

Neuroarchitecture Analysis in the *Mis Abuelitos* Nursing Home in Cochachinche, Huanuco, Peru – A Secondary Publication

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Abstract: Neuroarchitecture is a set of characteristics grouped into principles that seek to generate a certain behavior when applied. These principles will vary according to the type of user for whom the design is intended. In this research, these neuroarchitectural principles are identified in the nursing home *Mis Abuelitos* in Cochachinche, Huánuco. The home was designed and built with notions of nature and the Andean while emphasizing the occupants are the elderly. With this purpose, qualitative research was carried out using two sequential criteria, the first was to identify what these principles are and the second was to recognize the principles within the area. The principles that are assertively used for the elderly occupants were selected. The study observation was performed with observation and photographic sheets and was analyzed with ATLAS.ti processing software. It was obtained that the three neuroarchitectural principles are present in the nursing home which are 67% of the recommended characteristics for the elderly.

Keywords: Elderly; Nursing home; Neuroarchitecture; Architectural principles

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1. Introduction

It was formerly believed that neurons, cells of the nervous system, were only formed at birth and that they were lost as the years went by. However, neurobiologist Fred Gage demonstrated in 2003 that new neuronal cells can continue to form throughout the life of humans, thus leading to changes in the nervous system and consequently its behavior. This new fundamental discovery is how the field of neuroarchitecture was born ^[1]. Likewise, correctly applied neuroarchitecture can improve the physical and mental health of its inhabitants of any age group ^[2]. However, some limitations affect this method, such as in the elderly who have diseases that make it difficult for them to develop in living spaces with such characteristics ^[3].

In addition, many of these elderly do not have family members, or their families are too preoccupied to take care of them, so they end up in nursing homes which do not always meet their spatial needs because the homes are not prepared for this age group. This is one of the problems that prompted the World Health Organization to emphasize the importance of a building designed for its inhabitants and its function ^[1]. For

that reason, this article studies the nursing home *Mis Abuelitos* (**Figure 1**) where 26 elderly reside. Most of the elderly at the home came from different parts of Huanuco because they lived alone, on the streets, or in remote places. The home is located in the community of Cochachinche (**Figure 2**), in the district of Huacar, located 30 minutes from the plaza of the province of Ambo. This nursing home is built on the land of Father Oswaldo Rodriguez Martinez, who, in a philanthropic way, managed to build it together with many residents and financial help from selfless people. This is to provide a space for all the elderly who need quality of life. Its design and construction, as Father Oswaldo mentions, was inspired by nature and the Andean, always keeping in mind the type of user for which it was directed.

Neuroarchitecture provides different principles, a classification considered by the Academy of Neuroscience of Architecture (ANFA) to be used for specific users, with different characteristics that can help meet the needs of the elderly and provide comfort ^[4,5]. Neuroarchitecture is appreciated by the users of *Mis Abuelitos* despite the home having been built without the knowledge of this science. Based on this, the question arises if it is possible to achieve a similar response that gives the application of neuroarchitecture in the construction of a building with notions of nature, the Andean, and traditions to a certain type of user. The objective of this research is to study the principles of neuroarchitecture in the nursing home *Mis Abuelitos* in the community of Cochachinche, district of Huacar, province of Ambo.



Figure 1. Nursing home *Mis Abuelitos* in Cochachinche, Ambo, Huanuco



Figure 2. Cochachinche Community Plaza, located approximately 80 meters from the nursing home

2. Methodology

The present investigation involves the nursing home *Mis Abuelitos*, located in the community of Cochachinche in the district of Huacar, province of Ambo, with coordinates of Latitude 10°12'41.59" S, and Longitude 76°14'37.96" W, 35.9 km. The study utilizes a qualitative approach with two sequential criteria to recognize the neuroarchitectural principles present in the investigated area.

The first criterion was to know what the neuroarchitectural principles are. This was approached through parameters given by the ANFA, grouping them into three guidelines that were identified to be related to the elderly, which are sensation and perception, memory and learning, and emotion and affection, as shown in **Table 1** ^[2]. The neuroarchitectural principles are also characteristics that provoke a type of response in the behavior of their user when applied in spaces, which help them to achieve comfort, alleviate problems such as stress, depression, and anxiety, or promote the development of their mind.

