

## INTERDISCIPLINARY APPROACH TO EVALUATE ENVIRONMENTAL USERS' PERCEIVED RESTORATION IN HOSPITAL PUBLIC SPACES

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### Abstract

**Objective** – The study aims to: 1) assess the relationship between the quality of hospital's public spaces expressed in terms of accessibility and visibility of art and greenery and users' restorative experiences; 2) highlight how physical environment may promote health and wellbeing of patients and staff/user.

**Background** – The issue of public spaces in hospitals is very debated today: the direction taken by a few decades is to implement these spaces giving them a humanization feature to promote the well-being of patients and staff. Architectural trends have developed around the creation of halls, mostly glazed, with more volumes appearing, and large dimensions. The importance of restorative spaces as a mediator factor for health outcomes among the users is increasingly recognized.

**Research questions** – 1) Which public spaces are perceived to be more restorative? 2) Does familiarity with a place affect the users' perception of restoration in hospital public spaces? 3) To what extent does the perception of restoration vary across settings that support similar functions but present varying levels of art and greenery? 4) How does the combined use of Technical Environmental Analysis (TEA) and Observed Based Environmental Assessments (OBEA) measures support our understanding of perceived restoration across different public spaces in hospital settings?

**Methods** – A cross-sectional investigation was performed in seven public spaces of the Santa Maria Nuova Hospital (IT) by adopting TEA and OBEA tools.

Technical Environmental Analysis:

- Visits on site to evaluate the quality of the space, to assess the presence of artworks and/or greenery and to describe the historicity of the space
- Spatial analysis: Space Syntax evaluation parameters (Hillier, 2007) to evaluate the integration of the space (e.g., visibility, accessibility) and to quantify the presence of artworks and green view (% isovist area from key points), performed by Visibility Graph Analysis (VGA) and Isovist Analysis.

Observed Based Environmental Assessments:

- This type of assessments implies an evaluation of public spaces done by the users (n = 327) (i.e., outpatient, staff, relative, volunteer and social services). Their recruitment was done in place.
- Adapted version of the Perceived Restoration Scale (PRS) (1-5 Likert scale).

**Results** – Overall the results seem to suggest that the public spaces had relatively high restorative qualities. However, significant higher perceived restoration was also found for the Medicherie cloister, suggesting that some architectural and natural features affected the result. In order to gain a better understanding of what aspects of the physical environment of hospital public spaces might have had an impact on users' perception of restoration TEA and OBEA, data were merged together and their interaction was discussed.

**Conclusion** – New insights about the concept of restoration and its interaction with physical characteristics of hospital's public spaces is put forward. Furthermore, the methodology proposed by linking TEA and OBEA data contributes to a more reliable understanding of the influence that existing buildings might have on users' well-being.

**Keywords:** *Hospital public spaces | physical environment influence | evaluation tools | spatial layout | users' perception*

## Introduction

### *The hospital public spaces*

Only recently in the hospital building sector has there been talk of public spaces within hospitals in terms of a functional area that is as important as the areas dedicated to care [1] [2] [3]. This is due to the tendency to accentuate the humanisation of all hospital spaces, including those whose function is not chiefly related to healthcare, in that they act to promote the well-being of patients, staff and caregivers.

We can define the public spaces of a hospital as all spaces that are accessible to all users, that represent connections between the different functional areas of the hospital, and that represent the interface between the external city and that inside the hospital. Their function is to welcome users (entrance halls) who come to the hospital for a variety of reasons, to guide them along highly visible routes (corridors, elevators, stairs) to the different services, and they act as places for resting, relaxation and coming into contact with nature (atria with furniture/shops/artworks, and patios/healing gardens).

Public spaces are important not only because they perform a wayfinding function [4], but also because they are places of public life where relations among people occur [5], and where the right to health is protected [6].

Architectural trends in designing public spaces have developed around the creation of halls, mostly glazed, with more volumes appearing and of large dimensions. Many architectural elements come together to create them: canopies, covered squares, double-volume halls, hospital streets, galleries, loggias, and patios.

Some architectural studies have highlighted the relationship between aspects of the spatial layout and the behaviour of the users who spend time there in terms of visibility, accessibility and relationability [1] [7]. As of today, only a few studies have been carried out on the users' perception of these spaces, for example we can recall the experience of users in a children's hospital [8], the positive impact of art on users' psychological stress and overall satisfaction [9], and the contribution of the healthcare environment to wayfinding for visitors [10].

