The Post-Covid-19 Relationship Between Museum Space and Movements

An investigation on art museums' spatial and curatorial adaption for the reopening

by

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Abstract

The global pandemic of Coronavirus has led to a rethink of people's interaction with public spaces. As the spreading of infection is still not controlled, it is the role of spatial designers to figure out proper approaches for keeping social distance between people through spatial modification of public buildings as well as urban spaces. This study focuses on the reopening strategy of art museums in post-COVID-19 time, asking: what are the strategies for reopening adopted by museums and which spatial factors affect the adaptation of their layout and curatorial organisation? The purpose is to provide not only practical solutions but also a theoretical model for the future evaluation of the capability of museums for doing so.

Building on Hillier's theory of spatial types and spatial structures (Hillier 2019), four British museums have been chosen for the investigation of the socio-spatial changes implicated in their reopening process. These are: The National Gallery, Tate Britain, Tate Modern and The Wallace Collection. The Museum of Modern Art in New York is also explored in terms of the changes in its spatial layout brought about by successive strategies of expansion. The study attempts to have a more in-depth understanding of the role the spatial structure plays in the organisation of movement in art museums, both spatial and transpatial, based on the analytical findings. The study suggests that the use of d-spaces in spatial layouts is the determinant factor for the capability of museums to successfully respond to specialists' guidance for the reopening. It also proposes a model for a multi-layered spatial system in relation to the global-local network. On each layer, d-spaces present the particularity for the spatial configuration and transpatial intention in the meantime.

Key Words: Art Museums, D-space, Traversability, Exhibition

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Chapter1: Introduction

1.1 Perspective influence of COVID-19 pandemic on public spaces

At the time of writing this dissertation, 30 million people around the world have been infected by the virus, with nearly 1 million of them dead. As the World Health Organization (WHO) claims that the control of the spreading of coronavirus will take more time than expected (WHO 2020), keeping social distance and avoiding physical contact with others is still necessary for safety. Designed for large gatherings of people, public buildings such as libraries and museums are facing great challenges at the time of the reopening in order to bring people into their premises while also keeping the transmission of the decease under control. It is important to consider that how visitors use public spaces in the pandemic and post-pandemic era and how future public buildings will be designed will be permanently influenced by the global spread of COVID-19 (Megahed and Ghoneim 2020; Honey-Rosés et al. 2020).

The interaction between visitors in public buildings was mostly considered to have a positive effect on the use of their spaces before the outbreak of COVID-19. In their study of the Swiss Cottage Library Capillé and Psarra suggest that by encouraging people to interact with each other, the library layout supports innovative thinking, shifting the model of learning from a didactic to an interactive mode (Capille and Psarra 2014). In the field of museum studies, the theory of churning effect suggests that the unexpected re-encounters of strangers, which are modulated by the spatial layout of museums, help to make the experience of museums more socially exciting (Hillier and Tzortzi 2006, Hillier 2019).

Honey-Rosés et al. summarize and discuss emerging questions about public spaces raised from the pandemic (2020). Their study argues that it is possible to see a clear change in people's public social behaviour, mainly because the ability to communicate with strangers and develop a new relationship with them will be limited under the fear

of infection. As a consequence, social interactions in public spaces may be less spontaneous and informal, even if they are designed to be so. Their study also suggests that over the long-term, the requirement of social distance will change the scale of some indoor facilities and spatial arrangements since the required distance (normally 2 meters) exceeds some of the interior distance such as in seating arrangements. Change of distances may also affect the patterns of use. Another implication can be sketched out in relation to offices. It is possible to suggest that people will be less likely to communicate in the kitchen of their workplace, which as an argued by Sailer (2007) is the space where interaction happens if the facilities such as coffee machines and microwaves are dispersedly arranged.

1.2 Reflection of the pandemic on museums and their reopening

Despite the digital transformation of museums, based on placing photoprint of their artworks online (Agostino, Arnaboldi and Lema 2020), it is inevitable that museums around the world will have to reopen due to economic and educational pressures. One noticeable trend is the growing emphasis by museum curators on the influence of space on visitors' movement patterns. As Scott Stulen, CEO and President of Philbrook Museum of Art, claims, 'the museum we closed will not be the museum we reopen' (Stulen 2020). The rearrangement of museum spaces plays an important role in the reopening of museums during the pandemic crisis. The following guidelines are selected from the guidelines proposed by Ellis and Szanto for museums' reopening. They contain directly space-related instructions as well as social interventions that partly are influenced by the spatial layout of these institutions (Ellis and Szanto 2020).

Spatial Rearrangements:
Consider a phased reopening, expanding the open footprint over time
Define and indicate one-way walking paths in corridors and galleries
Define no-go zones where distancing is not practicable
Ensure sufficient circulation distance between all artworks and displays

Social Interventions:
Clearly post entry-point rules, orientation signage, and signage on cleaning

protocols
Consider timed (and time-limited) attendance via online registration
Consider audio announcements to guide the visitors and split the flows
Position guards in major intersections to steer public to under-trafficked areas

This dissertation investigates four British museums and one American museum that have recently reopened. Table 1 shows the comparison between museums about the safety rules they are applying. It could be seen that all the museums investigated by this study have limited the number of visitors, thereby reducing the visiting flows. However, the method of avoiding crowds by setting up one-way visiting routes has not been widely adopted. In fact, only British museums have adopted this method, while most of the Chinese and American museums tend to set up fixed entrances and exits without changing the patterns of internal visits (Figure 1.1). It should also be noted that although keeping a social distance is emphasized in basically all of the museums, based on the author's on-site investigation (Figure 1.2), this restriction has not been well implemented. These factors make the spatial arrangements of museums even more important in controlling the visiting patterns of visitors.

	Nation	Limited Visit	Appointed Entrance	One-way Routes
Tate Britain	UK	√	√	√
Tate Modern	UK	√	√	√
National Gallery	UK	√		√
The Wallace Collection	UK	√		√
Somerset House	UK	√		√
Saint Louis Art Museum	USA	√	√	
Virginia Museum of Fine Arts	USA	√	√	
The Museum of Fine Arts, Huston	USA	√	√	
MASS MOCA	USA	√		
Chrysler Museum of Art	USA	√	√	
The National Museum China	China	√		
Shanghai Museum of Art	China	√	√	
Long Museum	China	√		
Chongqing Art Museum	China	√	√	√

Figure 1.1: Reopening strategies of museums in Britain, America and China

Figure 1.2: Photos taken after the reopening museums. (a) Hunan Provincial Museum, China, (b) Tate Modern, UK

1.3 Research Aims

As the global pandemic will remain for a longer time than it was initially thought it would last, the great challenge for curators around the world is how to reopen their institutions ensuring safety measures without sacrificing the visiting experience. However, from the investigation this study has conducted, the actual implementations of safety measures by museums are varied, suggesting that they are arguably influenced by their different spatial configuration. With this in mind, this study aims to provide a syntactic examination of the spatial structure of selected museums. The second intention is to discuss the future spatial design of museums under the conditions of the global pandemic as we are currently experiencing them. Regarding the current situation, four main questions are raised.

1. How do the initial spatial features of museums influence their capability for reducing movement flows to a one-way circulation?
2. To what extent will museums change after reopening in post-COVID-19 time, both spatially and socially?
3. How spatial changes work in museums with different types of spatial configuration?

4. Will there be a new spatial culture for museums that illustrates a new relationship between curators and visitors, influenced by the global pandemic?

1.4 Dissertation Overview

Chapter two provides a detailed overview of museum studies in relation to how the spatial configuration, together with curatorial design, influence movement patterns and construct the visitors' experience. Chapter three introduces methodologies that will be used in the analysis of the case studies and explain the theoretical meaning of the syntactic approaches that are selected. Chapter four presents the views and floor plans of art museums investigated in this thesis. Chapters five, six and seven present the results from the syntactic analysis of the art museums. Chapter eight offers an in-depth discussion about the socio-spatial factors that are important for museums' reopening and proposes a theoretical model for future evaluation. Finally, chapter nine summarises the whole findings and explains the limitations of this study.

Chapter2: Literature Review

2.1 Chapter Introduction

This chapter reviews studies in the field of museology and spatial typology in order to establish a theoretical basis for the understanding of the current situation that museums are facing. The study first looks at syntactic researches that examine the relationships between spatial configuration and movement patterns. The focus then moves to four art museums than have been investigated in previous research about the architectural experience they provide. The selected museums will also be discussed in later chapters about how they react to the reopening. Finally, non-syntactic approaches to avoiding congestion in museums will be introduced since the avoidance of over-crowdedness is the priority in the current time.

2.2 Space Syntax Theory

2.2.1 Movement Patterns

In *Space Is The Machine* Hillier argues that instead of simply being treated as a background of human activity, space also creates social meaning. Space itself should be considered as an independent factor that provides the potential for people's movement patterns, both in architectural scale as well as urban scale (1996). The change of the spatial characteristics people experience in ambient space influences the way they interact with others. Hillier suggests that space is intrinsic to the activity of people. He proposes that it is the relationships between spaces, which he calls spatial configuration that generates or, sometimes, restricts patterns of encounter. Hillier et al.'s study of Tate Britain further examines the spatial effect on people's movement patterns through statistical comparison between the visual integration of space and the density of movement traces (1996). The strong correlation between two variables shows that the spatial layout of the gallery shapes visitors' pattern of co-presence and is itself an important determinant of how the gallery is used.

2.2.2 Spatial Types

In exploring the implications of spatial variations for human movement, Hillier divides the way spaces are embedded in spatial configuration into four types (Hillier 1996). An a-space is a dead-end which has only one connection to other space. A b-space allows through-movement with more than one connection on the way to the dead end. A c-space lies in a single circulation ring of connected spaces. In contrast to movement in c-space which has only one alternative way back, movement in d-space has at least two circulation routes, which, in Hillier's argument, makes the d-space a local distributor for movement.

Hillier further explores the impact of different spatial types (Hillier 1996, Hillier & Tzortzi 2006). Based on the characteristics of spatial types he suggests that a- and d-spaces help to create integration, while b- and c- spaces increase segregation, for the reason that the b- and c- spaces encourage through-movement. The balance of c-spaces and d-spaces inside the building is proposed by Hillier and Tzortzi (2006) as the crucial factor that influences the navigation and experience of visitors. They demonstrate that visitors tend to get constrained to particular sequences if c-spaces make the majority of spaces in a layout while, on the other hand, have more choices for exploration if there are more d-spaces in the building.

2.2.3 Spatial Structures

Building on the concept of spatial type, Hillier develops the concept of spatial structure which is generated by the fundamental spatial types (Hillier 2019). While there are four spatial types, similarly, there are four spatial structures associated with different spatial concepts: a-structure means *stasis*, b-structure means *axis*, c- and d-structure are associated with *route* and *network* respectively. In Hillier's definition, each spatial structure gives rise to potential for particular movement patterns, thereby generating interrelated patterns of social encounter.

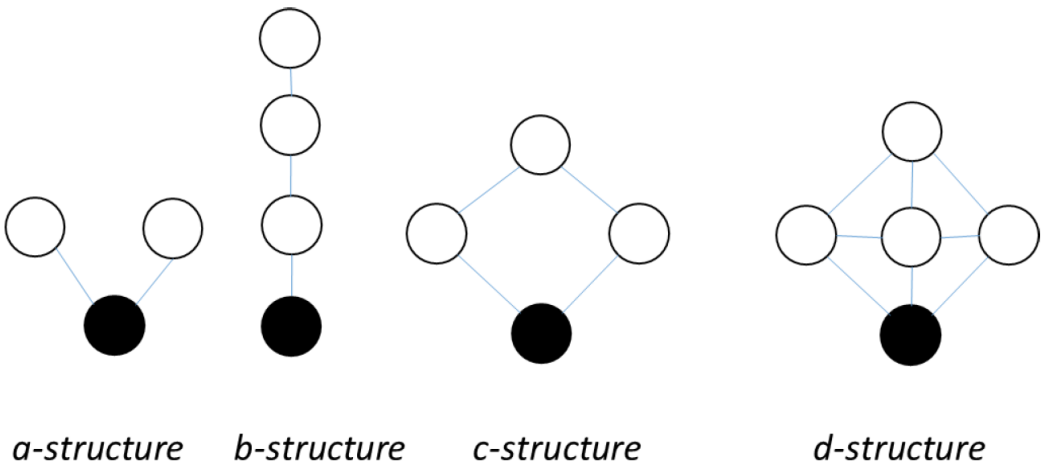

Figure 2.1: Spatial structures defined by Hillier (2019).

The main contribution of Hillier's work to this thesis is the comparison between c-structure and d-structure (Hillier 2019). By comparing the spatial structures of Tokyo and London's street networks, Hillier argues that Tokyo's d-structure generates routes from all part to all others, thereby encouraging exploration. In contrast, London's c-structure specifies routes through its city centre, which makes the city weaker than Tokyo in developing sub-centres. In the building scale, d-structure generates path divergence and convergence, increasing the rate of encounters and re-encounters. Therefore, while visitors in a d-structured building may have various movement patterns, re-encounters provide them with a common experience of spatial navigation.

2.3 Spatial Genotypes of Museums

An empirical study of eight museums conducted by Choi examines the effect of the museum's spatial layout on visitors' behaviour, including movement patterns and occupancy rate of exhibition rooms (1999). His study illustrates that the spatial configuration of these museums has more powerful behavioural influence than other factors such as exhibits and curatorial arrangement. As for the static use of the museum, Choi counts the number of people that are static or moving in spaces and compares the result with configurational variables. He suggests that instead of the spatial distribution of people, it is the number of people visible from each space that has a strong correlation

with the integration of the space in the layout. Therefore, space shapes the awareness of co-presence based on visual encounters. Furthermore, Choi observes that visiting paths tend to be more varied in those museums that have the most integrated and intelligible spatial layout. These museums also see a more evenly distributed pattern of paths at the global level, although individual visitor itineraries are more selective.

Inspired by Choi's work, two genotypical spatial themes of museums are proposed by Huang in his study, which investigates the change of museums' social roles through times (2001, 2006). In the first scheme, it is the strength of visiting sequence which defines organized walking and physically controls the movement of visitors. In the second one, it is the depth of integration core that congregates visitors. Both schemes influence the movements and encounters of museum visitors.

