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AN ANALYTICAL TOOL TO SUPPORT THE PEDESTRIANISATION PROCESS

THE CASE OF VIA ROMA, CAGLIARI

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ABSTRACT

The article focuses on the case of the modification of an urban road network: the transformation of a portion of an important distributor road in the urban area of Cagliari into a pedestrian space. By means of this case study the article aims to point out how the conditions of hierarchy constitute a supporting tool for controlling and verifying the project of pedestrianisation. This analysis uses the fundamental conditions of hierarchy as a tool to assess to what extent the modification of the road network articulation has resulted in conditions of lesser inter-connectivity, legibility and functionality.
This analysis evidences that pedestrianisation interventions have not been completely defined within a theoretical system that clearly establishes modes and conditions of implementation. In this perspective the article proposes a system of criteria, founded on the principles of hierarchy, meant to be a theoretical support for processes of pedestrianisation.

KEYWORDS:
Hierarchy, arteriality, constitution, configuration, network.

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支持行人专用区进程的分析工具罗马

卡利亚里案例

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摘要

本文聚焦在城市道路网络改造的案例：将卡利亚里市区的重要干路的一部分改造为步行空间。通过对这一案例的研究，本文旨在指出层次结构条件是如何为控制与证实行人专用区项目构成一个支持工具。本分析使用了层次结构的基本条件作为一个工具来评估道路网连接的改造在多大程度上能够导致连接性、易可识别性与功能性降低的条件。
分析表明行人专用区干预在明确建立实施方式与条件的理论体系中未能被完全界定。从这个角度来看，本文提出了一个建立在层次结构原则之上的标准体系，旨在为行人专用区进程提供一个理论支持。

关键词：
层次结构，干路（干道），构造（章程），结构（布局网络

1 INTRODUCTION

Contemporaneity is denoted by the rediscovery of the porous character of territories, that urges the research of different modes of interpreting, conceptualising and organising mobility networks (Secchi, 2005). The isotropic structure of environmental networks, of cycling and pedestrian paths, open spaces and mass transport, is regarded as the foundation of a porous and permeable configuration of territories; this spatial organization is the condition for redistributing the spatial capital, increasing resilience of urbanised territories, restoring continuity between different ecological systems and increasing the plurality of modes of practicing spaces. (Alexander et al., 1977; La Cecla 2014; Jacobs, 1961; Gehl, 1987; Salingaros, 2005; Secchi, 2013). In this last instance, particularly, are encompassed the modification of the relationships with one's own body and space (Secchi, 2000), the transformation of leisure time (Donini, 2008; Magris, 2005), the rediscovery of the significance of usual local-scale practices as opportunities for encounters generative of original identities, codes, ideas (BenjaminElliott, 2011, Jacobs, 1961; Alexander et al., 1977; Gehl, 198791; Salingaros, 2005a;b; Tonucci, 2005; Secchi, 20142013; La Cecla, 20152014, Tiboni & Rossetti, 2012).

A question emerges, related to the discontinuities determined by the primary distribution networks – and by their constitutive discrete elements (Secchi 2005, 20142013, Bianchetti 2014). This question meets the criticism to some figures on which the network articulation is based and the search for alternative metaphors and paradigms (Ventura 1989, Magnani & Val 1989; Magnani, 2005, Viganò 2010). As a consequence, an instance of domestication of main transport infrastructures arises: it often results in transformation policies of large mobility spaces routes – or of portions of these – into multi-functional pedestrian spaces.

When these interventions modify the hierarchies on which road patterns and relations between different modes of movement are established, they lead to conditions of lesser functionality of transport networks: pedestrianisation strategies have not been fully defined within a coherent theoretical system meant to establish fundamental criteria, conditions and modalities of implementation.

This article presents and analyses the case study of the partial pedestrianization of an urban arterial road, in Cagliari. This analysis points out how hierarchy is a fundamental condition of some desired structural properties of transportation networks: coherence, legibility, inter-connectivity of road patterns, and safety and fluidity of circulation (Jiang, 2009; Marshall, 2005; 20142016; Salingaros, 2005; Xie & Levinson, 2007; Yerra & Levinson, 2005). Moreover, it infers, from the structural conditions of hierarchy, a qualitative method for control and appraisal of the project of pedestrianisation from the structural conditions of hierarchy.