So it is difficult to identify which architectural characteristics (use of materials, morphologies, dimensions) of these public spaces have a positive effect on people. As a result, it is difficult to give design indications in this regard.

Interdisciplinary studies are therefore needed, which helps us to understand a phenomenon through the use of different methods that reveal the different factors in play belonging to the sphere of people's perception and of the built architectural object. This relationship should be investigated further for this type of space which, relatively speaking, has a fairly recent history.

### *Perceived restoration in healthcare settings*

The importance of restorative spaces as mediator factors for people's health and well-being is increasingly recognized in healthcare settings [11].

Restoration has been defined as the process of recovering depleted psychological (i.e., cognitive and emotional) and physiological (i.e., stress) resources by means of interactions with environments that hold restorative qualities (e.g. greenery elements) for the individual [11].

Predominant theories in the field of human restoration are: attention restoration theory (ART) and stress reduction theory (SRT), which have highlighted the health-related outcomes of restoration processes linked to millions of years of evolution and our psycho-physiological responses [12] [13] [14]. Both theories sustain that nature supports bottom-up mechanisms of human restoration, implying that restorative processes are triggered by visual information and thus occur without conscious responses.

The body of evidence on how nature influences human health has recently given rise to a wide range of nature-assisted interventions, which are now being tested in healthcare settings across the world (i.e., horticulture therapy and green exercises). Nature is therefore incrementally considered as part of the treatment options for a variety of medical conditions [15].

Recent theorizations on the construction of restoration based upon knowledge from the fields of social psychology and ecology are however of interest to this work. These latter theorizations stress the importance of other mechanisms involved in restoration processes, such as connectedness and the feeling of belonging to a place [16] [11].

This supports the opportunity to discuss restorative mechanisms that are not linked exclusively to the power of nature over other settings' qualities and meaning. By also considering how the role of human cognitive top-down processes affect restorative experiences, an opening towards other types of human-environment interactions and restoration outcomes can be discussed. For example, the role of the heritage and cultural meaning of a place, as well as that of attachment and identification with a place, acquires a new critical role in the discussion of what can be experienced as a restorative setting.

This work is an attempt to expand our understanding in regard to the role played by historical architecture and artworks of hospital public spaces in supporting restoration, and consequentially health-related outcomes among the users.

### Objective of the study

This paper focus on the topic of restoration and how different architectural qualities, such as the presence of artworks, historical architecture and greenery, might promote healthier human-environment interaction through the mediating effects of perceived restoration.

By investigating the specific case of Santa Maria Nuova Hospital in Florence (IT), which encompasses a significant number of heritage features and natural elements, the objective of this work is therefore to increase our understanding of the relationship between hospital public spaces, art, greenery and users' experiences.

For this purpose, an interdisciplinary investigation approach was developed, based upon merging theories and methodologies from the fields of architecture and environmental psychology.

### The case study: Santa Maria Nuova Hospital in Florence

The hospital of Santa Maria Nuova (SMN) is one of the most important hospital facilities in Florence. It boasts of a long history, starting with its foundation in 1288, and has undergone numerous expansions and evolutions over the years due to the lack of space or inadequate consideration of medical and technological innovations. From the outset, the hospital was structured around a cloisters and courtyards system that represents a genuine block of the urban fabric of the city. The hospital contains numerous artworks such as paints, fresco, sculptures and bas-relief from the XIV to the XVIII century.

In 2000, a complete renewal project was launched, which resulted in the complete redevelopment of the facility. The hospital was reorganised into three main functional areas: the emergency area, which includes the Emergency Department, intensive care, emergency radiology, surgery in the day hospital and operating theatres; the outpatient and services area, including the reception, samples collection centre, dialysis and pharmacy, on the ground floor; spaces for the different departments on the floors above. The connection between the emergency and outpatient areas is the most public area, which also leads to the museum and café, and is the focus of this research.

The entrances to the hospital are divided between the emergency area, spaces for patients, visitors, logistics, guiding the internal distribution along vertical and longitudinal axes (Fig. 01).

The vertical connections added with the reconstruction, in turn divided into three different blocks (emergency, staff and patient/visitor areas), did not alter the original structure, but they solved the problem of differentiating the flows with distribution in line with that of the floors above.

The distribution system therefore represents the cornerstone of the restructuring project, disrupting the idea of a Hospital as a "closed" building and making it accessible, from both a physical point of view and in terms of its function, giving it an identity for the city and citizens.