Comparing the syntactic structure of museums with time as an intervening variable, Huang (2006) suggests that the current trend sees a stronger spatial sequence and deeper integration core in comparison to earlier museums. Since the social situation in museums has changed from educational to commercial with the majority of visitors being loose consumers, Huang argued, the deep core and strong sequence contribute to subjective choice-making on visiting and ensure that all targeted exhibits could be seen within a single tour. Whether or not this is representative of global trends, Huang's study illustrates the implication of museums' spatial configuration on their social roles and how curators could modulate visitors' behaviour through the spatial arrangement.

2.4 Architectural Experience of Museums

Syntactic researches have investigated how the spatial layout of museums give rise to co-presence of visitors and shape their movement patterns (Huang 2006; Choi 1999; Hillier and Tzortzi 2006, Psarra et al. 2007, 2009). The relationship between spatial configuration and arrangement of displays is further discussed suggesting that how these factors interact is the crucial determinant of architectural experience of museums

(Tzortzi 2003, 2007, 2011; Psarra et al. 2007, 2009). This study chooses four representative art museums from current literature which have different characteristics of spatial layout as well as intentions of exhibition arrangement. These are Tate Britain, Tate Modern, the National Gallery, and the Museum of Modern Art in New York (MoMA). The selected museums are discussed in the following chapters since they all have different degrees of spatial modifications due to the pandemic.

2.4.1 Tate Britain

Located in London, Tate Britain is argued to optimise random movement patterns both on the global and local scale, and, generating unexpected encounters (Tzortzi 2007; Hillier 2019). The museum uses its main axis as the gathering space, space which connects local and global movements, with sub-cycles attached to the main axis being interrelated. Therefore, visitors are able to travel through the whole building just using the main axis once, while also having multiple choices to return to the gathering space of the main axis at many points. Although the display arrangement of Tate Britain follows a historical scheme of art, the rich choices for self-exploration provided by the high spatial interconnectivity of the museum's layout encourage visitors to start their own journey instead of following the sequenced routes. Therefore, instead of presenting specific pre-given meanings, Tzortzi suggests (2007), the spatial configuration of Tate Britain offers the possibility for producing meanings through visitors' individual navigation. Similarly, Hillier et al.'s report shows that visitors of Tate Britain appreciate the explorative informality (1996).

2.4.2 Tate Modern

In contrast to Tate Britain that has its main axis as gathering space, Tate Modern also has a visual axis that comes across the length of the layout, but the museum's gathering space is concentrated on the escalator in the middle of the axis (Tzortzi 2007). Tzortzi suggests that it is because the relationship between sub-cycles and the main axis is limited with an emphasis on the local sequence. Once visitors get into the subsequent

routes, it is unlikely to return to the main axis unless they finish the sequence. Compared with the dynamic spatial experience that Tate Britain provides, Tate Modern generates locally concentrated and strongly sequenced movement patterns.

The arrangement of displays in Tate Modern has a weak relationship with the spatial layout. The only contribution of the spatial configuration is the reduction of the levels of free exploration limiting visitor's movement in planned sequences, from which the designed aesthetic experience could be directly received by visitors without the intervention of other factors (Tzortzi 2011) independently of the way in which the displays are grouped. Tzortzi argues that this is the exact reason for which the logic of Tate Modern's exhibition arrangement does not follow a clear scheme but is decided by the curator's intensions. As the curators of Tate Modern once proposed, the museum is a 'machine of showing art' (Serota 1995:32).

2.4.3 Sainsbury Wing of the National Gallery

The spatial layout of the National Gallery's Sainsbury Wing approximates the network model as defined by Hillier in his 2019 study. Based on Hillier's proposal (Hillier 2019), this network shaped layout maximizes choices of routes as it generates various sub-cycles and has a strong visual connection at the local level. However, the fieldwork conducted by Tzortzi shows that visitors in Sainsbury Wing do not utilise the choices offered by the layout. They tend to choose the same routes and only make choices at certain positions when they have to. Tzortzi suggests that the reason is that the gathering space (integration core) fails to provide visitors with a clear awareness of the overall structure of the spatial layout. Although exhibition rooms are interconnected, the deep integration core of the gallery cannot be seen from the entrance and does have the ability for the global organization, unlike the main axis of Tate Britain. As a consequence, visitors do not follow individual routes at the beginning of the tour. Tzortzi also suggests that the curatorial arrangement, which aims to attract people's self-exploration

to enhance the use of space by putting major paintings in deep rooms, is weakened by the certainty of route choice in practice.

2.4.4 The MoMA

The expansion of MoMA in 2005, studied by Psarra (2009) and Psarra et al. (2007), presents a syntactic structure which uses spatial configuration to enhance narrative strategy for expressing the complex relationships among artworks and art movements. Their study suggests that reinterpreted from previous plans that emphasize a linear flow of history, the new spatial design in 2005 introduces interconnected secondary exhibition rooms related to the main sequence and visual links constructing multiple interconnections of spaces across distance. Based on the choices visitors are offered to depart from the main sequence through sub-cycles, especially on the fifth floor, displays are distinguished into different groups and arranged in intersected narratives to provide a dynamic visiting experience. Such experience is confirmed by the visitors' exploration patterns, illustrated by the authors' investigation of visitors' paths showing that visitors are more explorative on the fifth floor of the museum rather than the fourth level.

2.5 Crowdedness in Museums

As far as crowdedness is concerned (Pelowski et al. 2014) as another factor that affects people's experience in museums and safety issues, there is literature looking at non-syntactic variables that lead to the unequal distribution of visitors and provide technological solutions.

Yoshimura et al. investigate visitors' movements in the Louvre Museum by Bluetooth sensors to understand the causes of overcrowding in the museum (Yoshimura et al. 2014). Dividing visitors into two groups based on the length of time they spend in the museum, their study finds that both short-stay and long-stay visitors tend to visit similar rooms, containing popular art pieces. While long-stay groups appear to stay in

particular spaces for a longer time instead of visiting more spaces and having a longer touring path, the short-stay groups normally select the most spatially optimised route allowing them to visit all target displays within their limited time. Therefore, although the Louvre provides considerable route choice, the actual sequence is limited with many local exhibits not being visited. The uneven distribution of movement, therefore, leads to the congestion of certain museum spaces and uneven distribution of movement.

In order to avoid the overcrowding in museums, technological approaches have been proposed in recent years with a focus on personalised choices, and dynamic movement flows. Grouping the different navigation styles of visitors, Tsiropoulou, Thanou, and Papavassiliou (2017) build an algorithm system for customised routes. From their study, an 'ant visitor' would have a completely different preference for visiting compared with a 'grasshopper visitor'. While the former follows the longest path that contains all the displays and less influenced by the crowdedness, the later has clear intension of visit and tends to be affected by the crowds that prevent them from detailed aesthetic appreciation. By arranging different groups into different sequences, the system is expected to satisfy the preference of the visitors and, in the meantime, minimise the negative influence of crowdedness on visiting experience. Likewise, works conducted by Seo and Ahn on mechanisms of congestion control in museums examines the possibility of dynamically adjusting the route of tourists through the algorithm system (Seo and Ahn 2010). From their argument, overcrowding could be avoided through pre-planned individual routes associated with dynamic adjustment in certain points.

Based on this review, it is possible to propose the minimum number of changes in a museum's layout coupled with Bluetooth technology and an algorithmic system of customised routes to address safety measures in the museum after the reopening. Chapter six of this thesis analyses the museum layouts and evaluates the spatial strategy after the reopening with this proposition in mind. This is to allow the natural movement patterns of the museum to guide visitors' exploration alongside the potential adoption of technologies for distributing movement.

2.6 Discussion

This chapter has introduced existing research in the field of space syntax and museology that contributes to further understanding of the research questions. While Hillier's definition of spatial types and structures serves as the theoretical background for quantified approaches on the spatial changes (1996, 2019), explorations of the syntactic structure and spatial experience in museums are helpful to predict the spatial and social performance of museums in post-COVID-19 (Psarra 2009; Psarra et al. 2007; Tzortzi 2003, 2007, 2011; Hillier et al. 1996). However, because of safety issues brought by this pandemic, there may be limitations in existing knowledge in relation to the future spatial design and analysis. For instance, interactions between strangers in public spaces which used to be encouraged are now required to be avoided. In this sense, the rethinking of the syntactic theory based on the current situation is essential to this thesis.

Chapter 3: Methodology

This chapter introduces methodologies that will be used in answering the research questions. In general, the analysis of this thesis is divided into two parts: the historical evolution of the MoMA and the reopening of four British museums (Figure 3.1). Combining statistical data from the results of the MoMA and British museums' analysis, this thesis also conducts comparisons between different spatial variables in order to find the determinant factor that influences museums' capability for applying one-way strategy, which is argued to be essential for the reopening.

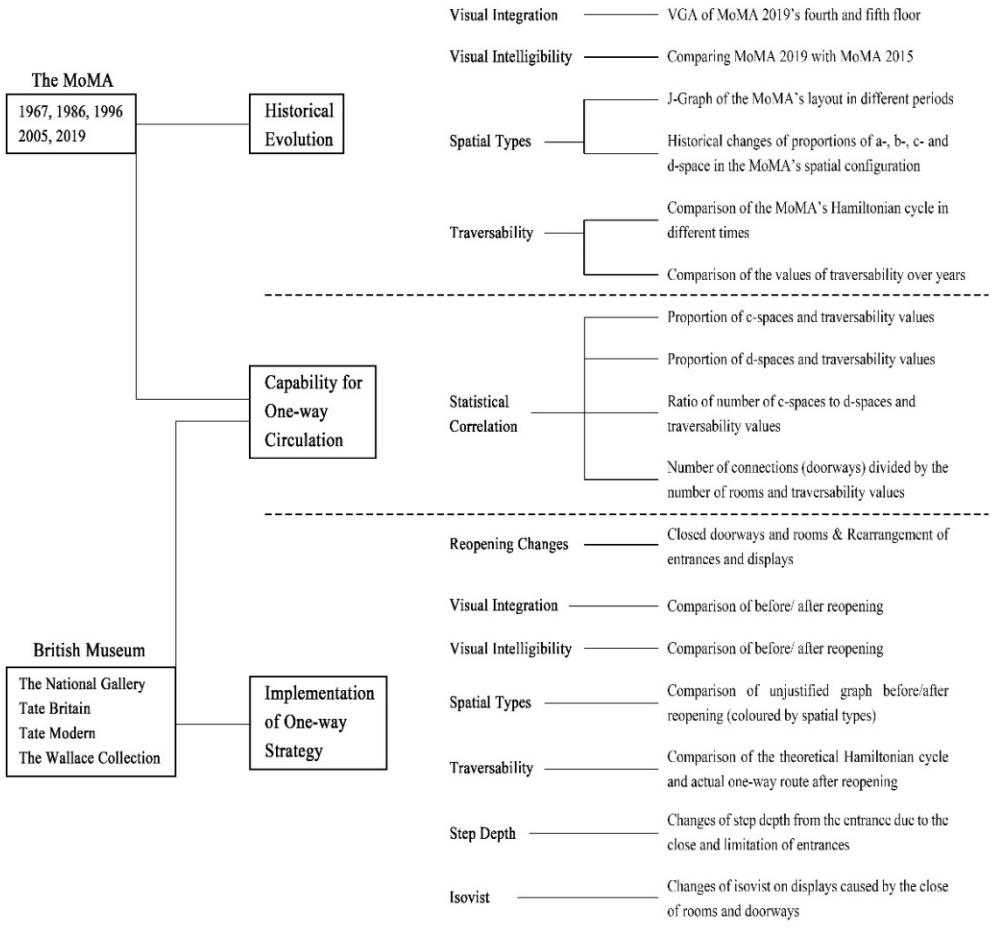

Figure 3.1: Methodology diagram of the thesis.

The principle methodological approaches are as follows:

- Hamiltonian Cycle & Traversability: A Hamiltonian cycle visits each space of the

layout exactly once without repeating, and ends at the start point. Developing from Hillier's study (2019), this thesis calculates the value of traversability using the formula: the total number of spaces in the Hamiltonian path /the total number of spaces in the layout. Layouts with high values of traversability have the better capability for reducing movement flows to a one-way circulation with fewer spaces being closed.

- Visual Integration & Visual Intelligibility: As Choi suggests (1999), visitors in a museum with a more integrated and intelligible layout have a better understanding of the global structure of the building and tend to choose more individual routes. This thesis measures visual integration (visual distance from all spaces to all others) and visual intelligibility (correlation between visual integration and connectivity) of selected museums for the prediction of visitor's movement patterns.

- Proportions of Spatial Types: This thesis calculates the proportions of a-, b-, c- and d-spaces in relation to the total number of spaces in the spatial configuration. While the distribution of spatial types illustrates the spatial structure underlying the layout, this thesis also conducts a statistical comparison between the proportions of spatial types and the value of traversability to examine correlations between the two spatial properties.

- Reopening Strategies & Spatial Changes: As on-site investigations are forbidden due to safety issues, this thesis investigates the actual approaches that museums have taken for reopening through online resources and interviews with museums' stuff. The spatial changes of the National Gallery's reopening, for instance, are summarised by comparing the previous plan before reopening and the current plan that the National Gallery publishes online. As for the investigation of Tate Modern and Tate Britain, the author contacted Tate's information assistant, Mrs Katarzyna Rakowska, who kindly provided a detailed description of the closes of spaces and how the two Tate museums rearrange their one-way routes.

Chapter4: Introducing the Case Studies

This chapter provides an overview of the art museums that are selected for further analysis in answering the research questions: one American museum, the MoMA, New York, and four British museums that have reopened recently: the National Gallery, Tate Britain, Tate Modern and the Wallace Collection (Figure 4.1).

Figure 4.1: Views of the investigated museums. (a) the MoMA, (b) Tate Britain, (c) Tate Modern, (d) the Wallace Collection, (e) the National Gallery

Building on Psarra et al.'s work on the historical evolution of MoMA, New York, this thesis first looks at the newest expansion of the museum in 2019 and all of its previous layouts (1967, 1986, 1996 and 2005) (Figure 4.2). The study then investigates and compares the layouts of the reopening of the National Gallery, Tate Britain and Tate Modern. All three British museums are situated in London and have similar sizes (Figure 4.3). As a small museum exhibiting private collection, the Wallace Collection serves as another interesting case by allowing the study to compare different spatial structures of different size. While the former large museums offer intersecting rings of circulation, the Wallace Collection offers one main sequence.

