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Review Article

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Cognitive Accessibility Designing Living Spaces for Older Adults

Berta Brusilovsky Filer*

Architect, Spain

***Corresponding Author**
Berta Brusilovsky Filer, *Architect, Spain.*

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1. Introduction

Designing inclusive spaces for children and education, despite the difficulties that this work entails for design professionals, is already widely used and is generally done in conjunction with specialists who speak a language adapted to XXI Century neuro-education: these are new approaches that involve different concepts and spatial relationships. Achieving this is a success for the child-youth population and their teachers, because everyone will benefit from a change in the principles that guide the architectural project.

However, when it comes to designing residential spaces for older adults - even though there are concepts of quantity and dimensions that have been updated and improved[1] - others remain that have not yet acquired the richness of design thought out - and considered - from neuroscience as has already been practiced in previous cases. In general, and especially in interior circulation spaces and living areas of large residential typologies, projects forget the importance that moving activities or simple walking have on the physical and mental health of those who live there. Many of these people spend almost all day sitting and some no longer walking. They move around in wheelchairs without stimulating the parts of the brain corresponding to multimodal sensory and motor activity. Hence the importance of circulation spaces: corridors for example, which should be provided with more creative and imaginative solutions for neuronal activation. Not only those that provide them with conditions (dimensions) "to go and return" in a monotonous wandering that is repeated without changes day after day.

Because space is part of what we are, of what we feel and perceive, of the environment that we build and that builds us. The ability to locate ourselves in different places leads us to connect with time: we come from a past that can be remembered as opposed to that forgetfulness that plagues us in the present. And we are in that present that has to become a helpful factor in knowing where we are, where we want to go and what we can do.

As professionals who, for one reason or another, are dedicated to working for the quality of life of the elderly, what we aim to do is to encourage people to perform better in their everyday spaces, because that is undoubtedly where they will carry out their activities, some sedentary but others in movement, with concrete actions or simply walking down the halls – some wandering erratically. What needs to be increased is the quality of both the movements and the activities, those that put in motion everything necessary for the messengers of the nervous system, the neurons, to remain active.

The aim of this article is to discuss the functions and processes that neuroscience includes when referring to spatial behaviors. And that designers of cognitive accessibility in buildings for the elderly have been warned of their importance. This is precisely why we must take them into account when approaching projects.

Functions and processes that advance in the text in a very synthetic way from the "motor cortex" - responsible for the cerebral control of movement - and the "practical systems of spatial communication" that in the context of complex spaces can guide the designer on what should be included in the projects given the characteristics of the older population, often affected by negative emotions and feelings.

We will try to do it in a practical way so that the importance of knowing these components is appreciated if they are designed for the health of these groups that are so sensitive in their experiences.

2. Background

With the experience I have gained from interventions in non-residential buildings where older adults move[2], I have learned through observation and subsequent research some particularities that I have expanded with the focus of spatial behavior neurology, trying to improve walking in spaces that are not always common for them. Because they are not in their personal space: their home; or because they forget so many times! where they are, where they should go, or what movements they have to make to take the right direction. Some specialists call this complex functional set "practical executions" and it is a part of neuroscience that has always fascinated me since with architecture we can improve the relationships of users with and in their living spaces.

Before discussing the solutions that professionals can provide, it is necessary to understand how these systems and functional processes works, as well as the implications that the different relationships of spatial components have for improving people's performance.

3. The Motor Cortex

Important information about stimulation in specific areas of the cerebral cortex encourages those of us who work with design to create spaces that can be generators-activators of motor actions.
-The activation of neurons in specific areas of the cerebral cortex causes movement in all parts of our body.

The premotor cortex is involved in the selection of appropriate motor plans for voluntary movements, while the primary motor cortex is involved in the execution of those same movements. What non-experts did not know (before studying it) is that stimulation of regions of the primary motor cortex causes movements that require the activity of numerous muscles.

-The primary motor cortex does not represent the activity of individual muscles, but the movement of individual parts of the body, which frequently require the coordinated activity of large groups of muscles in the body.

The point to be made before continuing is that our movements influence the neuronal activity of important and complex parts of the cerebral cortex. And neuronal activity "keeps life alive."

3.1 Limbic System

It is responsible for regulating emotions: some authors call it the "emotional brain". It plays an important role in learning and memory and is a fundamental feature in the physiological responses to certain stimuli to which humans are exposed and which provoke emotions such as fear, anger or joy.

