Architecture-Neuroscience Synergy: guidance to the landscape project of clinics dedicated to the care of Alzheimer's disease patients

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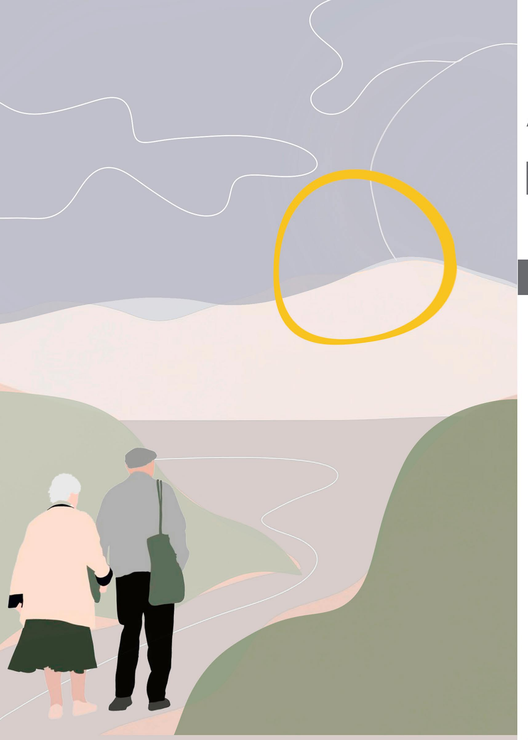
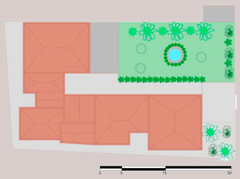


Abstract. This research analyses and defends the strong potential of landscape design for the promotion of well-being and life-quality of Alzheimer's patients, considering it as a part of non-pharmacological treatments for the disease. Grounded on Architecture and Neuroscience fields' cooperation, the study is structured on the basis of (1) neuroplasticity; (2) biophilia; (3) somatosensory, sensory-motor and cognitive stimuli to evoke affective memories with positive valence, which are capable to improve the organism's metabolic regulations and to increase human well-being. The results indicate 45 design guidances to the landscape project of clinics dedicated to the care of Alzheimer's patients, 25 of which derived from literature review and 20 from field investigations undertaken on two clinics in the state of Sao Paulo, Brazil: SeniorVit and Recanto Monsenhor Albino. These guidances are structured by eight categories: accesses; specific activities; pathways; comfort; spaces/stimuli; planting/-sensory stimulus; safety and conservation; and uses. The results at SeniorVit highlight 28 recommendations that are fully accomplished, 9 as partially accomplished and 8 as not accomplished; and at Recanto Monsenhor Albino, we found 23 directions that are fully applied, 15 as only partially, and 7 as not applied. Thus, a directly proportional relation can be inferred between the positive stimuli for patients' organism and well-being and the fully accomplished project recommendations. Furthermore, the absence of a landscape design specifically oriented towards the treatment of Alzheimer's patients explains the weaknesses of the landscape project in both clinics. Therefore, it is expected that the set of parameters reached by this research can be applied and expanded in further studies focused on improvements to human well-being.

Keywords: Architecture · Neuroscience · Landscape Design · Alzheimer's Disease · Non-pharmacological treatment



SENIOR VIT CLINIC

RECANTO MONSENHOR ALBINO CLINIC

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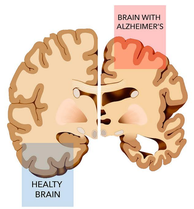
INTRODUCTION

Researches regarding the cooperation between architecture and cognitive and behavioral neuroscience **[1,2,3,4,5,6]** indicate the potentialities of the built space to promote a significant set of stimuli in the human brain. Those studies also suggest that such stimuli, coming from the environment, may impact and influence human behavior. From this understanding, it is possible to affirm that the built environment has the potential to impact on health and well-being of individuals.

The set of neural reactions models and shapes the structure of the brain through time and, as consequence, changes it. Therefore, these changes impact on human behavior and in its cognition, and how one experiences the built environment **[6]**. The capacity of the brain to adapt and to be molded, both in its structure and functions, is called "neuroplasticity" **[2, 7, 8]**. It happens during the human brain formation period and continues to occur through all stages of life.

To Ulrich **[9]** the memories formed by human beings are at some point related to nature. These memories have an emotional character and are crucial to the understanding of human behavior. Such recollections, which refer individuals to their own subjective universe, are called "affective memories". They can be evoked by scents, flavors, sounds, textures, colors, and landscapes. In this context, the senses play a very important role in evoking the affective memories, and therefore, the state of the body is changed.