The article consists of four sections; the first one introduces the case study and describes trans-scalar transformations induced on the mobility network by the partial pedestrianization of via Roma. These transformations are thus attributed to alterations in the hierarchical structure of interdependent and non-discursive (Hillier, 1996) relations between different routes. The second section, thus, defines the notion of hierarchy, related to transport networks, and identifies its fundamental conditions; the purpose is to show evidence that hierarchy is the condition of some desirable networks structure properties. The subsequent section identifies the cause of the discontinuity of minor networks; it proposes a hierarchy of modes of movement, based on speed bands, as a criterion for defining the relationships between different modes of interaction simultaneously present along a route. The fourth section describes a qualitative analytical method, based on the conditions of the hierarchy, and describes its application to the case study. The conclusions reflect on the findings of the previous sections and consider their potential as criteria for the definition and implementation of regeneration actions in road networks links.

2 HIERARCHY

As stated by Marshall (2005), in order to define hierarchy, a preliminary consideration concerning the distinction between the different dimensions of structures is required: *composition*, which refers to the metric

characteristics of a system; *configuration*, related to its topology; and *constitution*, which identifies distinct types of elements and determines their relations of interdependence. This distinction results in the definition of hierarchy as a structure of types (Marshall, 2005) and, more precisely, as a particular form of constitution, identified by four specific structural conditions: 1) differentiation of components; 2) ordered ranking of elements; 3), arteriality or necessary connections and 4) access constraint that restricts admissible connections only to those established between elements of the same type or complementary, i.e. whose rank diverges of just one position (or degree). Arteriality, in particular, is a fundamental feature of road networks: the contiguity of routes that constitute strategic itineraries at a specific level of scale. Thus, a network could be conceptualized as a structure of contiguous and complete sub-networks of different scales. Arteriality is the implicit fundament of any relevant functional classification of roads, since it is a category by which the specific function of each arc can be recognised in relation to the network, and referred to the dimension of the geographic realm served.

Some measurable properties have been identified to derive the function of each route from the analysis of the network configuration: *cardinality*, determined by observing the conditions of continuity and termination in the nodes of each route (Marshall, 2016), and *betweenness*, that measures the significance of each arc as a bridging element between distinct topological shorter paths (Jiang, 2009).

2.1 FAVOURABLE PROPERTIES OF A NETWORK

A road pattern that satisfies the structural conditions of hierarchy also possesses two fundamental desirable properties of networks (Marshall, 2005; Xie & Levinson, 2007): *legibility* and *inter-connectivity*. These properties are related to the user experience and determine individual behaviors and route choices, whose interaction defines the distribution of flows (Xie & Levinson 2007).

Legibility determines to what extent it is simple to gather the structure of a network. Arteriality and access constraint are fundamental features that allow users to determine their position within the network, according to the status of the route along which they proceed (Marshall, 2005). This condition thus implies the recognisability of the type, hence of the rank, of each route.

Inter-connectivity depends on the number, type and pattern of routes and intersections. Inter-connectivity can be measured as a function of the perceived continuity of movement across a network: this, in turn, is determined by measuring the number of transfers between roads of different classes (Xie & Levinson, 2007): as arteriality implies contiguity of strategic routes, it also ensures continuity of movement within the sub-network of primary distribution, thus resulting in an increased inter-connection of the entire system. However, this formulation of the continuity variable doesn't consider that the crossing of an intersection in case of vehicular mobility - even if between routes of the same class - results per se in an increased path discontinuity, due to the inconvenience associated with variations of speed and direction. Salingaros (2005) observes that, beyond a certain dimension, in an isotropic network of local-scale routes, the number of nodes traversed during a generic trip increases to the point of resulting in a perception of greater discontinuity and of decreased network connectivity. The introduction of larger scale elements and their configuration within a contiguous sub-network result in an increase of inter-connectivity and path continuity. Thus, the requirement of ensuring continuity implies the reduction in the number of accesses to the main routes and the spacing of consecutive intersections: it results in the configuration of arterial roads as discrete elements (Pisano, 2016, 2018) and, as far as vehicular mobility is concerned, in the requirement of ensuring conditions of access constraint.