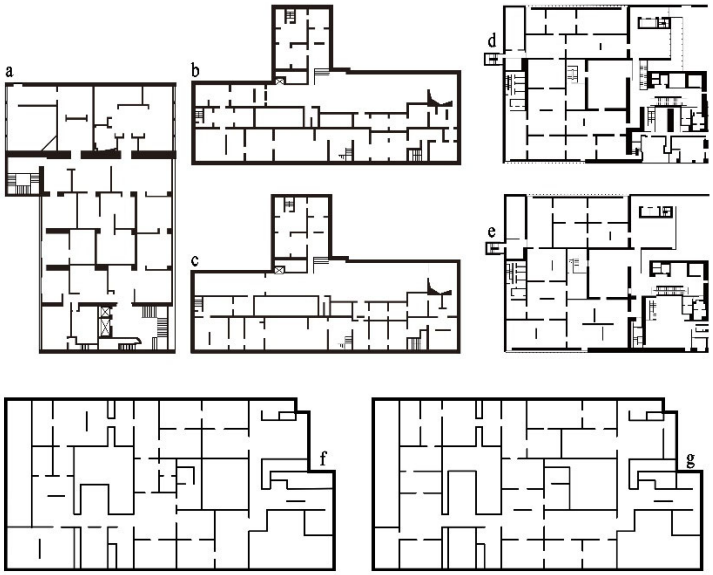

Figure 4.2: Floor plans of the MoMA in different periods. (a) 1967, (b) 1986, (c) 1996, (d) 2005 Fifth floor, (e) 2005 Forth floor, (f) 2019 Fourth floor, (g) 2019 Fifth floor.

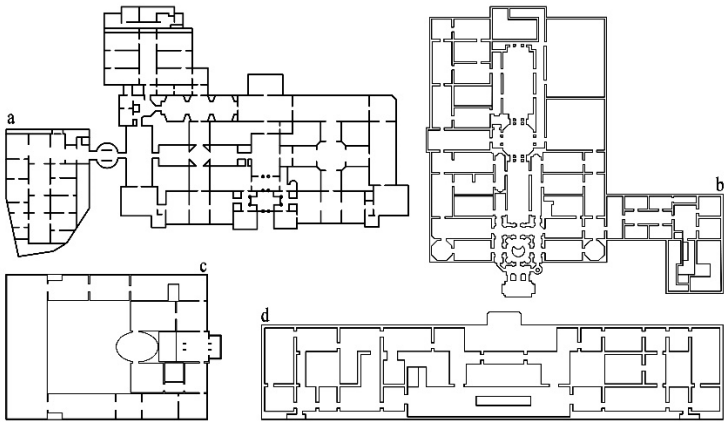

Figure 4.3: Floor plans of the four British museums. (a) the National Gallery, (b) Tate Britain, (c) the Wallace Collection, (d) Tate Modern.

Chapter 5: Historical Evolution of the MoMA

5.1 Introduction

This chapter focuses on the historical evolution of the MoMA's spatial layout from 1967 to 2019. Four spatial properties of the MoMA's spatial layout are presented in order to investigate how the layout changes over the years: traversability value, the proportions of a-, b-, c- and d-spaces in relation to the total number of spaces in the spatial configuration, visual integration and visual intelligibility (Figure 3.1). First, as previously argued in the literature review, the measure of traversability can show the museum's adaptability for the one-way strategy facing the pandemic. Second, based on Hillier and Tzortzi's argument (2006), the proportions of spatial types can indicate the patterns of exploration inside the museum. Finally, this chapter investigates changes in the visual integration of the museum from 2005 to 2019 for a more in-depth understanding of the potential movement patterns that the spatial configuration of the MoMA offers over time.

5.2: The latest expansion of the MoMA in 2019

> *"The real value of this expansion is not more space, but space that allows us to rethink the experience of art in the Museum." (Glenn D. Lowry, The David Rockefeller Director, 2019)*

MoMA's new expansion has rearranged the way exhibition rooms are interrelated. As shown in Figure 5.1, both the fourth and the fifth floors, which are the main floors of the exhibition, have a strongly sequenced circle covering most of the display spaces with two intersecting cycles in the middle of the large sequence where visitors can choose to move from the north to the south side of the building. Compared with the museum's previous layout (Psarra et al. 2007, Psarra 2009), the multiple intersected route choices provided in its expansion in 2005 are reduced to a single linear route. There is only one sub-cycle while both floors have a considerable number of dead-end rooms.

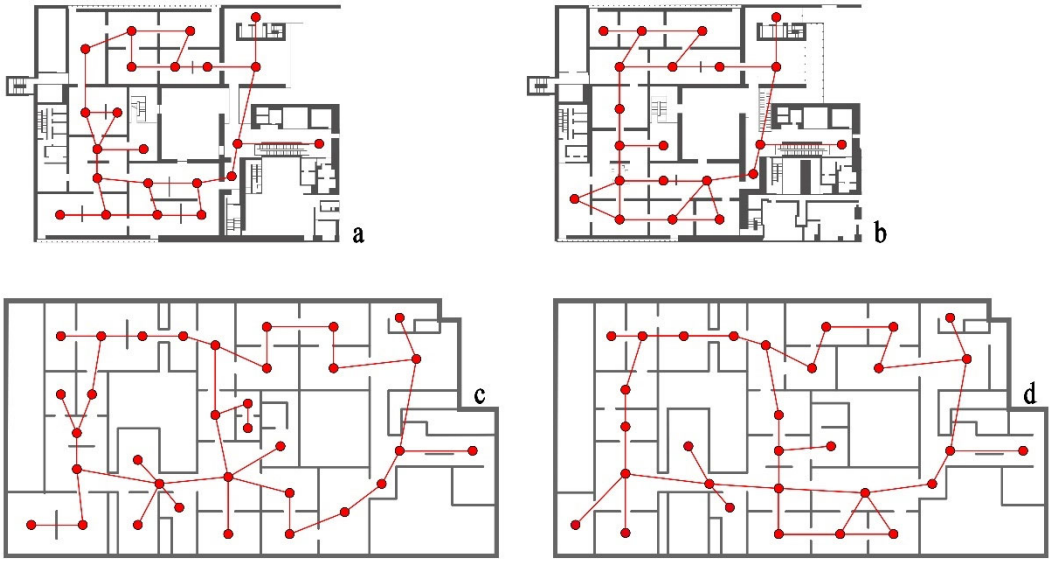

Figure 5.1: Unjustified graphs of the MoMA. (a) 2005 Fourth floor, (b) 2005 Fifth floor, (c) 2019 Fourth floor, (d) 2019 Fifth floor

5.3 Traversability and Hamiltonian cycle

The MoMA's traversability sees a considerable growth from 0.58 in 1967 to 0.72/0.79 in 2005 (4F/5F respectively), after with it drops to 0.59 in 2019 (4F&5F) (Figure 5.2). Figure 5.3 presents the Hamiltonian cycle of the museum in different periods, showing that it contains most of the spaces inside the layout. There is a clear spatial similarity between the latest expansion and MoMA's previous versions in the 20th century (1967, 1986&1996) as there are groups of spaces attached with the main sequence which made up the Hamiltonian cycle. While all of the northern spaces were not included in the one-way path in the MoMA's 20th-century versions, nearly a half of spaces in the fourth and fifth floor of the new MoMA need to be closed including those in the middle of the layout and the dead-end spaces on the sides. In contrast, in the expansion of the MoMA in 2005 most of the spaces are included within one Hamiltonian path. This layout has the highest value of traversability over time, especially on the fifth floor (0.79).

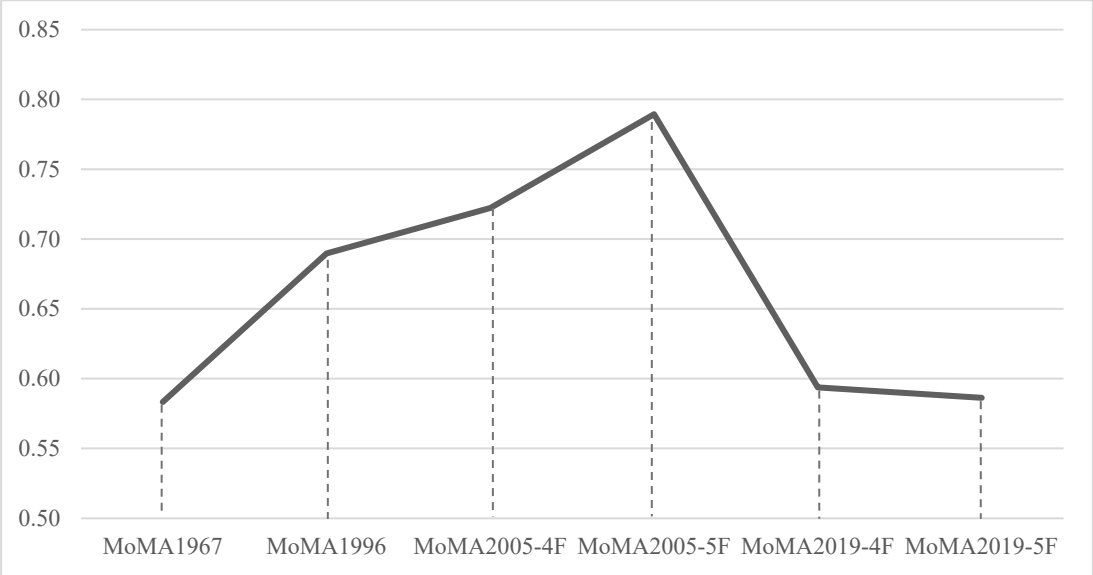

Figure 5.2: Changes of traversability of the MoMA in different periods

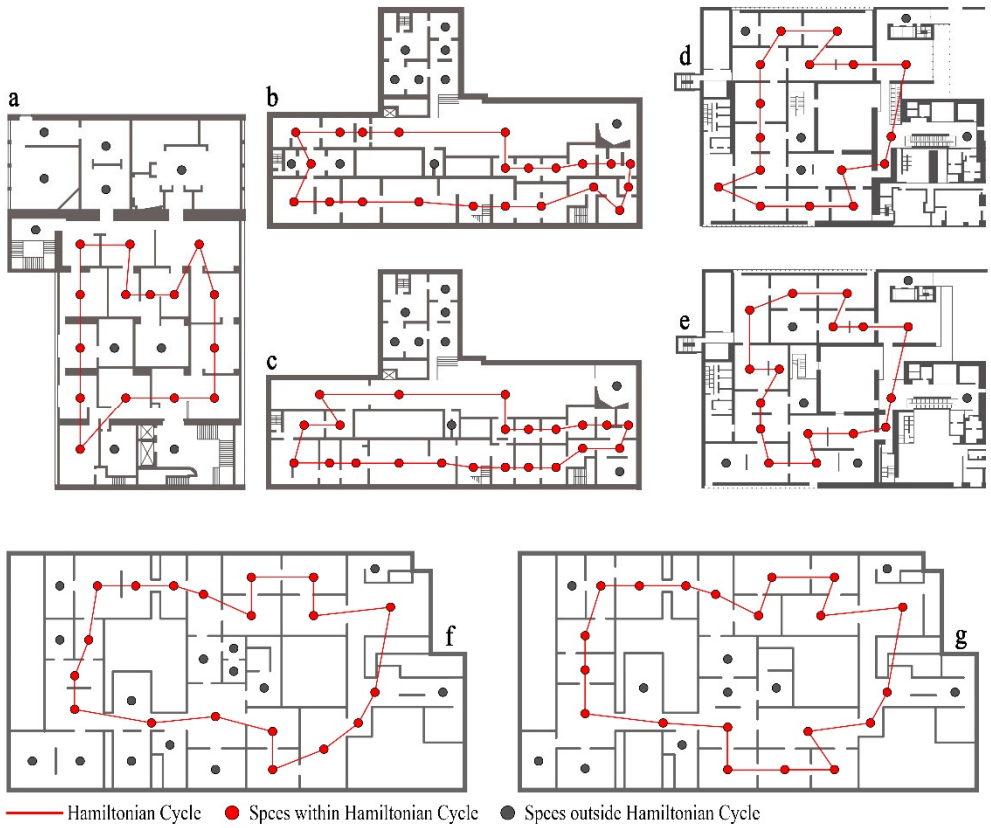

Figure 5.3: Hamiltonian Cycle of the MoMA in different periods. (a) 1967, (b) 1986, (c) 1996, (d) 2005 Fifth floor, (e) 2005 Forth floor, (f) 2019 Fourth floor, (g) 2019 Fifth floor

5.4 Proportions of a-, b-, c- and d-spaces

The proportion of d-spaces in the spatial configuration of the fourth and fifth floor of the MoMA sees a sharp drop in the museum's latest expansion in 2019 (Figure 5.4). The high proportion of c-spaces make up a linear sequence suggesting that visitors in the new MoMA (2019) are less likely to have the potential for individual pathways of exploration. Compared with the 2005 version, there are also more a-spaces in the new MoMA. In fact, there is a strong similarity between the new MoMA and its first design in 1978, which, suggested by Psarra et al. (2007, 2009), created a labyrinthine layout (Table 5.1).

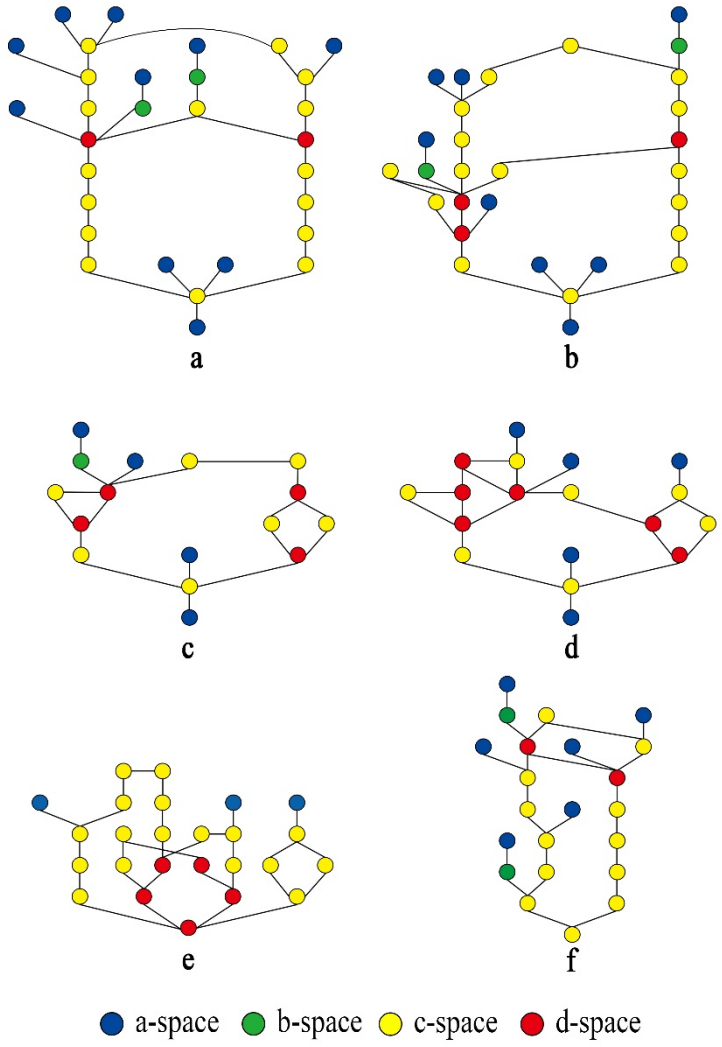

Figure 5.4: Justified graphs of the MoMA in different periods. (a) 2019 Fourth floor, (b) 2019 Fifth Floor, (c) 2005 Fourth Floor, (d) 2005 Fifth floor, (e) 1996, (f) 1978.