The beneficial relations that individuals establish with nature are discussed by the theory of "Biophilia". This concept indicates the connection between human beings and nature as intrinsic and permanent through all their existence. The human beings have their origins bonded to nature, which means that the individual is biologically prepared to feel safe and comfortable in natural environments and spaces projected with green areas **[13]**.



The changes on the brain structure can also be verified in individuals with degenerative neurological diseases, such as Alzheimer's disease: a neurological progressive disease that causes the gradual impairment of cognitive and motor functions. The number of diagnosed cases reaches 35,6 million people all over the world, being 1,2 million of them in Brazil **[4]**. The treatment is based on pharmacological and non-pharmacological procedures. The pharmacological consists of medication administration to the patient. The non-pharmacological includes a set of cognitive, sensory-motor, and somatosensory stimuli, like walking, light physical exercises, among other activities that provide positive experiences to the patient's health and well-being, which many of them can be provided by the space and natural features.

HYPOTHESIS

The built environment, in this case the landscape project, promotes a significant set of stimuli on the human brain. When landscape projects are oriented for Alzheimer patients' and the care staff's use by, it is capable to produce positive somatosensory and sensorimotor stimuli to the well-being and the health of these patients, and in addition, to contribute with the outcomes of pharmacological treatment.

METHODOLOGY

The literature **[3,13,14,15,16,17,18]** points out a series of recommendations concerning the layouts of therapeutic facilities to patients with Alzheimer. Based on these references, this research conducts field investigations on two Alzheimer's treatment clinics' green areas. The first one is in the city of Campinas, Brazil, and the second one is in the city of Catanduva, Brazil - The investigations took place between August 2017 and December 2018. The references from scientific literature review combined with the results obtained through field investigations configure the scope of overall project recommendations and parameters here presented, through which the green areas of both clinics were evaluated. This frame of recommendations is structured by eight categories: **accesses; specific activities; comfort; planting/sensory stimulus; pathways; uses; safety and conservation; spaces/stimuli.**

CONCLUSIONS

The cooperation between the fields of cognitive and behavioral neurosciences and architecture **[1, 2, 3, 4, 5, 6] i**ndicates that the built environment has the potential to change the physiological state of individuals, and consequently, their behavior. Additionally, it may contribute positively to non-pharmacological treatments for degenerative neurological diseases such as Alzheimer's. In this context, this research analyzes and endorses the strong potential of landscape projects to promote Alzheimer's patients well-being and quality of life as a complement to pharmacological treatment.
The results indicate 45 project recommendations to the green areas of clinics dedicated to the care of Alzheimer's disease patients. From these recommendations, 25 are derived from literature review and 20 emerge from field investigations undertaken on two clinics in the state of Sao Paulo, Brazil: SeniorVit (Campinas) and Recanto Monsenhor Albino (Catanduva). At SeniorVit, 28 recommendations are fully accomplished, 9 partially accomplished and 8 not accomplished; on the other hand, at the Recanto Monsenhor Albino, 23 recommendations are fully applied, 15 only partially, and 7 are not applied.
From these results, it is possible to affirm that the absence of a landscaping project oriented to contribute to the treatment of patients with Alzheimer explains the deficiencies and the need of project improvements in both clinics. It is also important to emphasize the research gap in Brazilian literature regarding the contribution of landscape projects that support the non-pharmacological treatment of patients with Alzheimer's. This background reinforces the relevance of Brazilian research focused on project recommendations that comply with the specific parameters of climate, flora species, and local culture. Thus, this study contributes to the scope of international projects and research, by expanding such discussions; as well as to the Brazilian context, with the set of categories and parameters oriented to the Brazilian scenario, adapted to their specific characteristics, that is, a support to the assertive design decision-making in landscape projects.
Furthermore, it is expected that these parameters can be applied and expanded through investigations in Brazil or abroad, once such expansion strengthens the cooperation between Architecture and Neuroscience and promotes the well-being and life quality of patients with degenerative neurological diseases.