Levinson and Yerra (2005) also demonstrate how hierarchy is an emerging property of complex systems: an isotropic network tends to modify and self-organize according to a hierarchical constitution. Jiang's analyses (2009) demonstrate the validity of this hypothesis by verifying the power laws informing the distribution of size and frequency of some fundamental variables related to the form or function of the routes in a network: for example, a rank order rule is recognized in the distribution of street length values and the cumulative

distribution of paths connectivity values and betweenness values resembles the 80/20 principle. Likewise, considering the distribution of flows within the road layout of the urban area of Gavle, Jiang concludes that the mobility function of a route descends from its morphology and its structural role within the configuration of the network.

2.2 A HIERARCHY OF MODES OF MOVEMENT

Having defined hierarchy as a specific type of *constitution*, indeed, as a structure of types, it can be concluded that the discontinuity of urbanized territories, pedestrian and cycling paths, and open spaces depends on specific functional and morphological features of types; thus, on parameters selected as a basis for route classification. The discontinuity of minor networks is implicit in conventional route typologies where the system function is derived from the mobility function, according to an imposed inverse relationship between the distribution function and the access function: thus an exclusionary relationship – hence a separation – is introduced between the transit function and any form of minute scale interaction that unfolds within the road space or between roads and buildings. Consequently, cycling and pedestrian surfaces occupy the last tier of the hierarchy and, consistently with the condition of arteriality, they constitute fragmented and discontinuous fabrics, dispersed among arterial routes exclusively designed for vehicular transit. Therefore, the restoration of continuity of territorial structures requires to overcome the inverse relationship between transit function and urban function and to interpret them as distinct but compatible dimensions of infrastructural spaces; this paradigm shift results in the possibility of conceptualizing strategic routes as multi-modal and multi-functional spaces; it is also consistent with the definition of route types in constitutional terms, according to the principle of arteriality.

The fundamental question arising from this first conclusion concerns the definition of the conditions within which different modes of movement can coexist in the same road section. This question can be expressed in terms of determination of admissible connections between elements of a hierarchy: the speed differential is considered as the most relevant criterion for determining the degree of separation between distinct modes of movement (Marshall, 2005). Thus, speed is identified as the parameter for a modal hierarchy; according to this, consistently with the principle of *access constraint*, the conditions of contiguity and separation between different modes of transport and their relative surfaces are determined. Moreover, these conditions are a criterion for establishing admissible connections between roads engaged by different modes of movement. Adherence to this criterion is a fundamental condition for ensuring fluidity and safety of circulation, as it implies a substantial reduction of conflicts among modes of movement characterized by significantly different speeds. In addition, since the categories of traffic admitted along a road depend on its function within the transport network, the degree of separation among surfaces intended for specific modes of movement constitutes a morphological parameter that determines the consistency between the typological definition of a route and its geometry. This coherence is implicit in the first principle of hierarchy: the distinction of components. The formalisation of these concepts as criteria of a tool for preliminary evaluation of transformation of the network structure constitutes the object of the research discussed here. In the following paragraphs authors present the methodology and the case study (the city of Cagliari).

3 METHODOLOGY

This section, based on findings summarised in previous sections, proposes a qualitative method founded on the structural conditions of hierarchy and explores its application as a tool for verifying whether the transformations of arterial routes into pedestrian spaces alter the functionality of mobility networks. This approach reflects the need of managing the road space at a network level (Jones, 2017). The analysis requiresfirst step is to reconstruct the configuration of the considered portion of the road layout: The Open Street Map database is selected as a fundamental, independent and available source of data (Almendros-

Jiménez et al. 2017; Jiang & Okabe, 2014) for reconstructing the configuration of the road layout. Then the road layout is represented as a route structure (Marshall, 2005, 2016). and a qualitative evaluation of its constitutional properties is developed. Moreover, in the OpenStreetMap database some types are defined according to several parameters and express the different dimensions of a road space: for example, the land uses along margins. These denominations specify the fundamental definition related to the significance of the route within the network. Nevertheless, these denominations have been rejected when implying an inverse relationship between distribution function and access function and, generally, between the transit status and the place status of a route.

Moreover, the proposed analytic method does not consider the principle of arteriality as an explicit criterion: the adherence of the network to this condition is implicit in the typological definition of each arc, classified according to the principle of arteriality, precisely because topologically contiguous within a complete and continuous sub-network that encompasses a specific geographic area. Consequently, only the conditions of *access constraint* and *differentiation of components* are individuated as pertinent parameters. The first condition is verified if non-complementary routes, attributable to types whose ranks differ of more than one position, do not connect contiguously. The second condition is verified if the morphological characters of an element are appropriate to its system function. The variable considered is the degree of separation between lanes and surfaces serving different uses or modes of movement, classified according to their speed values. Therefore, with reference to the categories identified in Table 1, three conditions are imposed: 1) modes of movement attributable to the same class can be accommodated by the same lane; 2) modes of movement of different ranks unfold along contiguous lanes if, among their coded types, there is a rank difference equal to or less than one integer value (S3 and S2); 3) if the difference between their relative coded types exceeds one integer value, the different modes of movement are segregated, each one within a confined surface, or within surfaces separated by lanes intended for intermediate-tier movement modes.