As for the second criterion, the principles present in the nursing home that are focused on the elderly are recognized. For this, observation was performed with the use of two instruments, the observation sheet and the

photographic sheet, which were constructed from a compilation and contrast of neuroarchitectural data from ANFA, the architecture notebook of Elizondo and Rivera, from *Eyes of the Skin* by Pallasmaa and from data on quality of life in the elderly from the research by Anastacio et al. and Vázquez [1,2,6–8]. Three observation sheets were constructed and divided according to the neuroarchitectural principles of sensation and perception with four characteristics, memory and learning with two characteristics, and that of emotion and affection with one characteristic, as shown in **Table 1**. The nascent characteristics of each principle are those that highlight its function. These sheets will be analyzed with graphs to pinpoint the singularities present in the study site. The photographic sheets contain images of different parts of the nursing home that have a direct relationship with the characteristics and were constructed from the aforementioned data. The sheets were analyzed within the same three neuroarchitectural principles using the ATLAS.ti program, which helped to examine qualitative data through the coding of the image, using groups, codes, and subcodes, that revealed their presence and frequency from the transcription of these principles.

Table 1. Classification of the three neuroarchitectural principles with their general characteristics

Neuroarchitectural principles	Characteristics
Sensation and perception	Light, shape, color, and material
Memory and learning	Visuals and spatiality
Emotion and affection	Vegetation

3. Results

Four tables were obtained for the first criterion. The first three tables show each type of principle with general and specific characteristics that can evoke in the user, while the fourth table provides the particularity of those characteristics most appropriate for a center that houses the elderly.

Both general and specific characteristics for better development and well-being in the elderly were delved into, which are the principle of sensation and perception that seek to evoke feelings of tranquility, the principle of memory and learning that stimulate their mind with happy memories, and the principle of emotion and affection that generate positive emotions that help their health [7].

As shown in **Table 2**, memory and learning are two processes of the nervous system that affect organisms to change their behavior and adapt to the surrounding environment, where learning acquires knowledge and behaviors, while memory stores them inside the brain [9]. It is because of this relationship that both are within a principle with visual characteristics and spatiality that seeks to generate variations in the behavior connected with adaptation.

Psychobiological expressions of emotion and affection are shown in **Table 3**. Emotion is constructed with expressions of culture and society, while affection is an exclusively biological and physiological behavior [10]. The characteristics encompassed by this principle use both of these expressions to generate responses at the biological and social levels.

Psychological processes of sensation and perception are shown in **Table 4**. Sensation focuses on the input and detection of information received through sensory receptors, while perception is responsible for interpreting this information to give a response [11]. For such reason, the characteristics within this principle involve behaviors produced by the acquisition of information through the senses.

Table 5 shows the specific characteristics of each principle selected for the benefit of the elderly, taking into account their condition with certain physical or mental limitations.

Table 2. Neuroarchitectural principles of memory and learning, showing how the desired effect can be achieved by applying the specific characteristics of visuals and spatiality in the home

Characteristics	Neuroarchitectural effect
Windows overlooking parks or gardens	Decreases and stabilizes the heart rate, decreases stress and anxiety levels, increases productivity and creativity, and helps children start learning.
Sound of nature	Generates sensations of tranquility and comfort.
Sound of running water	Decreases stress and anxiety levels, and generates feelings of relaxation and tranquility.
Colors inspired by nature	Reduces stress, increases feelings of comfort, and influences the perception of space. Increases serotonin and oxytocin levels.
Low ceilings	Encourage concrete thinking, focused and detailed thoughts. Improves concentration.
High Ceilings	Encourages creativity, promotes conceptual thinking, generating feelings of freedom.
Spatial Continuity	Generates visual connections between spaces, which increase opportunities for socializing and socializing.

Table 3. Neuroarchitectural principles of emotion and affection

Characteristics	Neuroarchitectural effect
Biophilic design	Increases productivity, creativity, and the assimilation of information, helps interaction between people.
Aromatic plants	Helps to remember moments, soft smells produce feelings of tranquility and joy.
Floral plants	The diversity of color generates emotions related to joy.
Indoor vegetation	Generates feelings of tranquility, helps focus and concentration, and lowers stress levels.

