comfortable?



Yes (120), no (55).

7. Do the warm colors of painting annoy you?



Yes (36), no (144).

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