5.5 Visual integration and intelligibility

The visual analysis of the fifth and fourth floors of the MoMA further illustrates the spatial limit on visitors' navigation. The two entrances of the fourth floor and the north entrance of the fifth floor are segregated meaning that they cannot provide visitors with a good understanding of the main circulation structure of the building on entering (Figure 5.5). Figure 5.5 also marks the positions of displays that are recommended on the museum's guide book. Most of those displays are either placed at the entrance, with depth step one in the layout, or in the deepest spaces, both of which have poor visual integration. In other words, the curatorial strategy is based on the attraction exercised by the exhibition content as in most areas, the structure of circulation cannot guide exploration.

Comparing the visual intelligibility of the layouts in 2019 with 2005, this study suggests that there is an additional problem in the latest expansion. This concerns the potential uneven distribution of visitors through the global layout. As presented in Figure 5.6, the visual intelligibility of the fifth floor drops from 0.5954 in 2005 to 0.3928 in 2019. Building on Choi's observation on visitors' paths in museums, visitors in the new MoMA are expected to have less varied movement traces. Under the consideration of the safety issues in the current time, the potential for over-concentrated movements in certain spaces could be a negative factor for the museum's reopening.

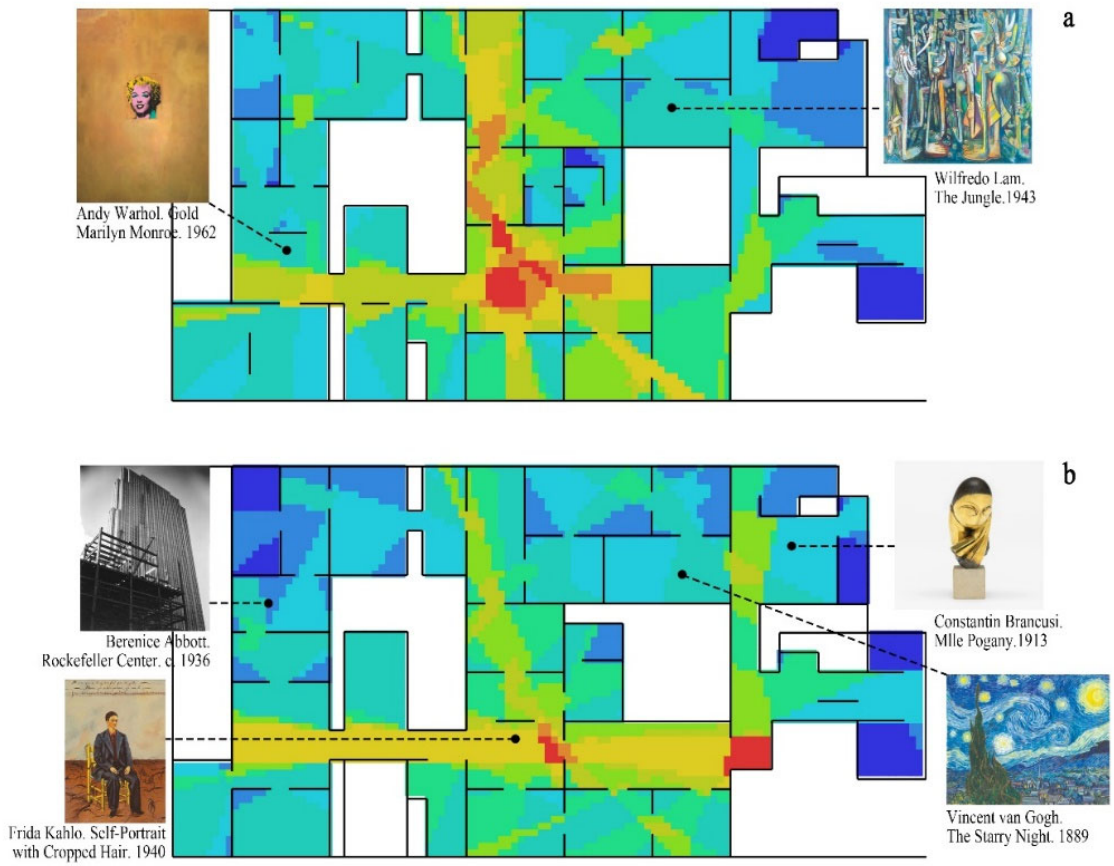

Figure 5.5: Visual integration of the MoMA with recommended displays marked. (a) Fourth Floor, (b) Fifth floor

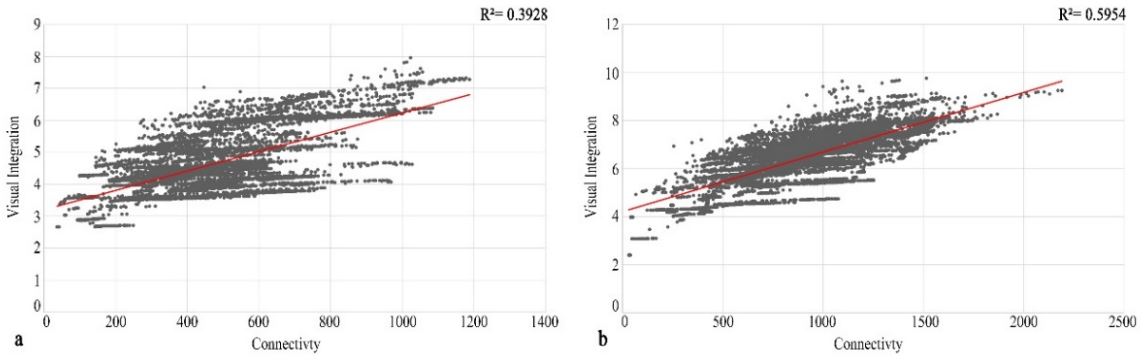

Figure 5.6: Visual intelligibility of the fifth floor of the MoMA. (a) 2019, (b) 2005

5.6: Statistical comparison of spatial properties

Table 5.1 shows the summary of the MoMA's traversability value and the proportions of spatial types at different times. Having higher values of traversability than other periods, the fourth and fifth floors in the 2005 version also had the highest proportion of d-spaces in its spatial configuration, at 22% and 42% respectively. Similarly, the traversability values and the proportion of d-spaces of the 1996 layout were higher than those in 1967 and 2019. On the hand, while the traversability value of the fourth and

fifth floor of the new MoMA approaches a figure similar to that of 1967 version, these three layouts also present a similarity in the distribution of spatial types in the spatial configuration.

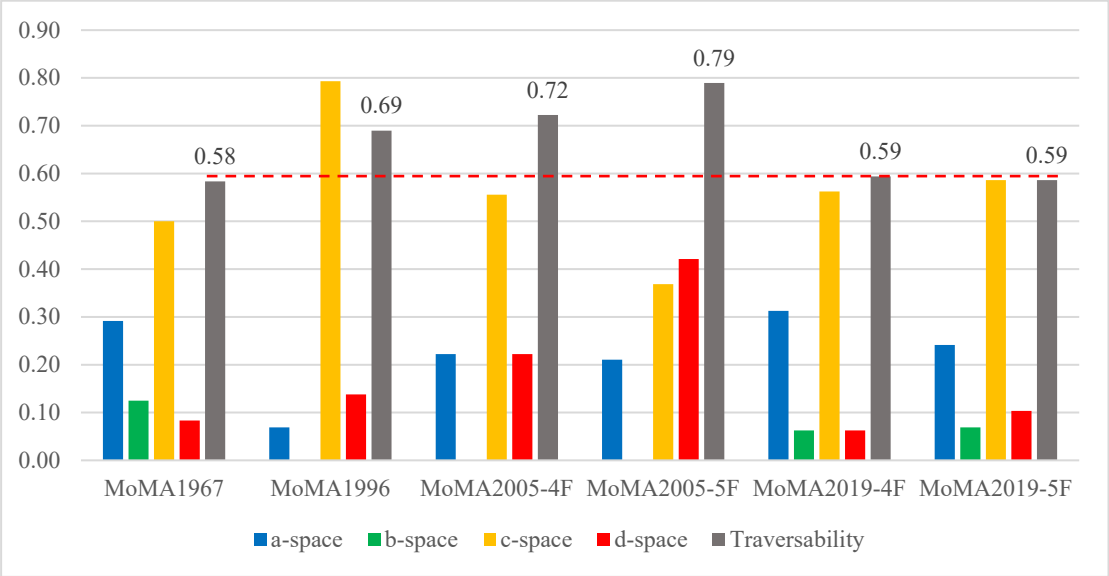

Table 5.1: Proportion of space types and traversability value of the MoMA over time

Chapter 6: The Reopening of British Art Museums

6.1 Introduction

From July, British art museums have gradually reopened to the public. Most of them apply the one-way route strategy to control the spread of the virus. Interestingly, although following similar policy, the ways museums take this strategy into practice are quite different from each other, depending on the different types of their spatial layout and curatorial arrangement. This chapter investigates four British museums that have reopened: the National Gallery, Tate Britain, Tate Britain and the Wallace Collection. With a focus on the implementation of the one-way strategy, this chapter discusses changes that happened in the museums' spatial configuration after the reopening, including visual integration, intelligibility and spatial structure.

6.2 Traversability of the four British art museums

Figure 6.1 presents the traversability value of the four British museums before the pandemic. It should be noted that this study examines the National Gallery into two parts: the Sainsbury Wing on the west side of the museum and the main building on the right. Despite the differences in scale, spatial properties and exhibition theme, most of the museums have a similar traversability value between 0.75-0.78. Surprisingly, the Sainsbury Wing, in spite of its grid-like spatial layout, has the lowest traversability value at 0.67. As shown in Figure 6.2a, in order to have the Hamiltonian cycle, the central vertical axis of the Sainsbury Wing needs to be closed. Tate Britain has the highest traversability value among all the layouts, with only 22% of spaces closed for the one-way path. It should be noted that compared with Hillier's calculation of Tate Britain's traversability which ignores functional spaces such as staircases and toilets (2019), this study calculates the value of traversability with including all the spaces within the layout for the cross-comparison between museums. Therefore, the traversability value of Tate Britain from this thesis is lower than Hiller's figure at 0.94.

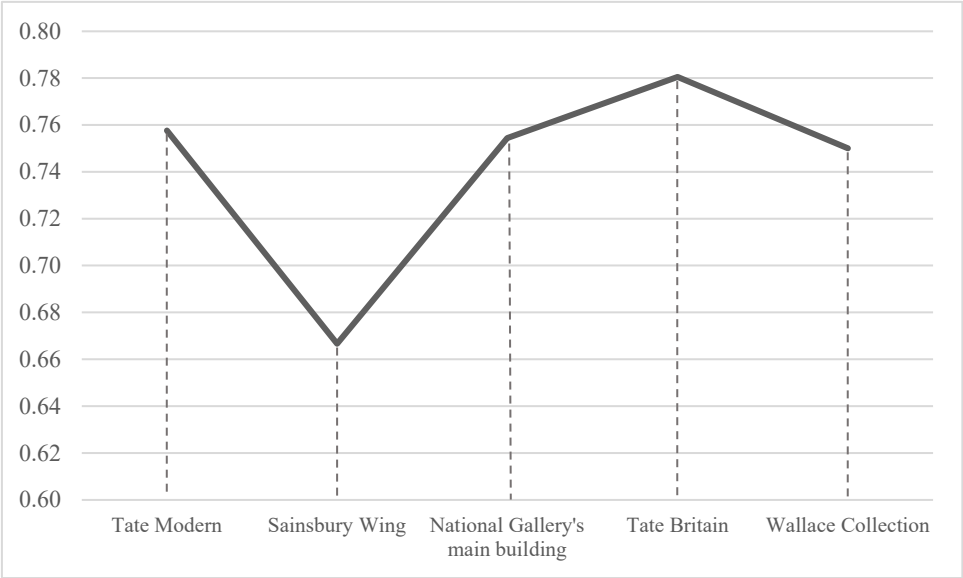

Figure 6.1: Traversability of the British art museums before reopening

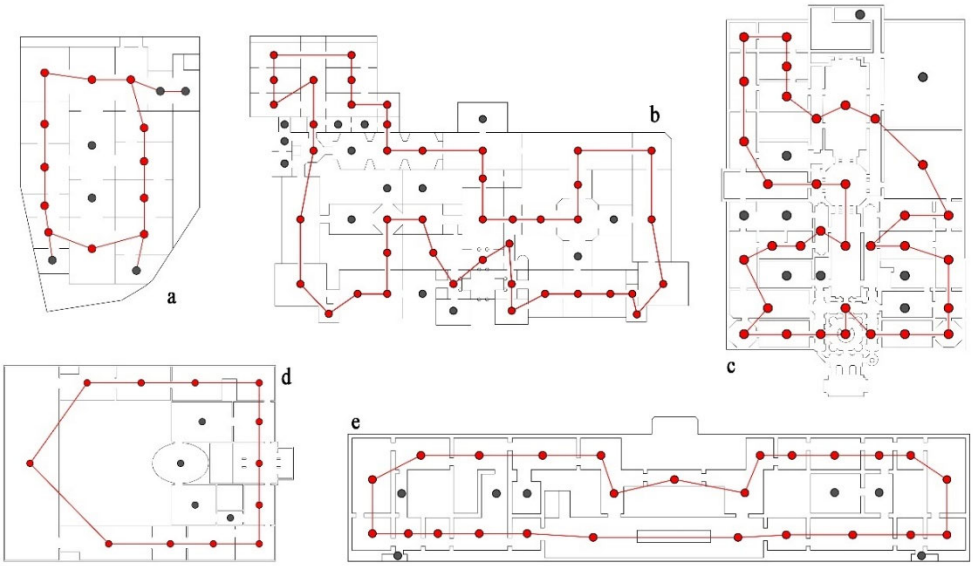

Figure 6.2: Hamiltonian Cycle of the British art museums. (a) Sainsbury Wing, (b) main building of the National Gallery, (c) Tate Britain, (d) the Wallace Collection, (e) Tate Modern

6.3 Reopening of the National Gallery

Reopening on July 20, three one-way routes are taken in the National Gallery, one in the Sainsbury Wing and another two in the main building (Figure 6.3). In order to minimize the closing of display spaces, the two recommended routes in the main building are not technically one-way. Both routes return in some rooms while they also intersect with each other in the central east-west axis. The entrances of the museum are

also limited with one entrance located in the Sainsbury Wing and one exit in the main building. Therefore, people visiting the main building need to enter from the western side via Sainsbury Wing and leave in the centre of the main building (Figure6.3c). It also should be noted that one of the one-way routes in Sainsbury Wing is separated into two paths at the south end. This means visitors need to make a choice between the western and middle path once they have finished visiting the east side. Following the one-way strategy, no returns are allowed once a choice has been made.