Table 4. Neuroarchitectural principles of sensation and perception, show how desired effect can be achieved by applying specific characteristics of light, shape, angle, color, and materiality in the space.

Characteristics	Neuroarchitectural effect
Natural light	Generates emotions of joy, pleasure, and relaxation.
Artificial light	Generates emotions linked to boredom, sadness, and sleepiness.
Artificial light warm or yellowish	Relaxing effect. Create a warm, relaxed, and restful environment that makes it difficult to focus on specific tasks.
Neutral artificial light	Creates both lively and relaxed environments.
Cool or blue artificial light	Creates stimulating environments for spaces with a lot of movement or that require focus, creativity, and alertness.
Square-shaped spaces	Crowded space with a greater sense of enclosure.
Rectangular shaped spaces	Less overwhelming spaces
Curved	Provides feelings of safety, security, and comfort.
Straight or linear	Favors the appearance of feelings of anxiety and danger.
Blue color	Generates serenity, and calm, and curbs appetite, but produces feelings of depression, sadness, and gloom if in excess. Generates productivity and joy in business spaces and nursing homes.
Yellow color	Generates stimulation of the senses and increases appetite in children's spaces
Red color	Generates relaxation, tranquility, freshness, and stability in commercial spaces and restaurants, but produces sensations of tension if in excess
Green color	Generates relaxation, purity, and tranquility, but produces feelings of boredom and tension in children's spaces and homes if in excess.
White color	Generates a feeling of mystery but produces boredom if in excess
Black color	Produces sensations of depression in spaces such as department stores if in excess.
Wood	Being a material related to nature, it generates an atmosphere of harmony and well-being.
Adobe and rammed earth	Being a material related to nature, it generates an atmosphere of harmony and well-being. It maintains the temperature inside the place.
Concrete	It tends to present greater temperature variation.
Panel	Provides acoustic insulation.

Table 5. Neuroarchitectural principles and characteristics for the elderly.

Sensation and perception	Memory and learning	Emotion and affection
<p>Light</p> <ul style="list-style-type: none"> - Natural light in social spaces and bedrooms. - Artificial lighting in bedrooms. - Neutral artificial light in social areas. - Cold or neutral artificial light in corridors <p>Shape and angle</p> <ul style="list-style-type: none"> - Spaces with rectangular shapes - Soft edges - Curved angles <p>Color</p> <ul style="list-style-type: none"> - white, green and blue <p>Construction material</p> <ul style="list-style-type: none"> - Adobe, mud, wood - Wooden floor 	<p>Visuals</p> <ul style="list-style-type: none"> - Window overlooking parks or gardens. - Sounds of nature. - Sounds of running water. - Colors inspired by nature. <p>Spatiality</p> <ul style="list-style-type: none"> - High ceilings - Spatial continuity 	<p>Vegetation</p> <ul style="list-style-type: none"> - Presence of gardens - Vegetation inside social spaces - Aromatic plants - Plants with flowers of different colors

For the second criterion, the results obtained from the application of the observation and photographic records show that despite the irregular shape of the land, most of the rooms have a view of the gardens. There are four gardens in total, one of which is used for gardening to help supply food products for the residents. The large garden and the arches that surround the infrastructure can be seen upon entering the area.

The nursing home has a two-story building where the caretaker who serves as the cook, the nurse, and the service staff stay. The building has rooms with toilets for the elderly who can move around independently, and other rooms for the elderly who cannot move around on their own. There are also rooms for the kitchen and social environments, such as the dining room, living room, and chapel.

For the observation sheet, three graphs were created showing images of different nursing home environments that match the characteristics of the neuroarchitectural principles that are present.

Figure 3 shows that the nursing home has social and rest spaces with views of its gardens and the predominant colors are similar to nature, with white predominating over olive green. The roofs are gabled, where at the lowest point the height is greater than 2.70 m, even in the hallways, which create a spatial continuity by maintaining the same materiality and color.