Figure 01. Plan of the hospital with accesses, areas, paths and courtyards

## Research questions

This work is part of a broader research project in which hospital public spaces are evaluated in terms of spatial parameters, environmental quality and users' experience of them.

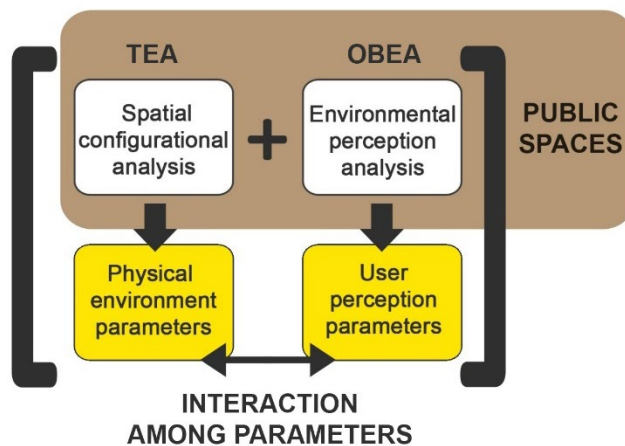
This specific paper focus exclusively on the restorative possibilities experienced by the environmental users during their visit to the hospital. Research questions are the following:

1) Which public spaces are perceived to be more restorative? 2) Does familiarity with a place affect the users' perception of restoration in hospital public spaces? 3) To what extent does the perception of restoration vary across settings that support similar functions but present varying levels of art and greenery? 4) How does the combined use of Technical Environmental Assessments (TEA) and Observed Based Environmental Assessment (OBEA) measures support our understanding of perceived restoration across different public spaces in hospital settings?

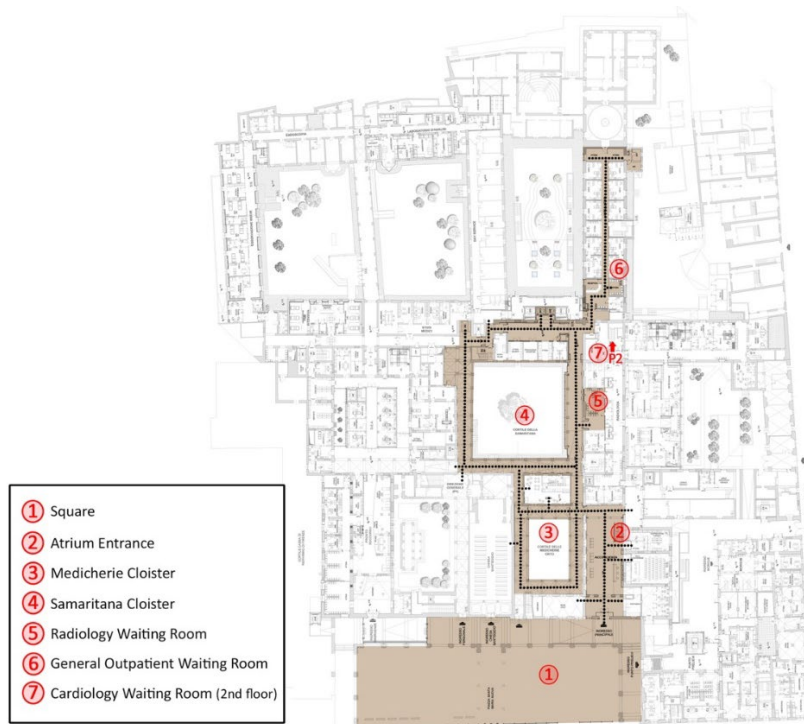
## Methods

The study has a between subject cross-sectional design and adopts a mixed-method approach of investigation, which implies the use of different methodology, such as Technical Environmental Assessments (TEA) (i.e. space syntax) and Observed Based Environmental Assessments (OBEA) (i.e. self-report questionnaires), to understand the human-environment interactions occurring.

A summarised visual representation of the interdisciplinary method developed is provided in Figure 02.



The setting investigated is SMN Hospital, where (N = 7) public spaces were evaluated using TEA and OBEA measures. These seven public spaces support different functions: entrance to the building, transition and connection spaces, and waiting areas. A short description of each setting is provided as well as a visual overview (Fig. 03). This work focuses on the overall perceived restoration across these settings and then takes a deeper look at the specific restorative value of the cloisters, (i.e., number 3 and 4 in Fig. 03).