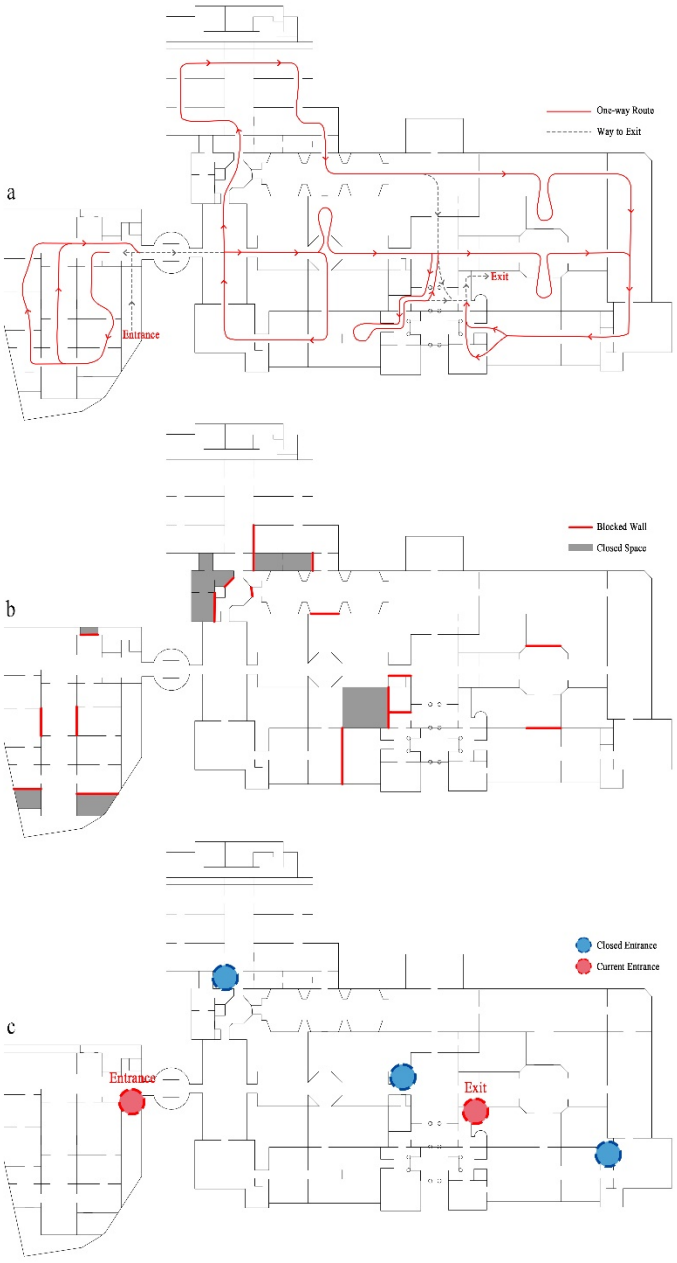

Figure 6.3a: One-way routes in the National Gallery

Figure 6.3b: Blocked doorways in the National Gallery

Figure 6.3c: Entrances of the National Gallery before and after the reopening

6.3.1 The Sainsbury Wing

One of the most significant spatial changes that happened in the Sainsbury Wing is the decreased visual interconnectivity among exhibition rooms. The main vertical axis, which has the highest visual integration before the reopening, loses its connection with the galleries on either side (Figure 6.4). The comparison of spatial types before and after the reopening provides a clearer view of the changes of spatial organization. Because of the blocked doorways, three d-spaces in the centre of the layout turn into c-spaces, thereby losing their role as organising spaces. Starting from the east side, visitors reach the south end without having awareness of the global structure. As a consequence, the decision of choosing to move along the middle axis or go to the west side would be more difficult than previously before the pandemic (Tzortzi 2003).

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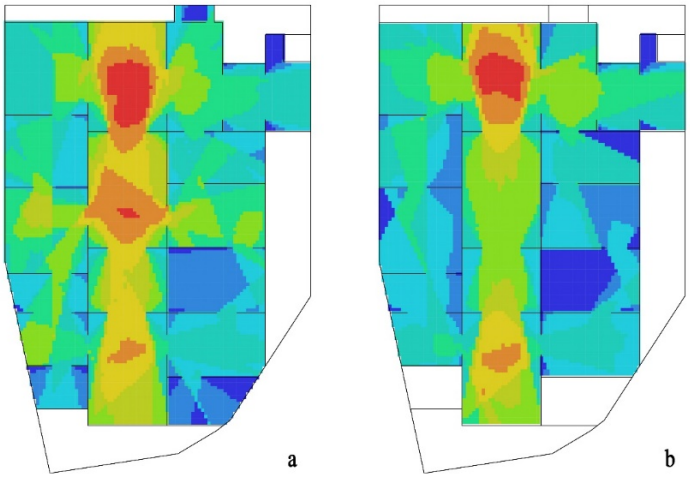

Figure 6.4: VGA of the Sainsbury Wing. (a) before reopening, (b) after reopening.

Figure 6.5: Isovist analysis showing the view of visitors in the exhibition room. (a) before reopening, (b) after reopening.

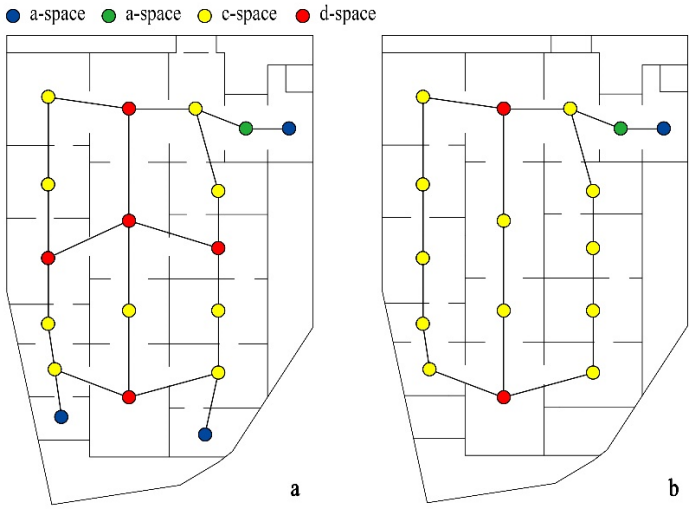

Figure 6.6: Unjustified graph of the Sainsbury Wing, classifying spatial types by colour. (a) before reopening, (b) after reopening

6.3.2 The main building

As mentioned before, the main building of the National Gallery has limited its entrance and exit for the reopening (Figure 6.3c). This study uses step depth analysis to evaluate the spatial changes brought by the closure of entrances (Figure 6.7). Before the pandemic, 75% of the exhibition rooms are covered within three steps of depth from the entrance. After the reopening, the figure drops to 26% while the deepest rooms are 10 steps from the entrance. The elimination of the entrance leads to a clear difference between the west and east side of the layout in terms of step depth, whereas spatial depth was more evenly distributed before the reopening.

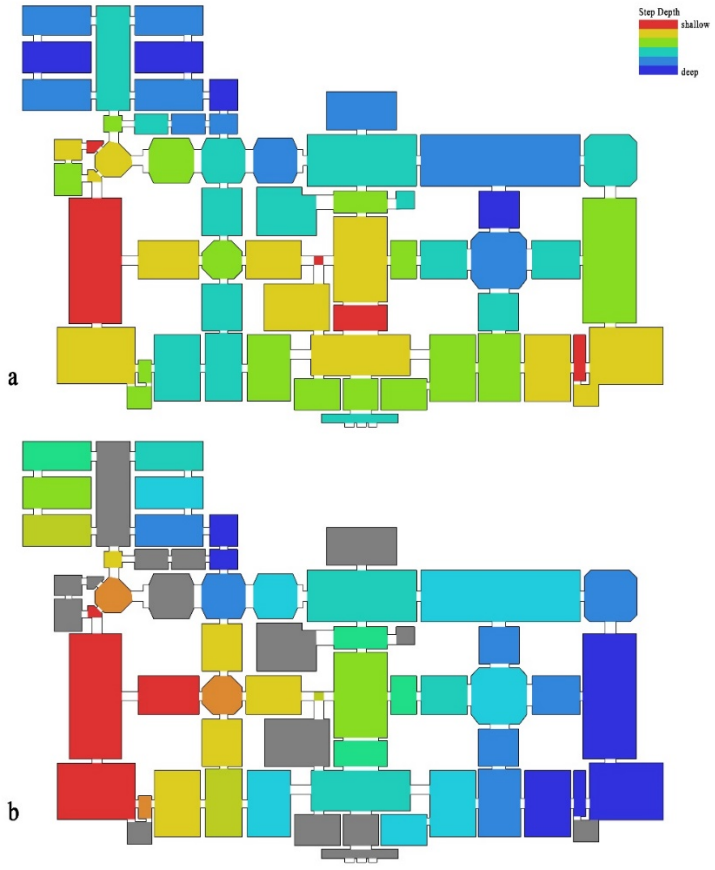

Figure 6.7: Step depth from entrances. (a) before reopening, (b) after reopening.

The result of visual integration analysis presents a grid-like structure of integration centres that cover most of the gallery's layout (Figure 6.8a). Building on the concept of the gathering space, that is, space which is highly integrated and connects global and

local scale, this study argues that the integration cores of the gallery have a hierarchical pattern of arrangement, creating a layered spatial system instead of the binary between global and local. In order to have a better understanding on the gallery's spatial structure, this study borrows the concept of the urban system and proposes a three-part structure consisting of the main centre, a network of subsidiary centres and the rest of the spaces. In this case, the main centres are located on the central axis organising movements towards sub-centres which in turn connect the local spaces (Figure 6.9). After the reopening, connections between the main centres and the sub-centres are cut by the blocked doorways (Figure 6.3b). As the integration centres concentrate on the central east-west axis (Figure 6.8b), there is also a considerable drop of the layout's visual intelligibility from 0.7024 to 0.5631 (R^2) (Figure 6.10). In other words, the initial spatial system before the reopening loses its organisational function and makes the spatial layout less intelligible. Referring to Choi's finding (1999), the spatial occupation will also tend to be unevenly distributed.

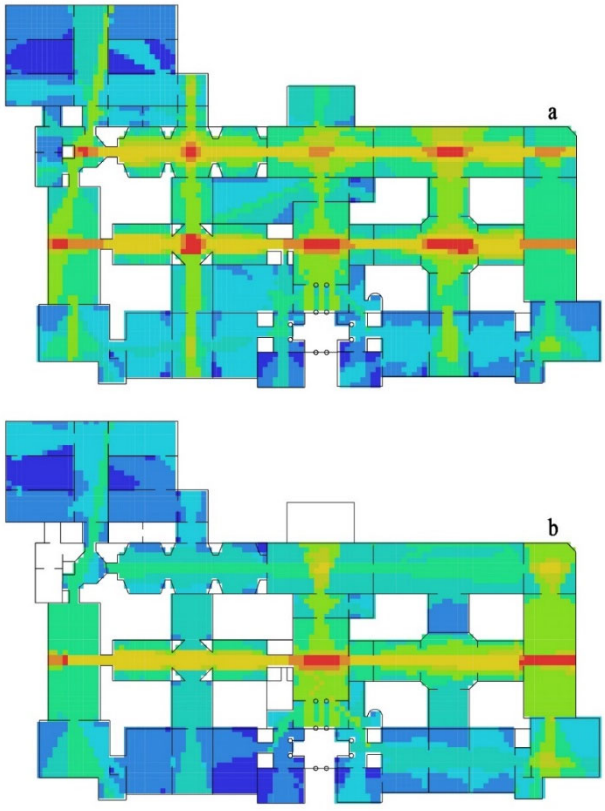

Figure 6.8: VGA of the National Gallery's main building. (a) before reopening, (b) after reopening.

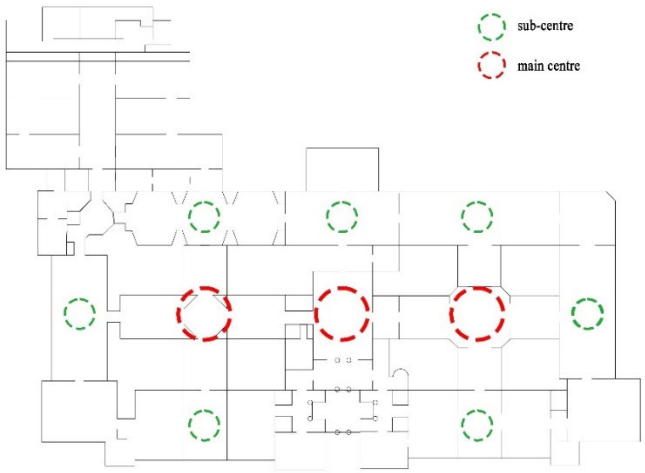

Figure 6.9: Main centres and sub-centres of the National Gallery's main building.

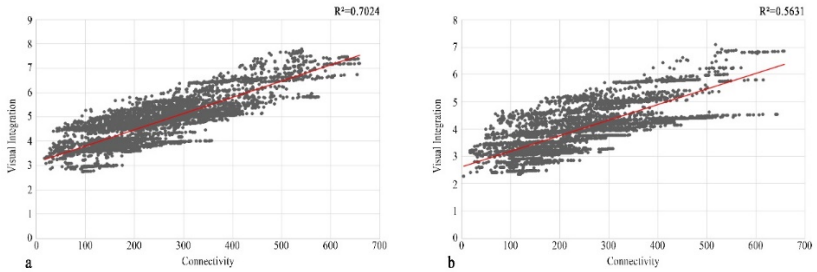

Figure 6.10: Visual intelligibility of the National Gallery's main building. (a) before reopening, (b) after reopening.