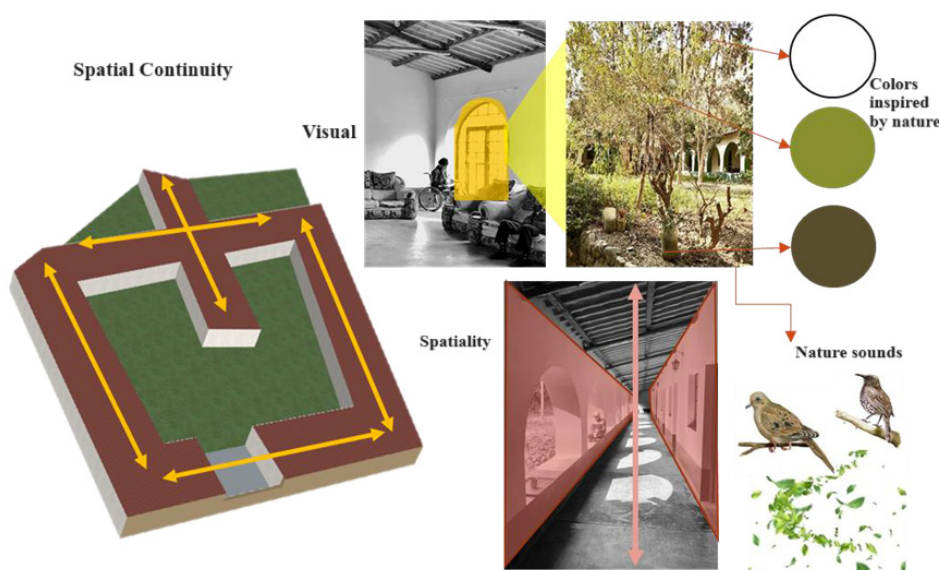


Figure 3. Characteristics of neuroarchitectural principles of memory and learning present in the nursing home *Mis Abuelitos*

Figure 4 shows the presence of a vast area of vegetation in the home, which occupies between 50% to 75% of its total area. This area provides fruit and edible plants to supply the kitchen as well as floral plants. Only one of the four gardens which is at the entrance to the house has a larger area of grass to rest on.



Figure 4. Characteristics of neuroarchitectural principles of emotion and affection present in the nursing home *Mis Abuelitos*

Figure 5 shows that the nursing home has internal facades facing east, north, and south, with light entering into its social areas and corridors blending with warm artificial lighting. The shapes and angles that predominate both in the interior facade and in the social environments are curves, represented by arches. The colors present are white and green, with the former in a higher percentage. The entire construction is made of adobe, which is a material with wood and corrugated iron roofs.

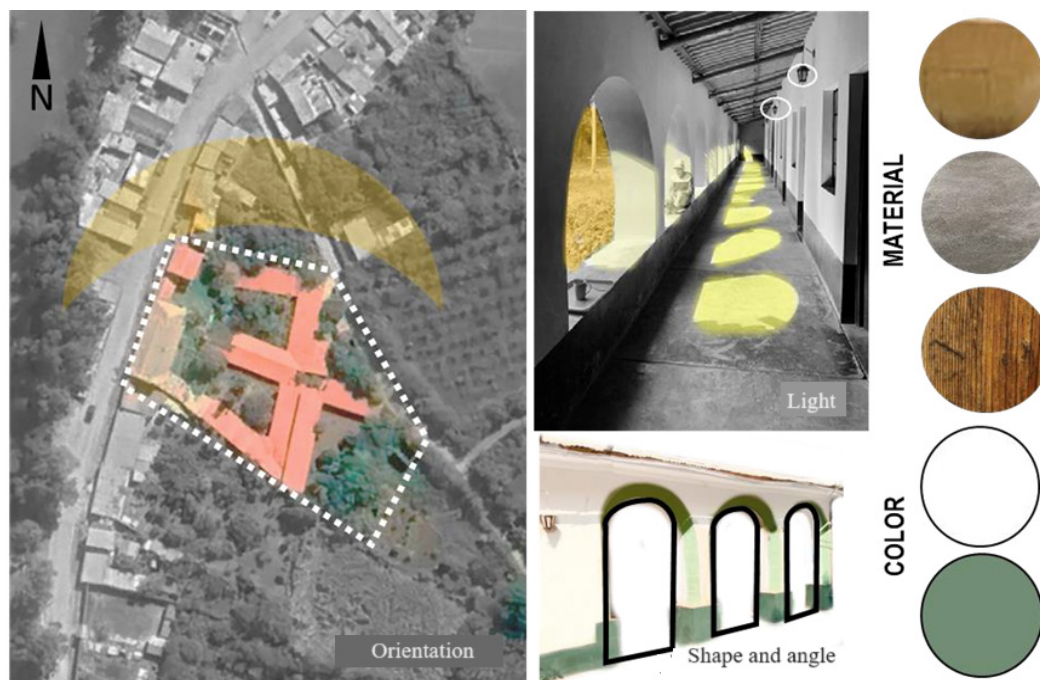


Figure 5. Characteristics of neuroarchitectural principles of sensation and perception present in the nursing home *Mis Abuelitos*