### Public space entrance

The entrance hall (Fig. 04) is the area that benefited the most from the restructuring, becoming a hub of the hospital environment, not only in terms of admission but also for resting and access to the museum area/bookshop. This area, in fact, is not only used by hospital users but also by citizens and tourists, representing a place of identity for the city and the quarter. It is a monumental and representative space, also due to its dimensions and volume, large but not oversized, and enriched by works of art (since 1300), use of the colour red and warm materials such as wood, and finally the harmony of the clever relationship between modernity and the ancient. The location of the fresco by Bicci di Lorenzo at the end of the hall represents a fundamental point of reference as it marks the junction between two routes: the main one towards radiology and the elevator system, and that towards the vertical route to the medicine and cardiology department.



### **Public space transition and connection areas**

The cloisters instead represent two hinge areas for the hospital system. The Medicherie cloister (Fig. 05) has retained its original structure and historical morphology and represents a resting and meeting place thanks to the hospital's café and the garden created with aromatic plants of historical value, where patients, visitors and staff members alike habitually stop to take a break and rest.



The Samaritana cloister (Fig. 06) on the other hand was completely changed by the restoration and represents the main connection to reach the different departments. The vaults were partly covered by the typical false ceiling of a modern hospital facility, the pillars were clad, and the central courtyard was screened and closed off by glass sheets with metal fixtures. In the centre of the cloister there is a magnolia tree in a green grass around. In one side of the cloister is the ancient fresco of the Samaritana, which cannot be seen directly from the entrance as it is positioned in the side corridor where user flows are low. Finally, there are no resting areas along the route in this area.



### **Public space waiting areas**

The waiting rooms on the ground floor are represented by rather small spaces which are often overcrowded. They have no artworks and no particular attention was paid to the choice of materials or colours, the openings to the outside or the lighting. The waiting room of the Radiology department is directly accessible from the Samaritana cloister and has two glazed portion of the walls connecting visually to the side of the cloister. (Fig. 07)



### **Technical Environmental Assessments (TEA)**

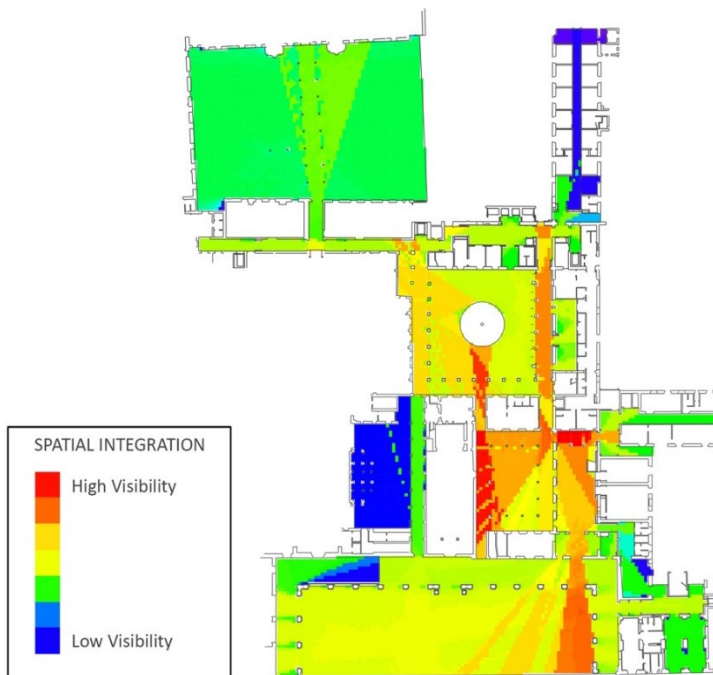
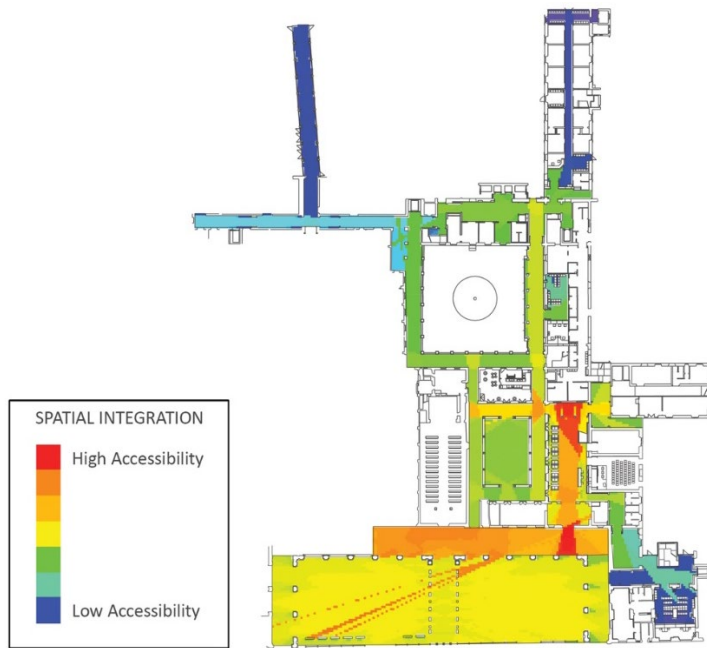
The technical assessments of hospital public spaces aimed to understand some quantitative and qualitative characteristics of the built environment, and were performed using some tools of the architecture discipline, such as:

- Onsite visits to evaluate the quality of the space, assess the presence of artworks and/or greenery and describe the historicity of the space (see the description of places above).
- Spatial Analysis using Space Syntax evaluation parameters [17] to quantitatively evaluate the layout and the presence of artworks and views of greenery. Two different types of analysis were conducted, a VGA (Visibility Graph Analysis) and an Isovist analysis, the results of which were represented with coloured maps.

The Spatial Analysis highlights the qualities of the spatial layout that are not directly visible to the naked eye in that they derive from the geometry and permeability of the individual environments and the relationships between the environments as a whole. The Space Syntax theory, based on the concept of spatial configuration [18], was taken as a reference and as a method of conducting this analysis in that it describes the potential of the spatial layout through some quantitative parameters. In particular in this study, we investigated the integration and visibility parameters using the VGA technique.

The integration map (Fig. 08) shows how accessible each individual portion of space in the system is from all the other spaces in the system. The degree of spatial accessibility within the spatial model considered is described using a scale of values (corresponding to a scale of colours on the map) which gradually shifts from the most integrated spaces, namely those that are more easily accessible (conventionally the red ones), to the less integrated spaces, namely those that are more difficult to access (conventionally the blue ones). The “degree of accessibility” is a property of the space calculated by considering variables such as changes in direction, length, distance, depth, connections and the size of the angles of intersection between spatial elements.

The visibility map instead (Fig. 09) represents all the visible spaces, even those that are not accessible, for example because they are behind a closed glass wall. In the hospital context, visibility as a syntactical property is related to the perception of quality of care, people's behaviours and movements, and to spatial cognition [1].



Referring to the concept of restoration, and in order to more explicitly understand how much time users in the public space of hospitals spend in contact with green areas and artworks, the isovist technique was used [19], which allowed us to identify the number of surfaces from outside green areas and works of art that are visible to a user (Fig. 10). The percentage of these surfaces was then calculated with regard to the total public space area and the area of each individual environment taken into consideration.

The isovist technique was applied inversely: the point of view is not that of an observer who moves through the space, but rather the location of the green area or work of art. From these points, 360° angles for green areas and 160° for works of art were then traced.





**Observed Based Environmental Assessment (OBEA)**

The hospital users’ perception of public spaces was captured in self-report questionnaires handed out onsite (i.e. between subjects’ study design, which implies that each of the seven public spaces were evaluated by different users) (Tab. 01) during the period 21-31 May 2018. Four researchers from the TESIS centre in Florence were involved in recruiting participants and collecting the data.

		FREQUENCY OF ANSWERS
<b>HOSPITAL PUBLIC SPACES</b>	Square and Loggia	11
	Atrium Entrance	56
	Medicherie Cloister	57
	Samaritana Cloister	50
	Radiology Waiting Room	49
	General Outpatient W. R.	50
	Cardiology W. R.	54
	<b>Total</b>	<b>327</b>

The questionnaires were developed in order to understand users’ background information: type of user (i.e., patient, staff, relative, volunteer and social services), gender, age, and familiarity with the place. Moreover, questions related to perceived pleasantness, attachment and identification with the place and perceived restoration were included to account for the interceding psycho-social processes that are known to mediate the influence of the environment on health-related outcomes [20].