CATEGORY	SPEED BAND	MODES OF MOVEMENT
S5	Very high speed	Train, fast motor movement on motorway, busway, etc.
S4	High speed	The highest speed for a carriageway associated with a footway or urban street
S3.5	Medium-high speed	Medium-high speed motor transport movement
S3	Medium speed	Medium speed motor transport movement
S2.5	Medium-slow	Running; cycling; medium-slow motor movement
S2	Slow	Jogging; slow cycling or very slow motor movement
S1.5	Very slow	Walking pace; cycling or parking at walking pace
S1	Walking speed	Slow walking pace

Table 1. Stratification by speed; (Marshall, 2005)

4 CASE STUDY

This article is founded on the analysis of a concrete case of modification of an urban road network: the pedestrianisation of a portion of a main distributor in the urban area of Cagliari. Cagliari is the core of the metropolitan ciy of Cagliari constituted by 17 municipalities and its territory is defined by a polycentric structure, in which a complex pattern of relations of communication and social dependence are easily identifiable. Cagliari emerged as an optimal case study because of the concentration of conditions relevant to our studies: 1) the structure of the urbanised region, determined by processes of dispersion of residential and productive functions along main transportation corridors; 2) the concentration of metropolitan-scale services (educational, cultural, social) and of administrative functions in the compact city; 3) a transport system mainly

reliant on the road network; 4) a strong pressure on arterial distributors and on the network of urban sub-arterial and secondary distributors. Recent surveys measure 164.637 cars entering the urban area of Cagliari in an average week day and 130.336 cars leaving the urban centre (Comune di Cagliari, 2012), on a population of 156.538 residents (Comune di Cagliari, 2017); 5) presence of urban corridors relevant as distributors serving the metropolitan areas and as urban places (Via Roma, Viale Colombo): hence a competition for space arises among different uses and practices; vi) the strong commitment of the local authorities in policies able to foster sustainable modes of transport, including the introduction of a service of bicycle-sharing, sporting events (Cagliari respira – since 2008) and cultural initiatives (Museo in Transito – since 2015), experimentations and promotional campaigns (Zeus - Zero Emission Urban Bus System – Project, started in 2015) and the reorganisation of public open spaces. This last action is articulated in the following interventions: (i) the network extension of lanes reserved for public transport means and of cycling paths; (ii) the pedestrianisation of different areas of Cagliari (such as the Villanova and Marina districts) and of roads (such as the Corso Vittorio Emanuele, starting from 2016), and finally, (iii) the restoration of significant outdoor urban places (such as via Manno, starting from 2017, via Garibaldi, starting from 2015, piazza Garibaldi and piazza San Michele, starting from 2017). These factors result in a particular sensitivity of the context to the implementation of policies not grounded on a solid theoretical framework.

As a result, our research aims at proposing a preliminary analytical tool for the evaluation of hypothesis of modification of the structure of road network, based on the recognition of the relevance of the figure of hierarchy and, thus, on the utilisation of its structural condition as pertinent criteria.

4.1 THE PEDESTRIANISATION PROCESS

Opened in 1883, Via Roma consists of two carriageways – "*Lato Portici*" towards the city and "*Lato Porto*" towards the sea – separated by a central tree-lined promenade and it is delimited by a sequence of buildings opening towards the road space through a passageway. It is one of the main arteries crossing the center of Cagliari: some of the major buildings of the political power, such as the Civic Palace and the Regional Council, aligned along its margins. After the Second World War, via Roma assumed the role of fundamental urban distributor, intensely frequented by pedestrians and engaged by large flows of private vehicles, trolleybuses and buses. Therefore, it emerges the significance of via Roma within the urban structure.