The comparison of unjustified graphs before and after the reopening also illustrates changes in spatial configuration and the way it organises movement patterns. D-spaces that used to be evenly distributed in the layout are now concentrated on the main axis, while the proportion of c-spaces in the spatial configuration has risen from 47% to 72% (Figure 6.11a&b). However, it should be noted that although the gallery has blocked off the four a-spaces for the reopening, six new dead-end spaces are created which are changed from c-spaces to a-spaces because of the elimination of connections. This thesis conducts an experiment by reconnecting the a-spaces and finds that the previous structure of d-spaces is re-instated (Figure 6.11c). More interestingly, the visual intelligibility of the layout is even higher than the original plan with the R^2 at 0.7353 (Figure 6.12). Therefore, other things being equal and transmission rates taken into account, it might not be a good option for the National Gallery to change its main building's spatial structure and give up the advantage it already has by organising

movement through its hierarchically organised network of centres. Considering the spatial changes brought by the reopening, such as the imbalanced distribution of spatial depth and reduced levels of intelligibility, this study asks: is the one-way strategy a global solution for all of the museums despite the difference of their spatial structure? At least for the case of the National Gallery's main building, there could be more proper reopening approaches. For instance, developing from the experiment (Figure 6.11c), the visiting route could be divided into multiple sub-cycles and dynamically organised by d-spaces. With higher intelligibility and a more coherent spatial system, the museum would be less likely to see the congestion of visitors along the main axis where paths already intersect, which is also important for ensuring safety.

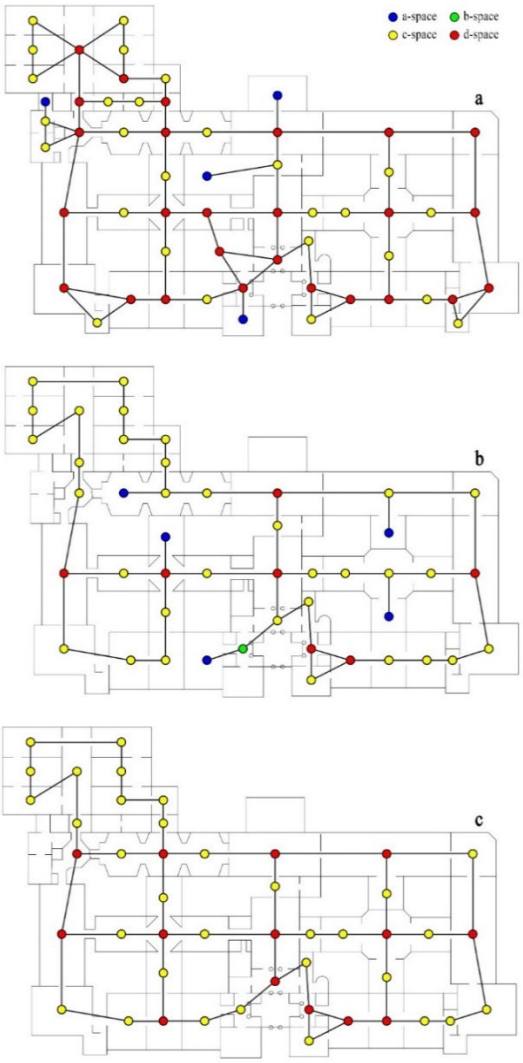

Figure 6.11: Unjustified graph of the National Gallery's main building, classifying spatial types by colour. (a) before reopening, (b) after reopening, (c) the experiment.

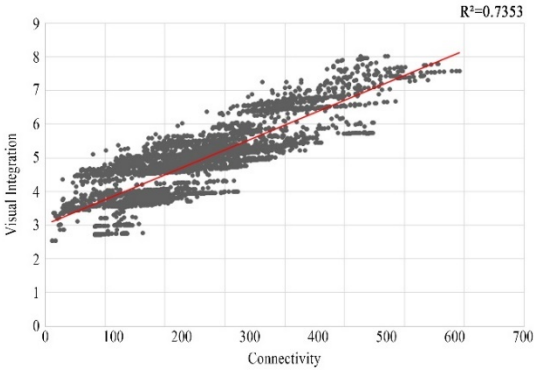

Figure 6.12: Visual intelligibility of the National Gallery's main building in experiment.

6.4 Reopening of Tate Britain

Reopening on July 27, Tate Britain has implemented the one-way strategy more thoroughly in a way that avoids repeated points of path intersection. The museum now offers two collection routes to visitors, organized by the main axis of the building (Figure 6.13a). Both routes are assigned a separate entrance and exit. The themes of the routes, 'British Art 1540-1890' and 'British Art 1930- now', follow a clear historical narrative line while display galleries are arranged based on the trajectory of periods. Figure 6.13b shows that a high proportion of walls have been blocked in this museum, reducing the high levels interconnectivity between sub-cycles which highly praised by Hillier (2019).

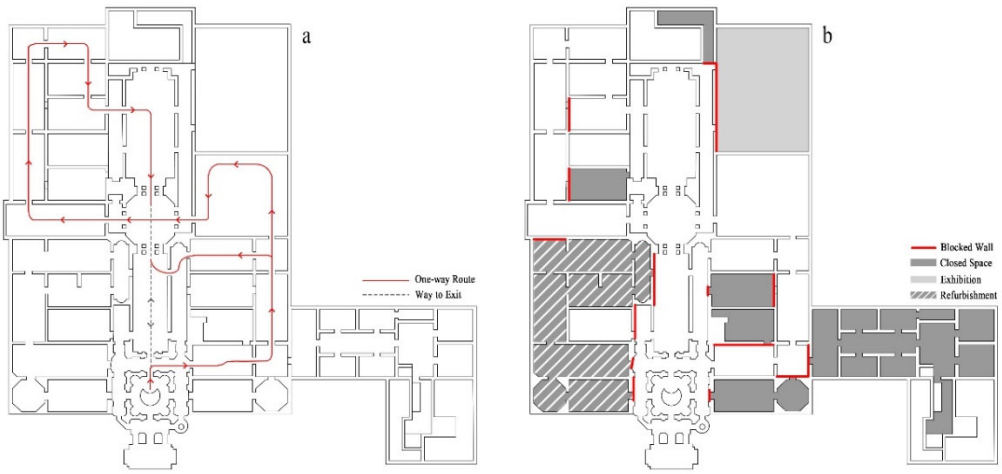

Figure 6.13a: One-way routes in Tate Britain
Figure 6.13b: Spatial changes happened in Tate Britain

In order to ensure the coherence of the historical flow of the narrative, the curators of Tate Britain closed more spaces than are needed to establish a basic Hamiltonian cycle. As shown in Figure 6.14, the collection route in the south-eastern part of the museum follows a chronological sequence, having three additional rooms closed compared to the number of rooms that can provide the ideal Hamiltonian model.

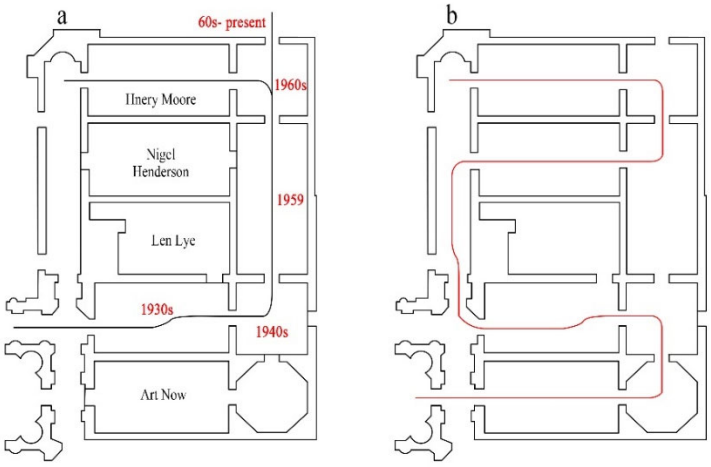

Figure 6.14a: The arrangement of displays in route 'British Art 1930-now'
Figure 6.14b: Ideal Hamiltonian path with only one room closed

Similarly to the main building of the National Gallery, Tate Britain has a grid-like structure of integration centres (Figure 6.15a). Building on the three-part system that has been proposed, we see that the central axis of the gallery serves as the main integration centre that is interconnected with sub-centres on the west, south and east sides of the building which rank second in values of visual integration. Applying the one-way strategy for reopening, the museum has changed the function of its main axis, from the previous condition which provided movement options for visitors covering both at the local and global level to the current condition of enforcing choice of sequences on the global scale only. From the point of view of changes of spatial types, like the National Gallery, Tate Britain has limited the d-spaces to those located on the main axis (Figure 6.16). However, what makes the spatial configuration different from that of the National Gallery is that the sub-cycles in Tate Britain are strongly sequenced with the entrance and exit assigned by the curator. Once they make a choice along the main axis about which route they want to visit, visitors can only finish a sequence and get back to the axis. In other words, Tate Britain's present organization of movements

are heavily relied on the main axis, with sub-cycles that are not intersecting with each other. This study suggests that the changes that happened in Tate Britain illustrate that after reopening Tate Britain come close to Huang's model of modern museums with a 'deep integration core and strong sequence' (Huang 2006). Each sub-cycle of Tate Britain is assigned a historical theme which is enhanced by the sequenced spaces. The style of the visiting experience thus changes from one where the rings of circulation guide the encounter of the visitors with the exhibits to one where the pre-decided educational message structures the visit, that is from a spatial to a conceptual pattern. Instead of exploring the museum guided by space, visitors in Tate Britain now are guided by the pre-figures sub-cycle, determining where to enter and leave the route. Taking into account the views of the curator of Tate Modern in the following section, the social role of Tate Britain shifts from an informal and relaxed to one that is guided and controlled in the spirit of commercial social practices.

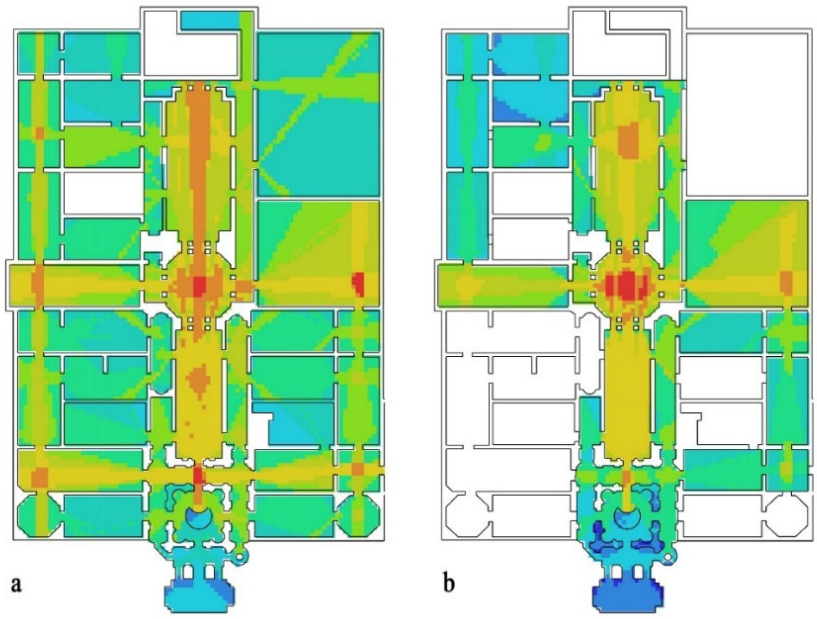

Figure 6.15: VGA of Tate Britain. (a) before reopening, (b) after reopening.

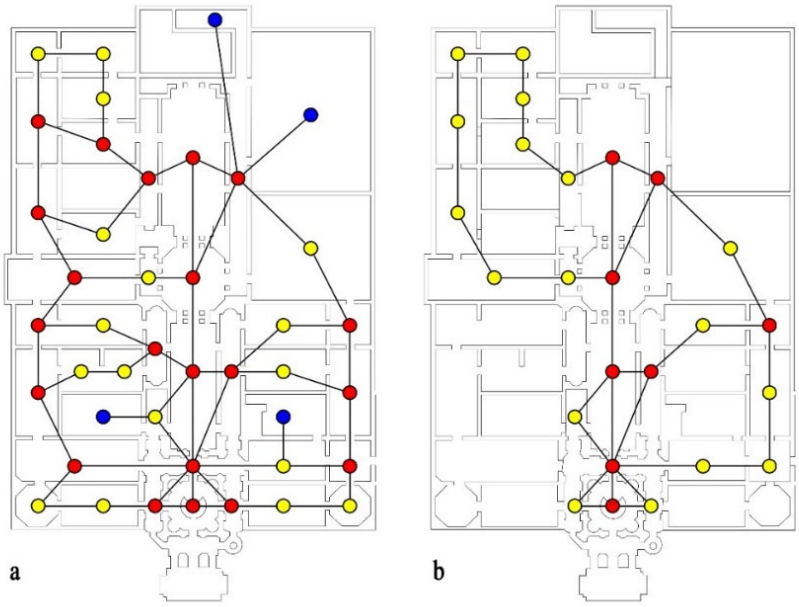

Figure 6.16: Unjustified graph of Tate Britain, classifying spatial types by colour. (a) before reopening, (b) after reopening

6.5 Reopening of Tate Modern

> *"One of the things that the architects did was they very specifically set out to create galleries that flowed into each other…… One of the things that I was absolutely clear about for Tate Modern is that I didn't want too much visual clutter. A lot of museums have put lines all over the floor and, you know, they kind of look like supermarkets. So what we've done at Tate Modern is its minimal signage and where it is you really have to follow it…… It is quite a clear message about how to negotiate the building. We found that our spaces are very suited to this kind of operation." (Director of Tate Modern, Frances Morris, Interview with The Voice Newspaper, August 2020)*

Applying a similar strategy with that of Tate Britain, Tate Modern uses its escalator space to organize one-way routes (Figure 6.17a). Compared with the National Gallery and Tate Britain, Tate Modern has introduced fewer spatial changes with a few closed doorways and rooms for preventing people from going in a reverse way (Figure 6.17b). According to the author's interview with Tate Modern's information assistant, Katarzyna Rakowska, the museum is still actively looking at ways to adjust the spatial layout based on the feedback from visitors' movement patterns after the reopening. This study suggests Tate Modern provides more flexibility in terms of the arrangement of the one-way route than the other museums for the reason that its displays are formed

independently of chronological sequence. The moving sequence in the western rooms, for instance, is now arranged in a way that reverses the direction recommended before the reopening (Figure 6.18).