The results of photographic sheets were obtained with ATLAS.ti as shown in **Figure 6**, where the bar graphs indicate the presence and frequency of the neuroarchitectural principles observed in the nursing home.

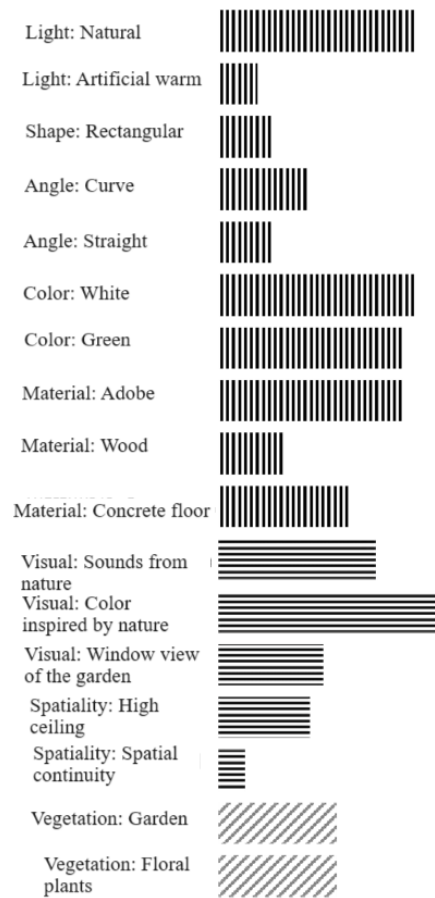


Figure 6. Presence and frequency of neuroarchitectural principles in the nursing home *Mis Abuelitos*

A map of networks that highlights the presence of the characteristics in the nursing home was also developed from the photographic sheets with ATLAS.ti.

Figure 7 shows the visual principle of memory and learning characteristics present, such as windows overlooking the gardens, areas of vegetation that attract different singing birds, and the environments inspired by the colors of nature. In terms of spatiality, the entire site has a gable roof, where the lowest height exceeds 2.70 m.

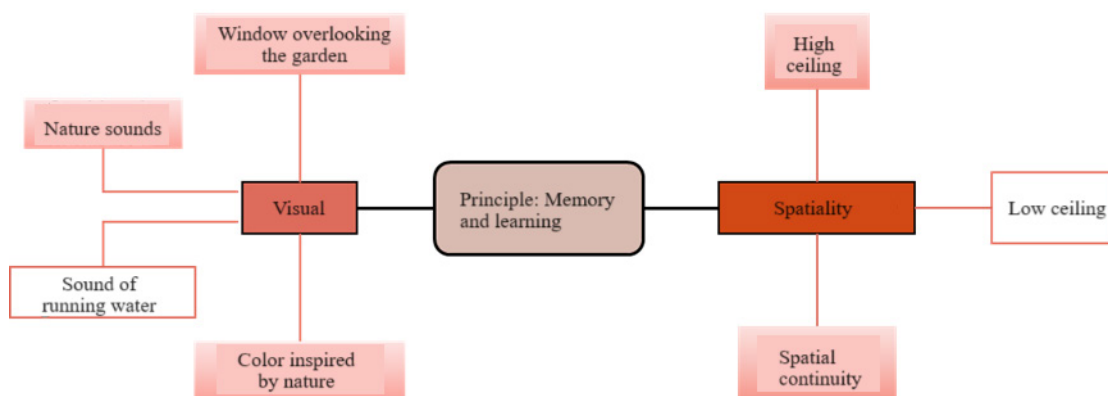


Figure 7. Network of the memory and learning principles characteristics in the nursing home

Figure 8 shows the principle of emotion and affection obtained from the observation sheet. The fruit and edible plants in the gardens can only be observed from the kitchen indoors.