In particular it emerges that Via Roma constitutes a multi-modal and multi-functional space, since it is part of contiguous circuits of strategic itineraries both at the metropolitan and at the district scale**.** Moreover, it is a fundamental arc within the public transport network. This condition is pointed out by the road classification derived from the Open Street Map database; this defines Via Roma *Lato Porto* as a primary road and Via Roma *Lato Portici* as a tertiary route. In recent years, a series of urban policies, in line with European trends, have led to a global requalification of the historic districts of Cagliari as restricted traffic zones and to the pedestrianization of main commercial streets.

The resulting configuration is connoted by the segregation between portions of the urban fabric – contiguous to the core of the compact historic city – connected by two links only: via Roma to the south and Porta Cristina to the northern extremity of the hill of Castello. This partial fracture and the consequent concentration of different flows along Via Roma have led to several proposals for the re-arrangement of the road surface: the re-configurations of the road sections, the concentration of public transport lines within a dedicated carriageway and the transformation of the central promenade into a reserved parking area for the residents of Marina district; these interventions add to the radical hypothesis of removal and confinement of vehicle lanes within entrenchments or tunnels, in order to release Via Roma from urban and metropolitan scale traffic flows. In this context lies the decision taken by the City Council to undertake the temporary pedestrianisation of Via Roma Lato Portici from August, 11 to September, 17, 2017. This experimentation, never conducted

before for such a prolonged period, resulted in numerous variations in traffic circulation and, in particular, in a significant modification of the network configuration.

Fig. 1. Separation between parts of the urban fabric

4.2 Analysis

The transformation of Via Roma *Lato Portici* in a pedestrian space introduces a modification of the road pattern that invests different levels of scale: it determines the overlapping – along the strategic itinerary composed of Via Roma Lato Porto, Viale La Playa and Via Riva di Ponente – between the inter-district/local sub-network and the primary network; moreover routes such as Via Sassari, identifiable as links between the primary and the inter-district subnetworks, evolve into strategic routes within the inter-district sub-network, canalising movement of secondary distribution and penetration towards the primary distributors. As a consequence, Via

Roma *Lato Porto*, Via Riva di Ponente and Viale La Playa – in addition to a function of primary distribution – perform functions of penetration and secondary distribution. Moreover, it is observed, along certain routes, a situation of interference between different modes of movement. For instance, along the first segment of Via Sassari, promiscuity arises between distribution and access of private vehicles, public transport bus access,

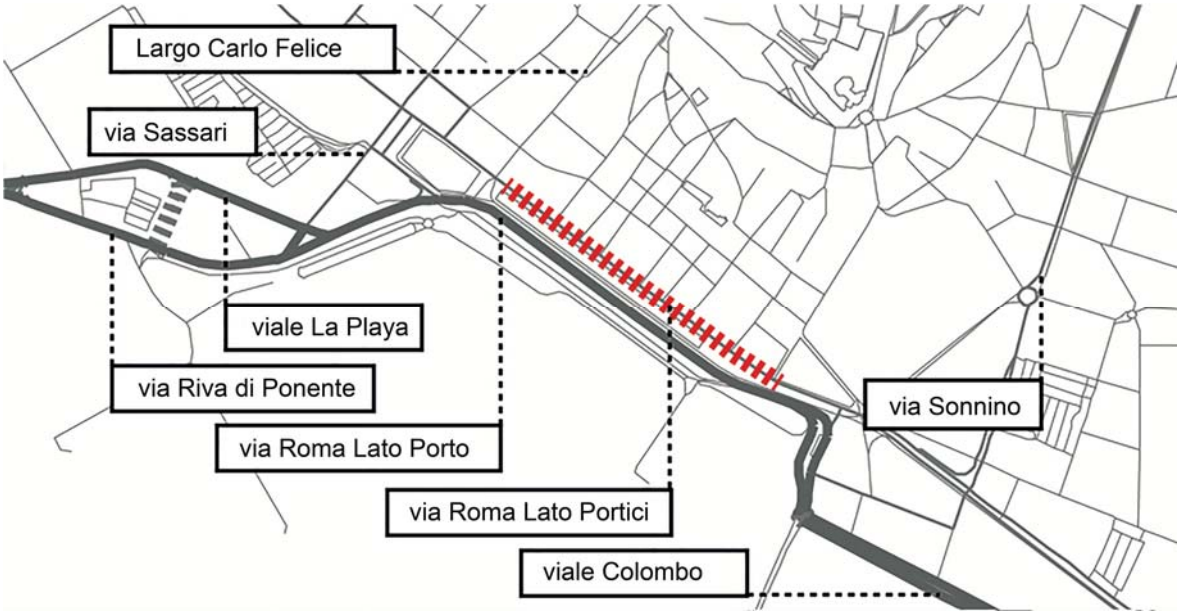

Fig. 2. The pedestrianized arc of via Roma Lato Portici.