This paper focuses exclusively on the construct of perceived restoration captured by means of an especially developed instrument based on the Perceived Restorativeness Scale (PRS) [21]. The original PRS accounts for several dimensions of perceived restoration: being away, fascination, coherence and compatibility, whereas the instrument developed for this specific study focuses on fascination and coherence in order to match the setting investigated. The result is an instrument made up of 10 items (i.e., statements about perceived fascination with a place and coherence) on a 5-point scale where ‘1’ indicates ‘totally disagree’ and ‘5’ ‘totally agree’. Four of the items on the scale were

reversed before the scale score was constructed. The overall perceived restoration score was calculated by adding together the items and then averaging them (Cronbach's alpha = .75).

An overview of the items making up the perceived restorative instrument is provided in Table 02.

DIMENSIONS OF PERCEIVED RESTORATION	ITEMS
FASCINATION	The setting has fascinating qualities. My attention is drawn to many interesting things. I would like to get to know this place better. I want to explore the area. There is much to explore and discover here. I would like to spend more time looking at the surroundings.
COHERENCE	There is too much going on. It is a confusing place. There is a great deal of distraction. It is chaotic here.

Table 02. Items making up the perceived restorative instrument

### Participants

A total of 327 subjects participated in the study; 62% were female and 37% were male, and the mean age was 51.1 (range 17-90). Approximately 56% of the entire sample was made up of patients and their families (i.e., 34% patients and 22% relatives). The remaining 44% was made up of different types of staff and volunteers. Furthermore, 55% of the sample was not familiar with the hospital's public spaces.

The total number of participant answers for each of the seven public spaces investigated is reported in Table 01.

### Statistics

Missing values for a single scale were replaced with the series mean (missing values < 10%). The analysis of variance (ANOVA) and T-test statistics were adopted to detect differences in terms of perceived restoration across the hospital public spaces. The data collected through self-report questionnaires was analysed by using SPSS, Statistical Packaged for Social Sciences for Windows, version 22. The p-value criterion for significance was set to  $p = .05$  (Field, 2009).

### Ethical considerations

The study was approved by the University of Florence's Ethical Review Committee (Commissione Etica per la Ricerca) with the no. 23/2018 act. Approval for the data collection was also granted by the Health Board of SMN Hospital. The hospital's managerial board, together with doctors, nurses and experts from the *Centro di Documentazione della storia della sanità*, actively participated in the discussion on how to better design the data collection of users' experience of public spaces.

## Results

### TEA Results

The visit on site showed that the greenery in the Samaritana cloister is composed by a big Magnolia tree and a not well-finished grass around it, while in the Medicherie cloister the greenery constitutes a botanical vegetable garden made up by vases of medicinal plants. The quantity of greenery area is quite different in the two cloister presenting in Samaritana the highest surface of greenery (480mq) and in Medicherie the lower (10,5mq).

Another factor that emerged from the onsite visits is the different historical value of the two cloisters: the wing of the Samaritana cloister where the questionnaires were handed out (Fig. 06) has the typical characteristics of contemporary hospital buildings: the fixtures have been replaced with aluminium ones, the ancient pillars have been clad and plastered, and a false ceiling of modular panels has been installed to accommodate the lighting and systems. So the medieval groin vaults and stone pillars, which can instead be found in the other wings of the cloister, were not visible to the people when they filled in the questionnaire. Instead in the Medicherie cloister the groin vault, stone cornices, bas-relief tondi and arches were restored but have remained exactly as they were in the Middle Ages.

The spatial analysis revealed that the cloisters and the atrium entrance have the highest accessibility and configurational visibility values in comparison to the other places. However, some differences were noted between the two cloisters with regard to accessibility (Tab. 03): while the average visibility value was similar (3.9 and 3.8),

the accessibility value varied from 3.5 for the Medicherie cloister to 3.1 for the Samaritana cloister. The internal courtyard of the Samaritana cloister is not in fact accessible to the public, and the green space inside is therefore visible but not accessible.

	AREA (Mq) (1)	HEIGHT (MT)	ART VISIBILITY AREA (Mq)	ART VISIBILITY	GREENERY AREA (Mq)	GREENERY VISIBILITY AREA (Mq)	GREENERY VISIBILITY (2)	LAYOUT ACCESSIBILITY INTEGRATION VALUE	LAYOUT VISIBILITY INTEGRATION VALUE
Medicherie Cloister	383	5,2	327	85%	10,5	352	92%	3,5	3,9
Samaritana Cloister	307	4,8	61	17%	480	212	69%	3,1	3,8

Table 03. TEA results. (1) is the accessible surface for people, (2) is the ratio between the visibility of green surface and the area of the environment

The isovist analysis showed the percentage of surfaces from which artworks are visible (blue on the map in Fig. 11) and the percentage of surfaces from which a view of the green areas can be enjoyed (green on the map in Fig. 11). While in the Medicherie cloister the presence of both artworks and green areas is high (85% and 92%), in the Samaritana cloister the only work of art present is barely visible (17%) and the greenery visibility area percentage is quite high (69%).