Made up of the oldest parts of the reptilian brain, it is worth remembering those that are important because they process emotions and memory: the amygdala, the hippocampus and the thalamus (gateway to the sensory networks except for the sense of smell) which receives, sends and integrates numerous motor and sensory impulses between the higher centers and the periphery. Negative emotions and distress[3], which could be caused by the perception of labyrinthine spaces, require a thorough study of the relationships at the project drafting stage:

- The organization of project activities is not always the best for the development of users. The designer is often limited by the dimensions of the parcel, the regulations and the budgets that he usually has to adapt to.

This is why some decisions are overlooked and later have no solution. Or they are more complicated when the work has been completed, with the corresponding additional costs of the necessary reforms.

3.2 The "Praxic System"

This is a system that corresponds to the functional set of gestural praxis, which is characterized by the ability to execute learned motor acts: it is a system of intentional motor functioning, which includes the ability to perform sequences of movements after a verbal order, to imitate or perform a movement or reaction in the presence of an object and then, be able to manipulate it. A functional system that is based on a complex organization in which different neurofunctional components intervene: those that are of interest here are those that allow composing-creating correlations with spatial design.

The praxical system[4] is extremely complex, so only its most important components are listed, those on which the design can act directly or indirectly in the activation of nerve impulses, mobilizing areas and generating spatial actions. For the correct praxical execution, there are stable motor patterns that contain implicit knowledge of the attributes of the objects from which a script can be made:

- They are sequential actions that the subject must select by executing an action plan, with the ability to inhibit non-relevant actions, memorize the set of schemes, store the intermediate steps and check the final execution. Something that seems so natural is complicated for people with practical and motor difficulties.

- Some actions are so automatic that they do not need voluntary control to continue their execution; others, however, require a new construction and the intervention of specific cognitive strategies to configure the plan.

- The imitation of gestures is part of communication systems and there is an important relationship between the production of speech and the generation of gestures. And from my learning of neuroscience as an architect, all the brain lobes are involved: frontal, which plans and initiates movements; parietal, which knows about spatial orientation; occipital, essential for visual processing; temporal, because it complements the work as responsible for hearing, speech and words.

Storage of Gestures: this is possible because there would be a system in the left hemisphere to store the representations of the learned movements, or "praxicon" (equivalent to the lexicon of reading but in this case, of the actions). They are representation schemes of spatial-motor formulas. Its "destruction" due to functional causes or accidents would imply the forgetting of the learned gestures.

Disconnection: one could distinguish between dysfunction caused by the "destruction" of the areas in which the "praxicon" is represented, and apraxia, which results – and this is extremely important – from the disconnection of these parietal areas from the frontal motor areas that implement these representations. The corpus callosum is an important piece since it links, coordinating, both hemispheres of the brain.

The answer is offered by authors[5] who postulate that gesture recovery is possible because the input processes: perception, comprehension, and gestural output: production, execution, are carried out through two subsystems, the "action input lexicon" the AIS, a system to receive information related to the code of physical attributes, and the "action output lexicon" the AOL, a code of physical attributes so that the action can be carried out. With the following particularities:

-The disorder in gesture comprehension would be explained as related to the input or corresponding to it. When comprehension is preserved but reproduction is impaired, the difficulty would focus on the ***output.***

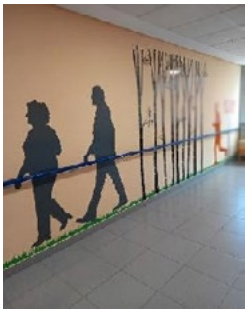
-Disorders in gesture comprehension would be explained as related to the input or corresponding to it. When comprehension is preserved but reproduction is impaired, the difficulty would focus on the ***output.***

-In the deterioration of gesture comprehension with good imitation execution, the subject can access the ***input*** but cannot access or activate the semantic access. It is possible to imitate movements that have never been seen or done, that are not familiar, through the **"non-representational-direct route"**, without accessing the store of spatiotemporal representations since there is no memory of them[5].

Through the study of practical tasks, it is possible to understand how the brain harmonizes certain learned movements if the storage areas and necessary connections are maintained. Or, if not, it is interesting to evaluate functional aspects to place the problem in its context and the possible solutions. Activating other regions, maintaining activity, and influencing the strength and effectiveness of the muscles, especially those of the lower limbs.