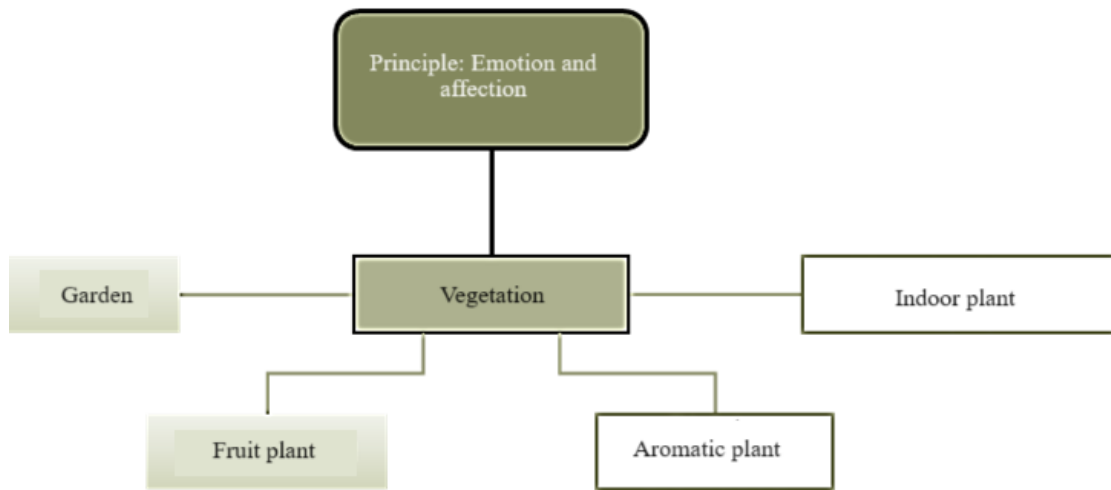


Figure 8. Network of the emotion and affection principles characteristics in the nursing home

Figure 9 shows the principle of sensation and perception obtained. Natural light is present in social spaces, but it is not enough in the bedrooms. The form that stands out most from the entrance is the arches. The color of the material is the same throughout the enclosure.