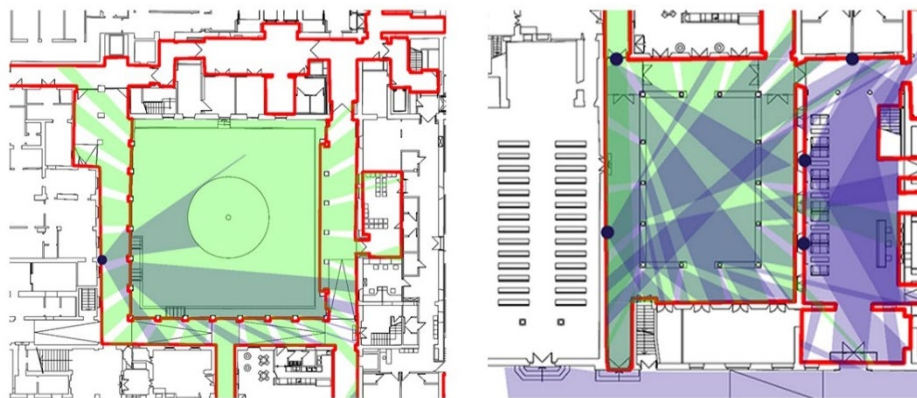


Figure 11. Details of the Samaritana (on the left) and Medicherie (on the right) cloisters representing visibility of artworks and greenery

If we look at the map of the atrium, we see how it is dotted with works of art whereas the green area is not very visible, only from the windows on the side adjacent to the Medicherie cloister.

## OBEA Results

On the whole, the results suggest that the environmental users perceived the overall public spaces of SMN Hospital as relatively restorative ( $M = 3.34$ ,  $SD = .73$ , range 1-5).

Of the seven public spaces, the Medicherie cloister was reported to be the most restorative ( $M = 3.76$ ,  $SD = .57$ , range 1-5). No significant differences were found in regard to familiarity with the place and its perceived restoration ( $F(3, 305) = .381$ ,  $p > .05$ ).

However, some significant differences in terms of perceived restoration were found when comparing settings that support similar functions (for example transition and connection spaces and waiting areas). In this regard, the Medicherie cloister ( $N = 53$ ) ( $M = 3.76$ ,  $SD = .57$ ) was found to be significantly more restorative than the Samaritana cloister ( $N = 46$ ) ( $M = 3.41$ ,  $SD = .75$ ),  $T(97) = 2.6$ ,  $p = 0.1$ .

### TEA and OBEA interaction

The significant differences in terms of perceived restoration found between the two cloisters suggest that some architectural and natural features of the environment affected users' perception. If we look at the results from the TEA analysis, it is possible to see how the cloisters differ in terms of spatial accessibility, percentage of surfaces from which artworks can be seen, and historical quality of the architectural elements.

The TEA suggests indeed that the Medicherie cloister provides greater opportunities to visually see and physically access artwork and greenery, which in turn seem to have had a positive influence on users' perception of restoration, as reported in the OBEA results. Particularly, the visibility area where people can enjoy artworks, which is greater in

the Medicherie cloister, seems to play a key role in restoring the users, in that the environments with the highest restoration are those with the greatest visibility of artworks, as Medicherie cloister is.

Despite the high area of greenery being present in Samaritana compared to that of Medicherie reported by TEA, Medicherie is perceived to be more restorative. The reasons appear to be related with the interaction between art and greenery and the greater possibilities to have visually and physically access to them, measured by isovist parameters. Also the maintenance of the greenery might have had an impact on such results, since the Samaritana green environment is not as well-kept as the Medicherie is.

Another crucial factor that might have had an influence on users' perceived restoration is that of architectural value and heritage differences of the two cloister. The Medicherie has a greater amount of perfectly preserved medieval elements, such as groin vaults, arches, bas-relief tondi, and stone materials, which show the value of the architecture as a work of art, in that it belongs to the past. While in the Samaritana some ancient pillars, vaults and fixtures have been replaced respectively with plaster, modular panels and aluminium.

All the above suggests that these environmental attributes, including the possibilities for the users to visually and physically access the places, played a fundamental role in the perception of restoration.

