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INTERMODAL TRANSFER

From node to place

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ABSTRACT

The research presented in this paper is a case study of intermodal stations of the integrated multimodal transport system implemented in Santiago de Chile, the Transantiago. One of the important innovations of the system is the implementation of a feeder and trunk system that promotes one and sometimes two transfers in a given trip. The fare integration was achieved but the physical integration among modes has been neglected and severely criticized.

The aim of this research was to understand the possibilities that these transfer stations can offer to not only improve the experience of the trip but also, increase the mobility of urban dwellers and provide subcentralities in poor areas with little or no infrastructure and services. For this purpose, three different types of stations were analysed in their urban setting, spatial qualities and use patterns. The results suggest that with proper design and a careful understanding of the city areas and population, a more sustainable transport system can be enhanced improving the quality of life of urban dwellers

KEYWORDS

Route Choice, Intermodality, Pedestrian Flows, Informal Commerce

1. INTRODUCTION

Though the Underground Metro plays a major role in Santiago's mobility since it opened in 1972, for decades it was operated as an independent system, and not coordinated with the surface public transport that consisted of an unregulated privately run bus network. It wasn't until 2007 that both modes were coordinated under the Transantiago, a centralized Metro and bus system. One of the most significant changes in the new system was that it considered a dual system of 'trunk' and 'feeding' services. The feeding services would collect the local travellers and feed them to the trunk lines, that would cross the city from one end to the other.

This implied, that contrary to the previous system where all lines crossed the whole city competing with each other, the passengers would almost inevitably have to transfer during their journey, once and sometimes twice. The system included intermodal transfer (metro and bus) by incorporating an electronic card with fare integration, yet there was no effective

integration in the actual transfer. Thus the intermodal trip was many times improvised and the transfers were solved in inadequate surroundings with little or no infrastructure. In fact, the Transantiago has been harshly criticized in its implementation and one of the most critical aspects has been precisely this: the transfers.

The governmental answer has been the construction of enclosed, hermetic buildings that offer environmental comfort, some commerce and pedestrian organization during the transfer. These solutions have managed to cut some comfort costs to the traveler (waiting time, walking distance, less uncertainty) but offer little or no additional value to the trip nor to the surroundings of the areas where they are located. In addition, the nodes without a formal intermodal definition, were only required to offer a certain proximity between transport systems –a maximum distance of 200 meters from the Metro access (Moreno, 2009)– giving no importance to the environmental conditions nor the opportunities that the integrated fare system offered.

In brief, the relevant modernization of the transport system with a massive and integrated public transport system was undermined and its full potential has not been developed. We believe that by understanding the intersections as nodes devoid of spatial and territorial characteristics, we are missing the opportunity of generating sub-centralities where passengers could chain activities during their daily trips and the local residents could benefit from commerce and services that previously were unsustainable in the area, as well as to serve as places for interaction and encounter between people. Aiming at this double task –improvement of the daily trips for the travellers and of the commerce and services for the local inhabitants– a study was designed to further understand the possibilities that the required transfer could offer to the users and the city.

Our first intuition suggested that the answer could come from the construction of a 'place' rather than a 'node' at significant interchange stations. This meant understanding the transfer not merely as an inevitable functional step of the trip, but as a socio spatial opportunity where daily urban needs can be satisfied and social interactions can be carried out. Our first observations had noted that the quality of the transfer was not only about expediency in time and distance, that the possibility of carrying out social, commercial and recreational activities was valued, and that the opportunity for these was many times provided by the informal sector. In sum, the question was: how can place qualities be strengthened in Santiago's intermodal stations?

2. METHODOLOGY

The study carried out considered systematic observation and modelling of three very different intermodal stations: (i) Escuela Militar, that includes an underground commercial gallery connected to the surface through a sunken square with services and amenities; (ii) La Cisterna, that was solved inside a five story building expressively build for the purpose; (iii) Macul, with no intermodal infrastructure other than Metro accesses and bus stops, but with a strong presence of informal commerce.