RESULTS

The white fields of the columns represent contributions coming from the literature **[10,11,12,13,14,15]**, while the green indicate contributions proposed by the authors based on the field research:

FULLY ACCOMPLISHED
PARTIALLY ACCOMPLISHED
NOT ACCOMPLISHED

	Project Recommendation	SeniorVit Clinic	Recanto Monsenhor Albino
ACCESSES	Number of direct access' doors to the garden	Split paths to the Garden: living room and suite's hallway may cause spatial disorientation.	There is one exit per wing (male and female). Due to this segregation, patients can feel confused when out of their rooms.
	Bathrooms placed near the garden	Two indoor bathrooms near the garden.	There are sheds that offer bathrooms, but they are far from the green area.
	Daytime unlocked doors with access to the Garden	Doors are kept unlocked during the day for patients in the first stage of the disease.	The doors of both wings are kept unlocked during the day for patients in the first stage of the disease.
	Easy access to the Garden by patients	Accesses are kept unlocked during the day under the supervision of nurses.	The clinic configuration allows easy access to the green area.
	Accessibility	Ramps and handrails are available in all the accesses.	Ramps and handrails are present in all the accesses.
	Internal pathways leading to the garden	Hallway in the dorm area guarantees direct access to the garden.	Every internal pathway has a connection to the garden, due to the green area design, which surrounds both wings.

	Project Recommendation	Senior Vit Clinic	Recanto Monsenhor Albino
SPACES/STIMULI	Architectonic elements that stimulate the brain and positive behaviors	Presence of different and familiar vegetable species to the patients.	Few elements stimulate the brain. Monotonous landscape.
	Elements composing the garden landscape relate to the cultural life history of patients	Besides the regular species of the region, already familiar to the patients, there are no other elements related to their culture or life history.	Only the grotto with a religious image represents an important cultural element for the patients.
	Avoiding plants, structures, shadows, statues and other architectural elements with forms that can trigger hallucinations or illusions	The structure of the garden is open-wide, without compromising shadows created by the covers or trees.	No elements work as trigger for irritability.

	Project Recommendation	SeniorVit Clinic	Recanto Monsenhor Albino
SAFETY & CONSERVATION	Presence of emergency doors	There is an emergency gate on the back of the garden. The access to it is visible and safe.	No emergency exits or signs were identified.
	Visibility of the entire garden perimeter	There's a wide view of the garden.	The garden is extremely large and its boundaries unclear, so patients may have difficulty understanding the garden's layout.
	Existence of toxic plants	No toxic plants present.	No toxic plants present.
	Existence of plant with textures that can hurt patients	There are some species such as the phoenix palm tree that can hurt patients' face or hands.	There are some species such as the phoenix palm tree and agaves that can hurt patients' face or hands.
	Support handrails for walks on the green area	The entire access to the garden has handrails, however, there is no support for walks on the green area.	There are handrails on the path that leads to the green area, however, there is no support for walks on the grass area.
	Direct connection between indoor environments and the garden	The main living room is connected to the garden.	The openings of the wings and shelters are connected to the green area.
	Garden maintenance	Maintenance is kept daily by a gardener. Patients are encouraged to help him under the supervision of the care staff.	Maintenance is kept daily by a staff of gardeners.

	Project Recommendation	SeniorVit Clinic	Recanto MonsenhorAlbino
PLANTING/SENSORIAL STIMULUS	Plants with shapes/scents that can trigger irritability	There are no species, shapes or scents that might stress patients.	None of the plant's species can trigger irritability.
	Plants that evince changes according to the change of seasons. Seasonal planting	Homogeneous planting, that does not value the seasonality of species and the reconfiguration of the garden they could provide.	Homogeneous planting, that does not value the seasonality of species and the reconfiguration of the garden they could provide.
	Plants and flowers with vibrant colors	No plants with vibrant colors.	The garden setting is predominantly green, with a few colorful species.
	Popular species that remind plants used in residences	There are popular species, recognized by the patients, such as palm trees, orchids, calliopsis, and edible vegetables.	There are familiar species for the patients, such as bromeliads, orchids, ferns, and palm trees, not to mention the greenery and vegetables from the vegetable garden.
	Species that can be assessed by the patients, stimulating their touch, smell, and vision	Every species can be accessed by the patients.	Every species can be accessed by the patients.
	Plant and / or flowers with remarkable scents	There are no plants or flowers with remarkable scents.	There are no species with remarkable scents.