## Discussion

### *A top-down cognitive process for restoration outcomes*

The results from this study seem to bring new insights in regard to the topic of restorative qualities perceived by the users in the physical environment of hospital public spaces. The public space which had greater possibility to restore the users and therefore has more positive influence of health and well-being related outcomes is that of Medicherie cloister. By looking at the TEA results, it is clear that this cloister does not have the largest amount of greenery, which instead is acknowledged to be the main facilitator of restorative processes, as suggest by the classic ART and SRT theories [11]. However, in comparison to the other cloister, Medicherie has the highest percentage of greenery visibility and provides the users with greater possibilities to physically access and be part of the environment. In fact, people can access the internal courtyard of the cloister and enjoy the green space which, in this case, is made up of medicinal plants which recall the hospital's ancient vegetable garden. Moreover, the cloister provides also greater possibilities to visually access the full historical quality of its architectural elements (groin vault, stone columns, bas-relief tondi) and to a large quantity of artworks. Finally, the Medicherie cloister seems to be the result of the integration of art, history and greenery.

Based upon this mix between historical greenery and artworks, as well as, the greater possibility to visually and physically access the place, it seems that restoration for this specific cloister might have been supported by the activation of top-down processes. Such type of processes are linked to the development of feelings of identification and connectedness with place and its history, rather than automatic visual responses to nature (i.e. bottom-up processes and perceptual fluency account).

These results are in line with recent discussion regarding the restorative effects of places that have special meaning for their users, and thus, implying that not only nature has potential for restoration but also historical, cultural and heritage sites with meaningful artwork that connect past and present [22].

We could further argue that the feeling of belonging and identification with place might have played a crucial role for the restoration outcomes, due to the peculiarity of this specific hospital, which is so deeply integrated into the city and has special meaning for its users by supporting the historical tradition, continuity of place and people's interactions over time [23].

### *The design of hospital public spaces*

The results of this study lead to a contribution on the designing of public spaces in hospitals in terms of three aspects which have a positive effect on people:

- 1) although artworks are included in the design of hospital spaces, in full recognition that they represent a beneficial element in a hospital, their visibility in relation to user routes is not consistently considered. This study proposes a new parameter to evaluate this aspect; 2) this study reveals the importance of spatial accessibility understood as how to create spaces and conditions in which it is possible to spend time and enjoy nature and works of art even in transition areas; 3) architecture has a historical value in of itself which, were present, should be enhanced.

Based upon the research results and ongoing discussions between the researchers involved and the managerial board of the hospital, some suggestions have been developed with the purpose of identifying potential improvements to other areas that scored significantly lower in terms of perceived restoration. For example, one suggestion was to improve the Samaritana cloister by making it possible to come into closer contact with the nature and artwork there by creating some covered micro-spaces with suitable furniture along the sides of the cloister for people waiting for relatives or to be examined, and by moving the fresco into a more central position.

### ***A method to evaluate human-environment interactions and well-being***

This work is an attempt to evaluate the extent to which art, historical architecture and greenery in hospital public spaces might affect users' perception of restoration. The place selected for this purpose was SMN hospital, a complex building with a long history and recently refurbished.

For this purpose, knowledge and methodologies from the fields of architecture and environmental psychology were merged together in order to develop a single protocol of investigation that integrates TEA and OBEA. These approaches were continuously merged throughout the entire research design, data collection and discussion of the results and publications. It was therefore developed as a form of interdisciplinary sharing from the very first discussion on the selection of the hospital public spaces to investigate, through to the operationalization of the concepts, and the measures administered to the users and evaluated by the technical analysis, and finally, for the creation of visual maps that support our understanding of users' perception of hospital public spaces.

Although the case of SMN is unique in the world, the proposed methodology is applicable to evaluate public spaces of other types of hospital, such as modern and contemporary hospitals. It would be interesting to identify the differences in users' perceived restoration as the type of art and historic architecture varies.

### **Conclusion**

On the whole, this work contributes to the development of a protocol of investigation that combines the knowledge and methodologies of two neighbouring disciplines; architecture and environmental psychology. It identifies methods and tools (TEA and OBEA) that support the possibility of evaluating the quality of existing buildings and suggesting which features of the physical environment might be more supportive for users' well-being-related outcomes, which in this specific work were operationalized in terms of perceived restoration. These features are related to some spatial layout properties such as good visibility of artworks and greenery, good accessibility of spaces and presence of historical architecture.

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