parking, and walking. These criticalities, partially pre-existing, are exasperated, in consequence of the pedestrianization intervention, by the concentration, along adjacent routes, of functions of secondary distribution and penetration previously served by via Roma *Lato Portici*. The intervention of pedestrianisation *thus modifies* the link status of adjacent routes (Marshall, 2004; Annunziata & Annunziata, 2015): it increases their significance as bridging elements between two portions of the network strongly connected internally but weakly connected to each other.

Therefore it can be concluded that the transformation of Via Roma affects the fluidity of the circulation, and the legibility of the system. These considerations arise from the situations of congestion observed during the period of the experimentation, at the extremities of Via Roma, particularly in via Sassari, Viale la Playa and Traversa prima La Playa, and admitted by the Municipal Administration (Ansa 2017; Unione Sarda 2017).

As a consequence, it can be observed that the transformation of a single route determines a modification of the structure of the network. Nonetheless, these modifications do not seem to have been adequately considered in the implementation of the intervention of the pedestrianization. In a more general sense, it can be observed that the projects and strategies of transformation of infrastructural spaces – and particularly those regarding the conversion of spaces of mobility in multi-functional pedestrian spaces – lack of adequate predictive tools, meant to support the control and evaluation of trans-scalar effects produced by localized interventions. As a result, an analytic tool is required: this should be founded on a broad comprehension of the network properties engaged by the radical transformation of a road, as in the case of its conversion in a pedestrian space. It can be observed that the intervention proposed for Via Roma Lato Portici seems to engage a complex of interdependent relations constituting the implicit, non-discursive, structure of the network (Hillier, 1996; Cutini, 2017). These relations, as observed by Marshall (2005), constitute the most pertinent basis for a functional classification of roads: “the classification of an individual section of road refers to its relationship with the rest of the network. In other words, this is designation by relation” (Marshall, 2005, p.60): in this perspective, thus, function is intended as network function and not as traffic function; moreover, a classification system founded on the network-function of each road section, constitutes an ordered system

that underlines the relative importance and the significance of each element with respect to the network: thus, it defines a hierarchy of roads.
As a consequence, it can be argued that the modification of the status of a road determines the modification of a pattern of relations associated and profoundly connected to the hierarchical organisation of the network; thus, it is by understanding the fundamental properties of hierarchy that a consistent analytic tool can be defined. In the sequent section the authors discuss the application of the proposed qualitative analytic method to the case study.

4.3 CONSIDERATIONS ON THE CASE STUDY

The proposed qualitative method can be regarded as an analytic tool, by means of which to reconstruct alterations in the structure of the road pattern produced by the pedestrianization of via Roma Lato Portici.
The analysis requires to reconstruct the configurational and constitutional properties of the road layout: the network function of each element, hence its type and rank, is derived from the *Open Street Map* database.
The analysis of the road network reveals the existence of three circuits, or rings, that constitute contiguous subsystems of strategic itineraries. Hence, a metropolitan arterial sub-network is identified, consisting of trunk roads and primary distributors and an inner sub-network, contiguous at the scale of the compact urban settlement; these two circuits include the strategic itinerary unfolding along Via Roma (Lato Porto), Via Riva di Ponente and Viale La Playa.

Fig.3. Configuration of the road network and classification of its routes

Then, a contiguous sub-network of secondary and tertiary distributors is identified; this inter-district circuit encompasses Via Roma Lato Portici. This route carries out a local distribution function towards Marina district and it connects to the finest scale district network composed of local streets and pedestrian routes. Applying the proposed analytic method, it can be observed that trans-scalar effects of this intervention, are interpretable as consequences of the modification of the network constitutional properties, that is, of constitutional relations between routes. The partial overlapping between the inter-district network and the metropolitan network – determining the direct conjunction of a tertiary road and of a local road with a primary distributor – implies,

in fact, a pattern of connections between routes attributable to different types that does not verify the access constraint condition. Likewise, situations of conflict and interference between different modes of movement and different practices can be interpreted as a pattern of relations between different functions not consistent with the access constraint condition, referred to the proposed modal hierarchy based on speed values.