	Project Recommendation	SeniorVit Clinic	Recanto MonsenhorAlbino
COMFORT	Presence of furniture for patients' rest in garden. Layout suggesting places to stay	Furniture is present on the annex building and barbecue areas. No permanent furniture is present in the grass area.	There are permanent benches in the green area.
	Sun Trajectory X Staying area layout	Seats are available only on the roof covered areas (annex building/barbecue area).	There is a plaza with plenty of shadows, but there are no layout areas for permanence.
	Living room for patients with a direct view of the garden	The living room (indoor environment) offers a direct view of the garden.	The living room of both wings has openings for the green areas.
	Orientation of predominant winds in the region	The wind comes, especially from the southeast. The clinic's building appropriately blocks strong winds without making the environment unhealthy.	Low-speed winds, predominantly from the east. The low speed of the winds allied with the topography of the region produces a pleasant climate for the patients.
	Presence of a water element in the composition of the garden	There is a water fountain in the garden.	There is no water element in the green area.
	External sounds that can disturb interaction	The clinic site is on an urban area, surrounded by residences and retail, and it is very near to the street.	The clinic area is located far from the city, so it has pleasant ambient sounds, like birds and animals. Loud noises or cars are not heard.
	Pleasant environment temperature	The elements of the area favor a stable mild temperature.	The elements of the area favor a stable mild temperature.

	Project Recommendation	SeniorVit Clinic	Recanto Monsenhor Albino
USES	Separate gardens for the different stages of the disease	The garden is used by all the patients with no separation according to disease stages.	Every patient enjoys the same area of the Garden with no separation according to disease stages.
	Elements that encourage patients to help with the garden care	The vegetable garden and the drinking fountain for birds encourage patients to take part in the garden's care routine.	Besides taking care of the vegetable garden, patients are not encouraged to take action for other spaces of the green area.
	Uses of the garden by the care staff	Care staff members use the garden to relax.	All the care staff declares to use the garden for resting, contemplation, and socialization.
	Uses of the garden by families of the patients	Families use the garden when visiting the patients.	Families use the garden when visiting the patients.
	Nocturnal use of the garden	Rarely, patients, assisted by the staff, are taken to the garden for short periods of time, usually after dinner.	The garden area is not used during the evening.
	Garden configuration for the practice of therapies, socialization, and diverse activities with every patient	The annex building and the barbecue area work as extensions of the garden, where socialization and therapeutic activities take place.	Even though the area is suited for these activities, they are performed indoors.

	Project Recommendation	SeniorVit Clinic	Recanto Monsenhor Albino
PATHWAYS	Route complexity for patients	Open space with no defined route, no complexity at all.	Pathways are marked with different floor tiles; roof covers and handrails are only noted in the wing's connection area.
	Landscape marks and attention-grabbing elements along the patients' pathways	There is a water fountain in the middle of the garden. Three huge tree species configure distinctive marks.	Some marks are noted: a grotto with the image of Our Lady of Aparecida; tall vegetable species stand out in the area.
	A route is suggested by floor planning and design	There is no floor planning or design suggesting a particular route.	The entire route is specifically planned and designed.
	Smooth topography for the patients' walks and permanence	Plain topography all over the garden area.	The terrain is plain enough to be comfortable for the patients.
	Pathways that protect patients from bad weather	The green area has no cover at all.	Pathways are protected by a roof cover; however, its dimension is not appropriate in cases of wind and rain combined.

	Project Recommendation	SeniorVit Clinic	Recanto Monsenhor Albino
SPECIFIC ACTIVITIES	Areas for manual tasks: horticulture and soil managing	There is a vegetable garden, but not an expressive amount of fruit species. Patients are encouraged to participate in the garden's cultivation.	There is a great vegetable garden for planting and internal consumption, and a wide variety of vegetables and greenery, which are cultivated with the help of patients.
	Suitable areas for physical activities, such as physiotherapy and walks	The garden arrangement is suited for the care staff to develop physical activities with the patients.	There is an outdoor area with gym equipments used by patients in the first stage of the disease, but physical therapy occurs indoors.
	Patient interaction with species and garden caring	Patients are in daily contact with the garden and are encouraged to take care of various species.	Some patients with light cognitive impairment help to take care of the garden, however, this activity is not part of a sensory therapy program.
	Harvesting species for use in manual tasks	Patients are encouraged to harvest species and perform manual tasks with them, such as producing paintings, bouquets, and collages.	Manual tasks involving horticulture, growing vegetable species and flower harvesting for indoor decoration, are only undertaken by patients in the first stage of the disease.
	Daily time for patients to interact in the green area	Patients interact with the green area daily, usually at the same time in the mornings and afternoons. They are also free to enjoy the area when not performing scheduled activities.	Morning walks are the only activity and period for using the green area, but it's not part of the patients routine.