Figure 6.17a: One-way routes in Tate Modern
Figure 6.17b: Spatial changes happened in Tate Modern

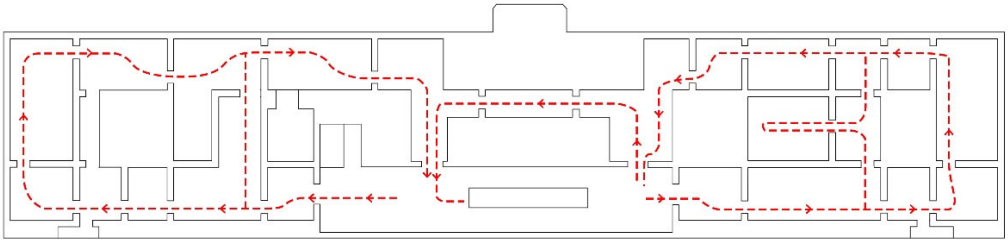

Figure 6.18: Recommended directions of route before reopening

The distribution of visual integration in Tate Modern after reopening is not significantly different from that of the original layout, apart from the decreased integration values in the north part (Figure 6.19). Looking at the changes in spatial types, after applying the one-way strategy, all of the spaces are now c-spaces (Figure 6.20). In fact, among all the museums this study has investigated, Tate Modern is the only one that has successfully achieved the Hamiltonian cycle.

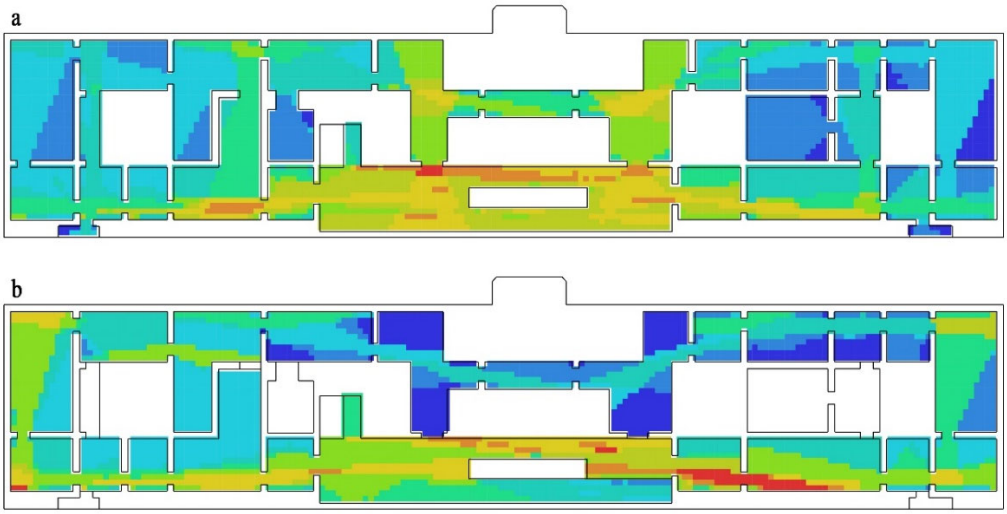

Figure 6.19: VGA of Tate Modern. (a) before reopening, (b) after reopening.

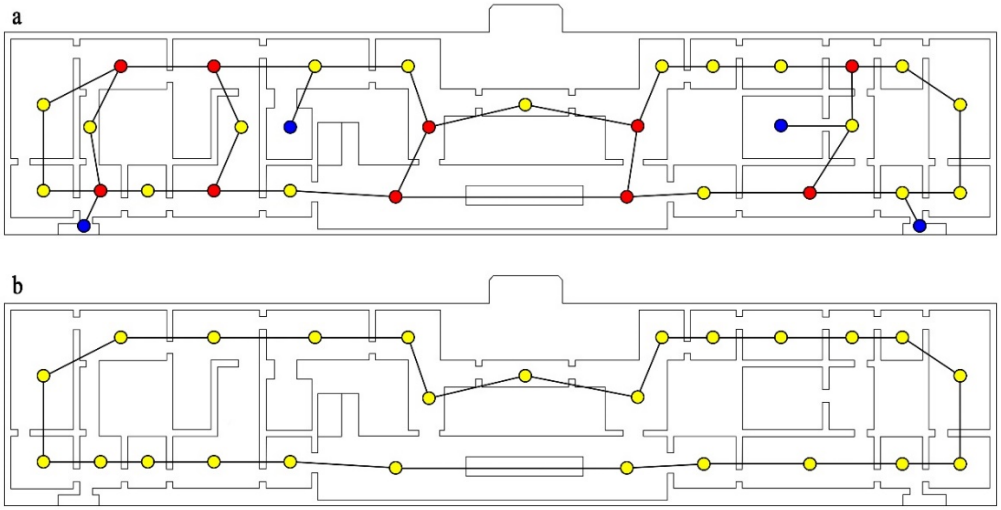

Figure 6.20: Unjustified graph of Tate Modern. (a) before reopening, (b) after reopening.

6.6 Reopening of the Wallace Collection

Previously owned by a private collector, the Wallace Collection is now a national museum exhibiting European collections from the 15th to the 19th century. The museum is much smaller compared to the other cases and has a large main-sequence intersecting with an inner sub-cycle (Figure 6.21a). The one-way strategy that the Wallace Collection has taken for reopening is also different. Instead of defining a Hamiltonian path through closed spaces and doorways, this museum orients a single-directional path starting from the entrance in the south to the exit in the west side (Figure 6.21b). As a consequence, the c- and d-spaces before reopening are turned into b-spaces (Figure 6.21e&f). By doing so, the Wallace Collection's spatial changes are also minimal, with only three spaces been closed. Similar to Tate Modern, the arrangement of displays in the Wallace Collection does not follow any narrative. Due to the small

size of the collection, displays are simply arranged by themes such as decorative arts, French paintings and furniture. Since there was no chronological or thematic sequence of the exhibits, this study suggests that the effect of the oriented visiting sequence on visitors' experience after reopening will also be minimised.

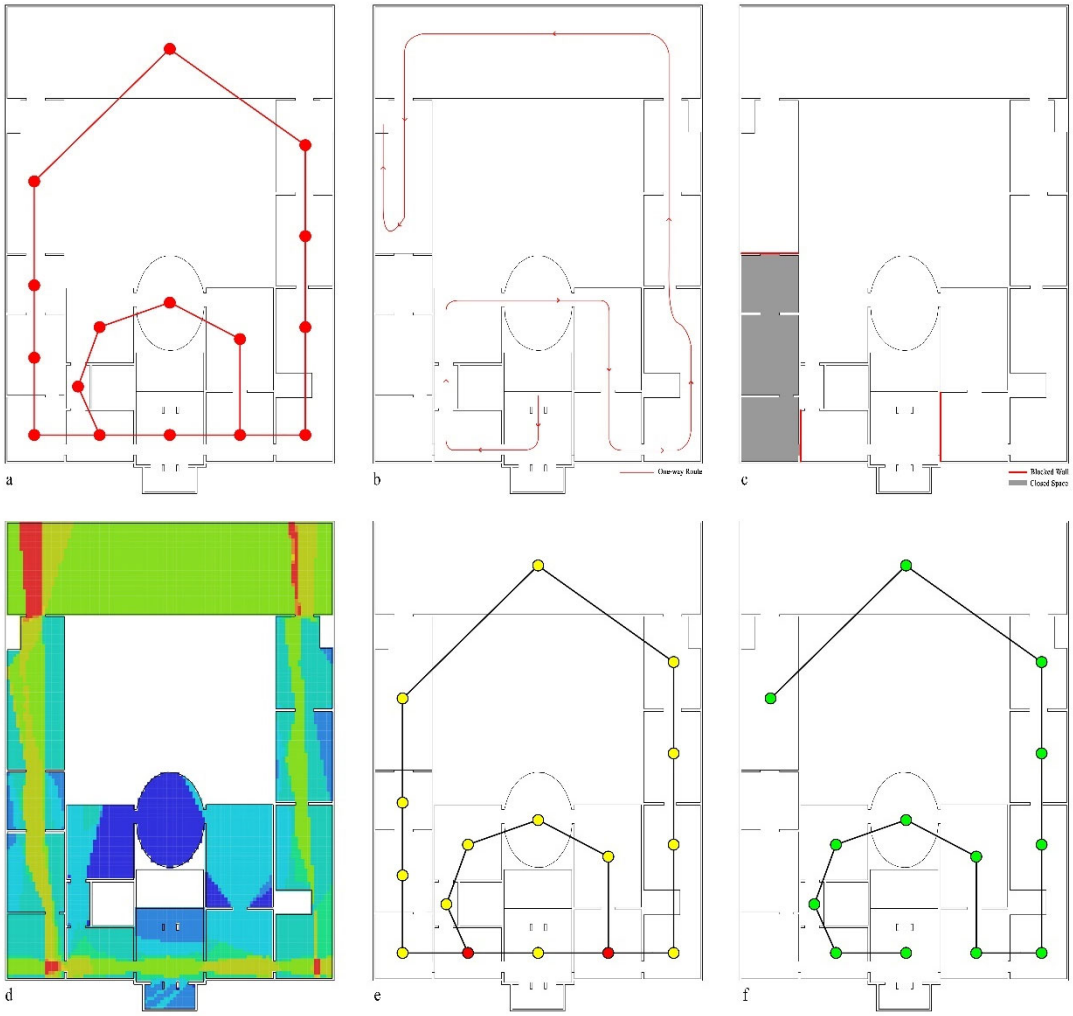

Figure 6.21: Analytical graphs of the Wallace Collection. (a) unjustified graph of initial layout, (b) one-way path after reopening, (c) spatial changes, (d) VGA of the museum before reopening, (e) unjustified graph before reopening (coloured by spatial types), (f) unjustified graph after reopening (coloured by spatial types).

Chapter 7: Correlations between Spatial Types and Traversability

This chapter measures the degree of correlation between spatial types and traversability value of the layout of museums. The Wallace Collection is not included in the comparison as the size of this museum is smaller than the others. It is noted that this is a preliminary study and more cases should be added to the sample for a statistically reliable result. However, it is the first test of Hillier's theoretical model in the 2019 paper proposing that a high number of d-structures and c-structures characterise layouts with the highest traversability values.

Figure 7.1 shows that that layouts with a higher proportion of d-spaces, the number of d-spaces divided by the total number of spaces in the layout, tend to have higher traversability values, confirming Hillier's proposal about d-spaces (R^2=0.8359). In contrast to Hillier's model about c-spaces, the correlation between the proportion of c-spaces and traversability values is weak (R^2=0.1889). Based on Hillier and Tzortzi (2006) suggestion that the balance between c-spaces and d-spaces is the crucial factor influencing visiting experience, this thesis also calculates the ratio of the number of c-spaces to d-spaces and find that there is a high negative correlation with traversability value (R^2=0.8371). In other words, the higher the number of d-space compared to c-spaces, the better museums can adjust to a Hamiltonian path, which is closely associated with traversability, and to the one-way strategy.

However, does this result illustrate that as long as museums increase the interconnectivity of spaces, they can get better levels of traversability? In order to answer this question, this study calculates the correlation between the number of connections (doorways) divided by the number of spaces within the layout and traversability (Figure 7.1d). The weak correlation between the two variables (R^2=0.3395) suggests that simply enhancing spatial interconnectivity by opening more doorways is not an ideal approach to the increase of traversability. Figure 7.2 shows the

experiment conducted by Hillier about spatial types (Hillier 2019). While all nodes in the left graph are c-spaces, the right graph has three d-spaces with the traversability at 1, which is higher than the figure for the left (0.57). Therefore, this thesis argues that it is the arrangement of d-spaces in the spatial layout that contributes to the museum's traversability. A detailed discussion will be provided in the following chapter with a focus on the c- and d-structures.

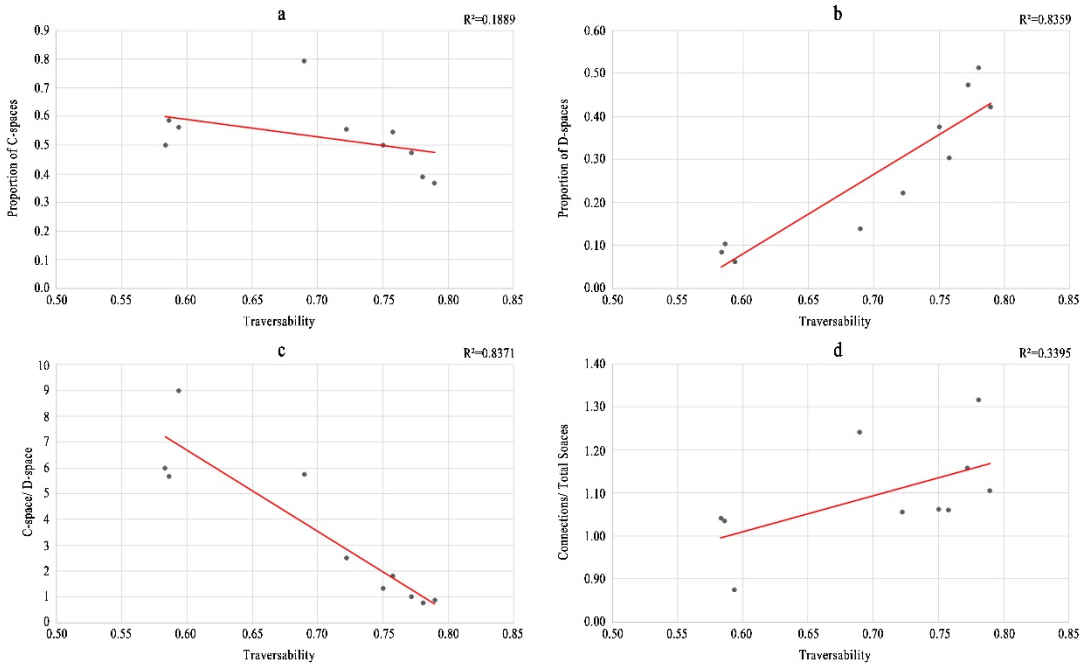

Figure 7.1: Correlations between spatial properties and traversability. (a) proportion of c-spaces (R^2=0.1889), (b) proportion of d-spaces (R^2=0.8359), (c) quotient of the number of c-spaces and d-spaces (R^2=0.8371), (d) quotient of the number of connections between spaces and the total number of spaces (R^2=0.3395)

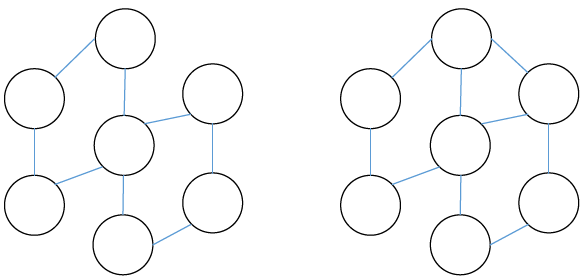

Figure 7.2: Hillier's experiment about spatial type (Hillier 2019). All nodes in the left graph are c-type while the right graph has 3 d-type nodes.