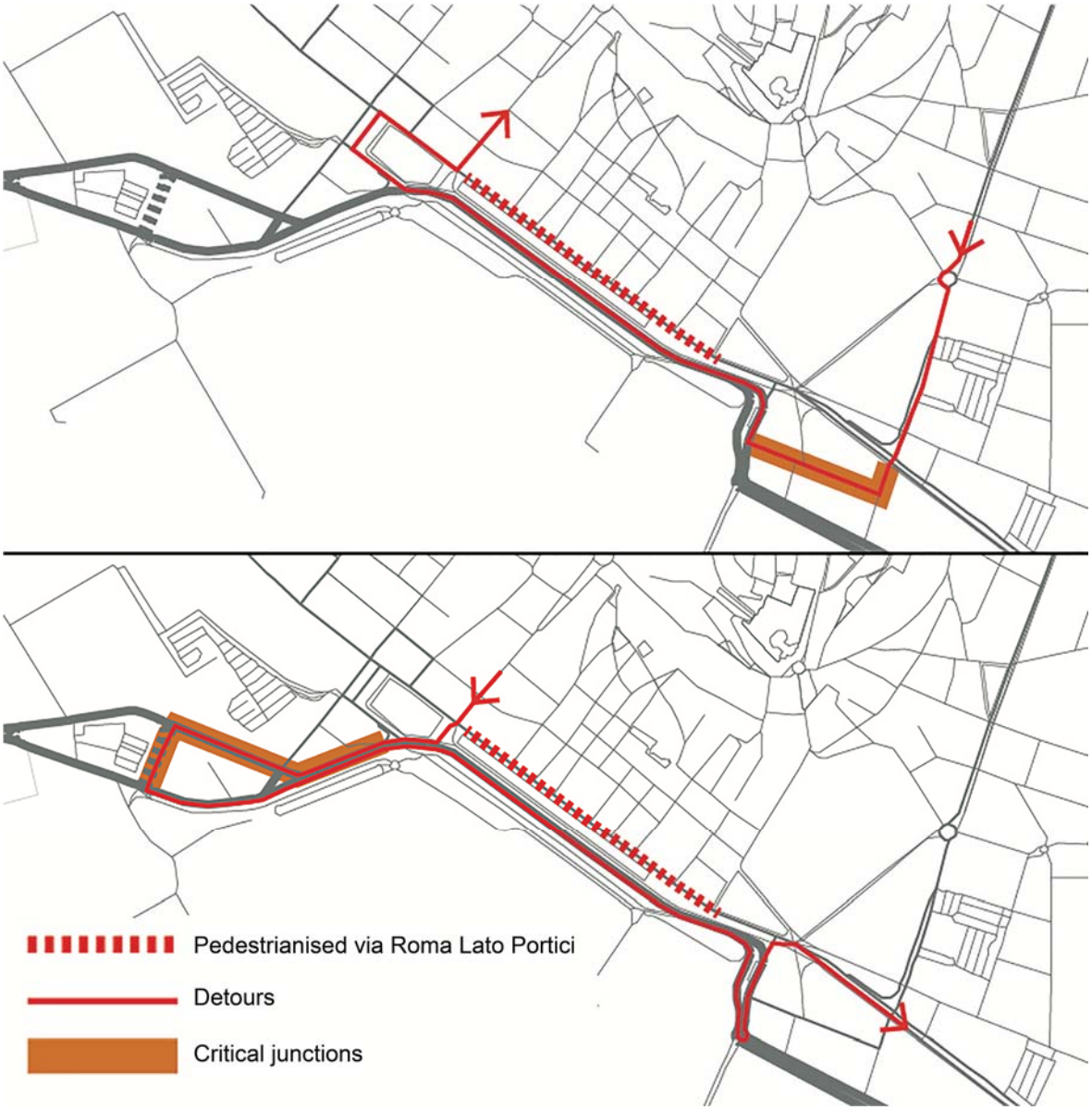

Fig. 4. The Effects of the overlapping between the primary and the inter-districts sub network.