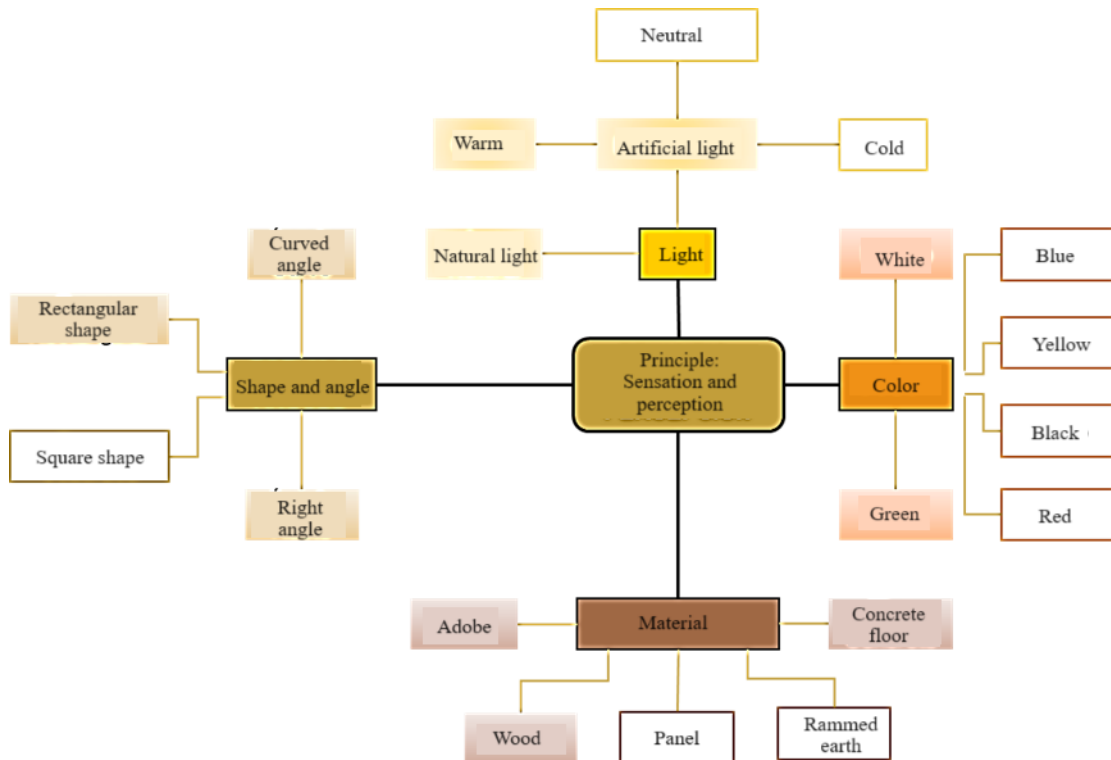


Figure 9. Network of the sensation and perception principles characteristics in the nursing home

According to the results obtained in the previous criteria, the characteristics of the neuroarchitectural principles present in the nursing home *Mis Abuelitos* are compared with the list recommended for the elderly. For the principle of memory and learning, the visual design has suitable features, except for the lack of a water

body that produces sounds of running water that could help to relax and reduce the levels of stress and anxiety of its occupant. The spatiality is fulfilled by having high ceilings and visual continuity to help the occupant socialize without feeling stressed.

For the principle of emotion and affection, vegetation is present in more than 50% of the nursing homes with diverse flora. However, there is a lack of aromatic plants and potted plants in the social spaces and bedrooms.

As for the principle of sensation and perception, natural light is widely present in social spaces, but it is not enough in the bedrooms, so the dark rooms are artificially illuminated by a suitable warm light that can provide a relaxing effect to its occupants. Artificial lights are suitable for the bedroom but are not recommended for spaces such as social areas and corridors. The shape and angle are appropriate for the elderly, where social spaces and bedrooms are rectangular and the predominant angle is curved with soft edges of the arches. Two colors predominate the walls of the bedrooms, corridors, and social spaces, which are white, approximately more than 65%, and green occupying the rest. The walls and roof that have been built with adobe and wood structures also comply with the recommendation of maintaining a warm temperature inside the spaces to preserve the health of the elderly. However, the use of concrete floors can lower the temperature which harms their health.

It can be observed that 14 of the 21 characteristics recommended for an elderly nursing home are present in *Mis Abuelitos*, reaching 37% assertiveness in the application of different characteristics in its design. The final result can affirm that it is possible to design a building with assertive characteristics that can achieve a positive response in the behavior of its occupant with notions of nature and the Andean despite not knowing about neuroarchitecture. Another factor that also supported the successful design of the nursing home was following Father Oswaldo's objective by basing the design on its occupants, which are the needy elderly. Having notions of nature and the Andean are characteristics present in ancient, vernacular constructions, and even Inca ones. This leads to the question if neuroarchitecture could have been a tool to achieve the buildings of their cities and how successful they could have been.

4. Conclusion

The elderly are a type of occupant that requires special care, either due to physical or mental limitations, which in some way can be alleviated with the application of neuroarchitectural principles aimed at meeting their needs. Likewise, they are not a group of users that are exempt from the effects of neuroscience and architecture, since it is possible to provoke certain responses in their behavior with the help of neuroarchitecture, as nerve cells will continue to form through one's life ^[1]. The nursing home *Mis Abuelitos* is a facility that houses the elderly, which has designs that are suitable for its occupants. The designs are inspired by the Andean and nature, such as its color is inspired by plants, its shape is inspired by the hills or its local material, and it is also inspired by the connection with ancestors. Therefore, those ideas to which the nursing home adhered in its construction process were what determined the direct relationship with neuroarchitecture, achieving the presence of 67% of characteristics throughout the place, affirming the objective of identifying these characteristics in the enclosure. Among the three neuroarchitectural principles aimed at the elderly in the nursing home, the first one is memory and learning which helps with adaptation to the place, the second one is emotion and affection that generate social relationship behaviors, and the third one is sensation and perception which cause responses to stimuli acquired through the senses. Consequently, this research sought to establish neuroarchitecture as a topic that should be further investigated, not only about future constructions but also in those already built to affirm the

expected result when applying them by looking for similarities. Finally, neuroarchitecture can become a tool in future designs with effective and beneficial results for the user, as neuroscience and architecture continue to be studied and better understood.

Disclosure statement

The authors declare no conflict of interest.

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