Chapter 8: Discussion

8.1 Spatial structure and traversability

As suggested by Hillier (2019), both c- and d-structures have the highest traversability at 1. Theoretically, this means that a spatial layout with a cyclical form or a grid form does not need to close any connections between spaces in order to have a Hamiltonian path. However, in practice, the spatial arrangement of museums is often more complicated with dead-end spaces and sub-cycles, especially large and complex museums. Among the museums this study has investigated, the fifth floor of the MoMA in its 2005 version, and Tate Britain have the highest levels of traversability than the other layouts, at 0.79, and 0.78 respectively. This study suggests that while the 2005 MoMA illustrates how the spatial organization of a complex c-structure can have higher levels of traversability, Tate Britain has higher levels of adaptability to strategies specifying one-way route.

As mentioned in Chapter 2, Psarra proposes (Psarra et all 2007, Psarra 2009) that the expansion of MoMA in 2005 expressed Alfred Bar's original narrative of Modern Art as a dual trajectory (the 'rational' and 'intuitional' thematic lines) through the spatial arrangement which interconnects sub-cycles connecting exhibition rooms which showcase the rational theme, to the main sequence that presents the intuitional theme. Sub-cycles are locally organised by d-spaces through which visitors are able to take a detour and move back to the main sequence after their exploration (Figure 8.1b). As for Tate Britain - the d-structured museum as defined by Hillier (2019) - a clear global network composed of d-spaces, consisting of centres and sub-centres, covers the whole layout with local-scale connections through a series of c- spaces intervening between the d-spaces at the centre and the edges of the building. In both buildings, d-spaces play an important role in constructing the global structure as well as interconnecting global-scale and local-scale movement. This dissertation argues this is the reason for which the proportion of d-spaces and the ratio between c-spaces and d-spaces have a high

correlation with the traversability of the layout. Proper use of d-spaces and their relational logic with c-spaces in spatial design will not only give rise to social co-presence and encounter in the process of visiting, as Hillier suggests (Hillier 2019), but also increases the adaptability of the layout to Hamiltonian paths.

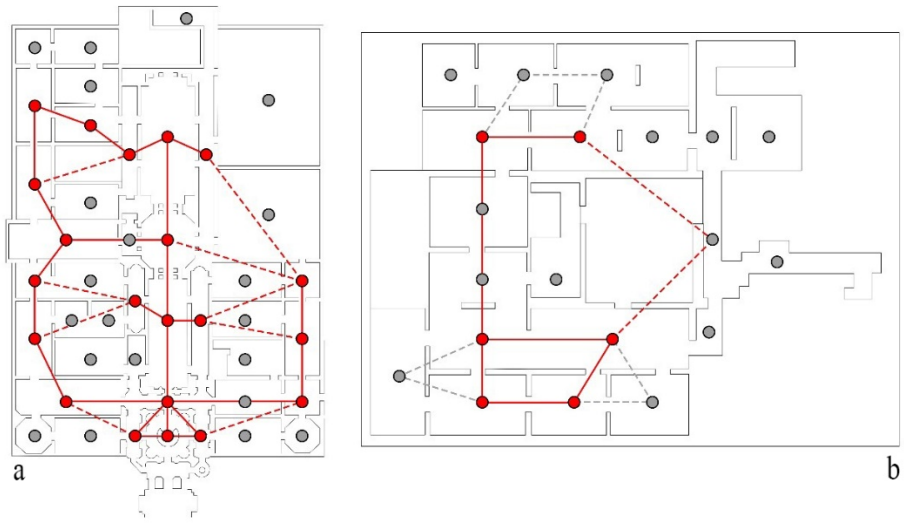

Figure 8.1: Unjustified graph showing connections between d-spaces and intervening c-spaces. (a) Tate Britain, (b) fifth floor of MoMA in 2005

8.2 The effect of spatial system

Apart from the types of spatial structure, the different implications of the one-way strategy in the British museums illustrate the importance of the spatial system in the reopening. In contrast to the lack of organisational connections in Sainsbury Wing as suggested by Tzortzi (2003) and discussed in Chapter five, the spatial systems of the National Gallery's main building and Tate Britain are found to have stronger control on people's movement. However, different changes that happened in the two museums illustrate that there is a three-layered system rather than simply a local-global system, with an additional layer of sub-centres in between the main centres and the local spaces. Figure 8.2 shows schematic diagrams of the spatial structure of the museums' layouts before reopening. The spatial organisation of integration in the National Gallery hierarchically transfers movement from the main centre along the east-west axis to the sub-centres and then to local spaces found at the periphery. In contrast, the local spaces

in Tate Britain are situated in between of the main centres and sub-centres. Therefore, since in the main building of the National Gallery the connections between its main centre and sub-centres are blocked, the relation between global-scale and local-scale movement is weakened. As a result, the spatial layout becomes less intelligible. On the other hand, in both the National Gallery and Tate Britain, although the sub-centres have changed to c-spaces (Figure 6.16b) and lose their organizational role in the system, the main centre retains its power in distributing movement since it has direct connections with local spaces.

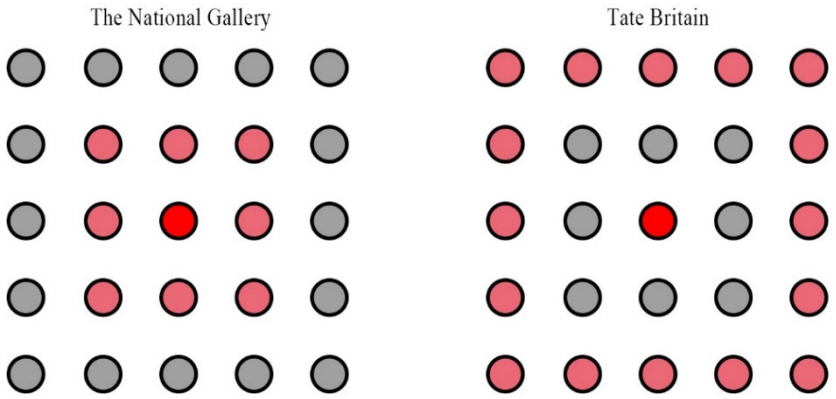

Figure 8.2: Schematic diagrams of the spatial structure of the National Gallery and Tate Britain's layouts before reopening

8.3 The effect of the display arrangement

In the British art museums, the curators' intention about the arrangement of the exhibition also plays an important role in the modification of spatial configuration based on the reopening strategies. This study proposes two curatorial factors that influence the architectural experience of museums as well as the spatial changes for reopening: whether the narrative is linear and if the meaning of the display has been pre-given (Figure 8.3). As suggested by Tzortzi (2007), the visitors' understanding of exhibitions is more likely to be varied in museums which spatially encourage exploration. Based on the case studies, this dissertation argues that the spatial layouts of Tate Britain, the National Gallery's main building and the MoMA 2005 provide visitors with potential for individual experience. On the other hand, the limited number of alternative sequences in Tate Modern, the MoMA 2019 and the Sainsbury Wing are

more likely to express an educational message and aesthetic experience that are pre-designed.

Although similarly changing to a linear sequence with a chronological narrative after reopening, Tate Britain and the National Gallery's main building present different approaches to adapting to changes due to the pandemic. Sequenced narratives had existed in Tate Britain before the pandemic, but were weakened by the spatial configuration which encouraged self-exploration. As suggested in Chapter six, the changes that happened in Tate Britain are mainly directed by the chosen narratives of the exhibition sequences, since the museum blocks more spatial connections than a Hamiltonian cycle needs (Figure 6.14). On the other hand, having no initially sequenced narrative, the one-way routes in the National Gallery's main building creates a new narrative. Since the one-way strategy forbids free exploration, all British art museums are now offering pre-designed visiting experiences based on their curators' intention.

To summarise, it is suggested that the spatial structure of museums determines their spatial capability for adapting to the necessary changes for one-way circulation based on d- and c-spaces. Furthermore, the interrelationship between the global and local network of spaces (d- to d- spaces, d- to c- spaces and to the rest of the spaces) determines to what extent the one-way routes can be applied. Associated with spatial properties, the narrative of the display arrangement further carries the potential to affect the organisation of the routes limiting or optimising the available sequences to define the spatial, educational and aesthetic experience.

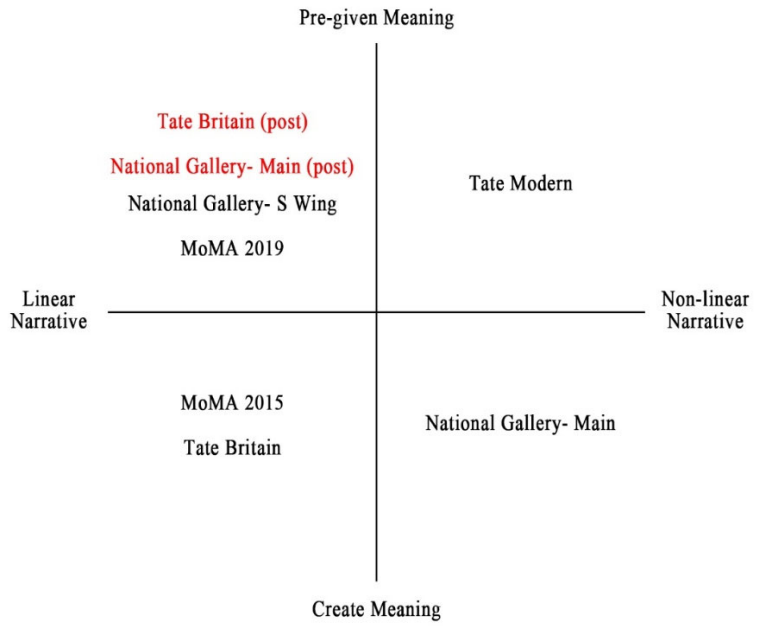

Figure 8.3: Types of investigated museums' display arrangement.

8.4 A dynamic strategy instead of one-way circulation

Aside to the one-way strategy that British museums are applying, there might be an alternative solution for controlling congestion through curatorial and technological interventions on route choices. The National Gallery's main building, for instance, is expected to have a more intelligible organization of movement patterns if the spatial interconnectivity is not weakened while visitors are guided by dynamic instructions provided through audio-equipment or signages in the main centres and sub-centres. Developing from the previous discussion about d-space and spatial structure in Chapters six and seven, this study suggests that the distribution of d-spaces inside the layout and the connection between global and local spatial network are the two factors that determine whether the spatial configuration of museums is able to accommodate such dynamic strategy. Even in the future when social distancing is no longer important, the joint operation of spatial configuration and curatorial interventions, such as customised visiting route and defining no-go zones where the density of people has reached the top line, will still contribute to improving over-crowdedness and other potentially undesirable situations.

8.5 The spatial culture of art museums in post-COVID-19

It is still arguable whether the relationship between museums and visitors is going to have a permanent change because of the pandemic. However, the responses of the British art museums this study has investigated, reflect in some sense Huang's proposal that the role of museums is gradually transforming from educational to commercial environments. The powerful spatial control at the global level achieved by Tate Britain, and the strong sequences with pre-given meaning provide visitors with an experience that has been pre-structured before they even begin their exploration inside the building. While the museums are changing both spatially and curatorially, visitors are likely to be more knowledgeable as well, since virtual museums are recently becoming popular and people can have a pre-visit online before they pay the actual visit. Whether the museums are used to be the 'machine of showing art' (Serota 1995:32) or 'civil education authorities' (Hulten, 1974), it is necessary for curators to understand the transformation of spatial cultures in terms of the new spatial-curatorial arrangements as well as in the visitors' attitudes and profiles.

Chapter 9: Conclusion

This study has investigated the influence that the outbreak of COVID-19 has brought on four British art museums and one American art museum. While the spatial effect on movement patterns has been emphasized by curators around the world for the control of virus spreading, British art museums synchronously chose the one-way circulation strategy for their reopening. Based on the findings from the analysis of spatial changes in these museums, a spatial-curatorial evaluation system is proposed for examining the current reopening approaches and the likely effects on the future spatial design of museums.

Building on Hillier's theory of spatial structure (Hillier 2019), the use of d-spaces in the spatial configuration is suggested to be the determinant factor that not only influences spatial exploration and navigation but also plays an important role in the social and aesthetic construction of meaning together with exhibition arrangement. Similarly to the dual-network of urban streets (Hillier 2003), this study has found that there is also a dual-, sometimes three-layered, network in the spatial layout of museums. While the d-structure serves as the foreground network, the way in which global and local structures interconnect with each other affects the exploration patterns of visitors and the adaptability of museums to restrictions introduced by the pandemic. Different from Hillier's proposal that the d-structure, which tends to be more grid-like, has more advantages to create dense patterns of social encounters, this study argues that what really matters is the cooperation between curatorial approaches to narrative and spatial networks. With the proper socio-spatial arrangement, museums which have predominantly a c-structure in their layout, such as the fifth floor of MoMA 2005, will also give rise to the social meaning and have the capability to face the necessary spatial changes in the meantime.

There are two limitations to this study. First, the art museums this study has investigated are all large museums with a considerable amount of displays. Therefore, a pure c-structured spatial layout is not likely to be seen in these museums. In fact, small art museums which often have only one sequenced visiting route do not need to adapt to many spatial changes even if there are no d-spaces in their spatial configuration. The Wallace Collection in London, for example, has traversability value at 0.75 and successfully chooses the ideal one-way route because of its initially single-sequenced rooms with small a number of collections that cannot add up any coherent narrative. The second limitation is the lack of observational studies in this thesis collecting empirical data during the reopening museums, due to the lockdown and fieldwork restrictions imposed by the University. In a future study, it would be essential to test the theoretical model that this study has proposed with the data from on-site work. Examples of this data would aim to identify how visitors choose routes in the south end of Sainsbury Wing and how people in Tate Britain use the gathering space along the main axis after reopening.

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