Therefore, the interference, observed along Via Sassari and Viale La Playa, between distribution of vehicular traffic, access function, parking and pedestrian mobility, can be interpreted and described as a condition of contiguity between medium-high speed motor movement (S3) parking at walking pace (S1.5) and slow walking pace (S1), thus as a pattern of direct connections between modes of movement attributable – according to their specific speed bands – to types whose ranks differ of more than one integer. This particular condition results in decreased safety and fluidity of circulation. Moreover, this situation implies the loss of a clear relation between the typological definition of roads, related to their specific function, and the pattern of separation and contiguity relations among surfaces dedicated to different modes of movement: this aspect represents a fundamental morphologic feature of the road space; Therefore, the first principle of hierarchy, the distinction of components, is not satisfied: this results in a lesser recognizability of road types and in a decreased legibility

of the network structure. As a consequence, the situations of congestion and the decreased functionality, legibility and coherence of the network, observed during the experimentation period, appear to be interpretable as a consequence of the rupture of the hierarchical properties of the road pattern.

5 CONCLUSIONS

Hierarchy is a fundamental figure for both the analysis and the organization of mobility systems; nonetheless, as it is often interpreted as a generic form of order and identified with particular configurations, it is increasingly invested by a radical critique that prefigures its overcoming (Astolfo & Boano, 2014; Marshall, 2005; Secchi 1989; 2000; Viganò, 2010). Reaffirming the conclusions from previous studies, this article pointed out the distinction between *constitution*, *configuration* and *composition* as different aspects of the same structure, and defined the hierarchy as a specific type of constitution, by investigating its fundamental conditions, referred to road patterns: *distinction of types, rank determination, arteriality* and *access constraint*.

It was then observed how these principles are the condition of certain desirable properties of a transport network, such as *legibility* and *inter-connectivity*. Subsequently, it was noted that the discontinuity of minor networks depends on specific *configurational* and *compositional* features of networks and of infrastructures that constitute the main routes; these aspects are determined by an imposed inverse relationship between the distribution function and the access function. Conversely, the reference to *arteriality* as the most pertinent basis for the functional definition of routes, allows the overcoming of the opposition between mobility and urban place status and the configuration of roads as multi-modal and multi-functional spaces.

Likewise, the condition of *access constraint*, referred to a modal hierarchy based on speed classes, permits to coherently articulate the relationships between various functions along a road. In this way, the fluidity of circulation and the consistency between the typological definition of a route according to its system function and its morphology are guaranteed. From these considerations it emerges the significance of hierarchy as the fundamental condition of a transport network. This case study analysis, conducted by applying a qualitative method based on the conditions of *access constraint* and *distinction of types*, confirms that modifying hierarchical relationships between routes and modes of movement could result in a decrease in functionality of a road network. From these conclusions two alternative strategies emerge:

– the first one, that we could denominate the *recycle strategy*, entails the the modification of the network function of a route and its adjustment or radical transformation, for instance, through its complete pedestrianization. Nonetheless, this strategy requires to verify that the resulting *constitution* of the network still satisfies the conditions of hierarchy, in particular with respect to the principles of *access constraint* and *distinction of types*;

– the second one, referred to as the *healing strategy*, involves the centrality of the *composition* of roads, as the specific aspect to be addressed by interventions of *domestication* of infrastructural elements aimed at restoring the continuity of the territory, increasing its porosity and permeability, and reconstructing and expanding the minute systems of open spaces and of pedestrian and cycling paths.

In this perspective, numerous examples demonstrate the potential of this second strategy as a comprehensive research spacing from corrections of the infrastructure layout to the re-configurations of its transverse and longitudinal sections, from the connection to the soil to the design and organization of margins and residual spaces. Among these examples are La Gran Via de Les Cortes Catalanes designed by Carmen Fiol and Andreu Arriola, Jordi Henrich's Ronda del Mig, the Moll de la Fusta, by Manuel Solà-Morales, in Barcelona; the Atlantic Passeo in Porto, also designed by Manuel de Sola-Morales, and the rest area in Nîmes - Caissargues, designed by Bernard Lassus. It therefore emerges the necessity of the project as a device for investigating strategies that do not alter the function of a route within the mobility system – hence its constitutional and configurational properties – but pursue the integration of different movement functions and practices in the space of the infrastructure, by modifying its compositional features.

6 NOTES

This article is the result of the joint research developed by the two authors on the relationship between network, infrastructure, urbanization and landscape (see Annunziata, Pisano, Annunziata, 2015). In particular, the research on the network properties is mainly attributable to Annunziata, the analysis of the relationship between the network and the urbanized physical space is mainly attributable to Pisano, the methodological construction was jointly developed by Annunziata and Pisano.

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