During the imitation of meaningful gestures, the required gesture must be evoked from the representations stored in the semantic memory and personal memories, such as dancing. If this fails, responses will be impossible. On the other hand, when an imitation of meaningless gestures is required, the gesture is developed exclusively from the direct route: it is copied without any meaning or objective.

Examples of praxical activation with references:

Figures 1, 2, 3, 4: Pamplona Day Center. Madrid City Council



Figures 5, 6, 7: Activators and "Provocateurs". Almorox Day Center. Madrid City Council

4. Conclusions

The above text and these conclusions are intended to encourage reading of the aspects that, from neuroscience, can provide important clues for designing spaces for health and improving the walking conditions of older people. Actions that have such an impact on their quality of life.

4.1 Design

Orientation and activation

Practical examples carried out in projects for the elderly are presented for the reproduction of actions in various ways:

- Orientation and direction with user-adapted figures, guides, shapes and colors
- Spontaneous activities that generate positive and "provocative" graphic components (similar to advertising stimuli).

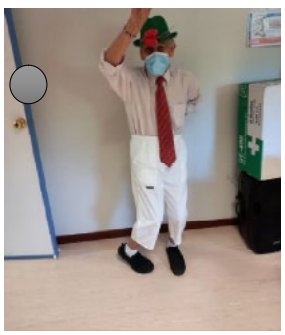
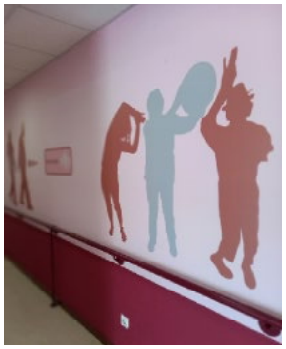
- Positive incentives to generate memories of individual or organized movements such as dances. Activation of the amygdala and hippocampus in the limbic system.

Examples of orientation and direction and identification


Figures 8, 9: Guides with shapes and colors. Day Center Francisco de Goya. Madrid City Council


Figures 10, 11: Day Centers: Pablo Neruda and Entrevías. Madrid City Council. **12.** Private Residence Proposal


Images 13, 14: Dances. Pamplona Day Center. Madrid City Council

Images 15, 16. 17: Doing Yoga and Dancers. Peñagrande Day Center. Madrid City Council

4.2 Changing Focus to Interior Corridors

When designing buildings where elderly people live together, such as residences and other types of living arrangements, the circulation areas should be approached with a different and innovative eye, thinking about how these spaces can serve not only to go to and from private spaces. They can be the "streets" where they can sit to chat and water the plants that they themselves have chosen and placed.

It calls for positive feelings and emotions that, like joy, will change the spirit of the inhabitants 180 degrees (images 18, 19 and 20).

Corridors with Games, Physiotherapy Elements and Biophilia

Figures 18, 19: Ciudad Pegaso Day Center. Madrid City Council

Figure 20: Private Residence Proposal with Corridor as a Street

In this way, and encouraged simply by a change of perspective, their life will be positively altered, compared to traditional ways of using circulation spaces that do not encourage active living.

And where the handrails - which represent the support needs for safe movement - must be correctly integrated among vital biophilic references: greenery, plants or elements for their physical activities and, above all, the best natural and artificial lighting.

Let's start preparing places where joy, that much-needed emotion, can be cultivated. I just read this reflection, and I thought it was excellent to share it with you:

-Will you be left behind or will you lead the way forward?

References

1. This refers to the maximum number of places or individuals gathered in the same building, minimum and maximum safety conditions, length and width of corridors, with or without refuge areas, automatic isolation doors. Spain Technical codes.
2. Day centers of the Madrid City Council.
3. The consequence is the generation of cortisol that can block the systems: somatization begins and the damage to health can become very serious.
4. It is a system that does not always appear in published materials on neuroscience, but which is given a lot of importance when it comes to delving into the study of the neurology of spatial behavior. It can be seen very clearly in the text: Neurology of behavior and neuropsychology. 2007. PANAMERICANA. Coordination by Jordi Peña Casanova.
5. Roth et all (page 144) and Cubelli et all (page 144) in Neurology of behavior and neuropsychology cited.
6. During the imitation of meaningful gestures, the required gesture must be evoked from representations