In order to understand the urban context of the intermodal nodes, the surrounding area was described and analyzed at three scales: (i) public space use and transport infrastructure (Metro accesses and bus stops) in a 300 m radius; (ii) land use in a 500 m radius to the station, including typical location of informal commerce; (iii) configurational properties in an area covering 1500 meter radius.

At the same time, a detailed systematic non-participatory observation study was set out regarding the pedestrian routes and activities carried out in the three stations. In each intermodal station, 100 passengers were followed, without interacting with them, segmented according to the transport mode: 50 passengers arriving in Metro, 25 in bus, and 25 distributed among taxi, car and bicycle. Each track was monitored from the arrival to the node in one transport mode to the boarding of the next transport mode registering all the activities carried out during the transfer, the timing and distance covered.

The data collected considered gender (male, female), age (20 to 40, 40 to 60, or over 60 years old), and activities carried out: banking (cash withdrawal, paying bills), eating (in formal or informal places), groceries (mainly in supermarkets), health (shopping in pharmacies), window shopping (visual interaction with commerce without transaction), leisure (social meetings, rest, contemplation), others (specific commerce such as clothes, electronics or repair shops). Also the physical characteristics of the service when occupied was noted: use of furniture, outdoors or indoors, environmental control, etc.

Time and distance for every path was registered (maximum 500 meters) as well as the time dedicated to each activity (the waiting time for the bus, taxi, or car was not included). The observed routes were classified as Morning Peak (6:00 to 9:00), Midday (12:00 to 15:00) and Afternoon Peak (17:00 to 20:00).

3. TRIPS, TRANSPORT AND MOBILITY

Urban dwellers inevitably need to move through the territory in order to meet (Sheller, 2006; Le Breton, 2006; Urry, 2002); in fact, not even the technological revolution has been able to replace physical movement by virtual communication (Urry, 2002). Probably, in consideration to its relevance, movement –of both people and goods– has remained within the concept of transport, an operative approach to trips. Thus, the subject has been approached emphasizing the economic relation between cost and time: how to achieve the movement from point A to B considering the moving entities as equivalent subjects (Le Breton, 2006). Only from the beginning of the 2000's sociology, geography and anthropology theorists have proposed to extend the limits of trip study assimilating the social conditions of people, which have different levels of access to movement and hence, opportunities in the urban realm (Gutiérrez, 2012).

Within this framework, access is understood as the ease with which people overcome the distance between two places, and practice their rights as citizens (Miralles and Cebollada, 2003). The rank of the subject's possible moving differs depending on its spatial environment organization as well as its networks, income, gender role, age, socio-cultural background, etc. Hence, it is no longer relevant 'how the individual trip habits are' but 'how individuals make their identity through their relation with the territory' (Le Breton, 2006).

From this point of view, mobility itself has been considered a right in its own. Gutiérrez (2012) declares that mobility is about the paths that people make over the territory to concrete everyday needs, and not about getting to places. Mobility is defined as a social performance of movement which combines desires of moving and the capacity to satisfy them. In that event, Urry (2002) claims that a 'good society' wouldn't limit nor prohibit the desire of co-presence, but it would extend the possibilities of co-presence to every social groups. Within this perspective, mobility becomes the aim and transport the means.

The different levels of mobility have been classified according to their reach and capacity. Among these, everyday trips are those made at high frequency and necessary for survival (Kaufmann and Bergman, 2004). Due to the diverse levels of density of urban areas and the different levels of accessibility of its inhabitants, everyday trips are solved with different transport modes (Miralles and Cebollada, 2003): private (mainly cars), public (buses, railways), and non-motorized (cycles and pedestrian). Sustainable mobility promotes the last two categories as they represent advantages in easing congestion, are more energy-efficient and they are equally accessible for people.

In order to take the best advantage of each mode, intermodal transfer has come out as a strategy that allows to combine local means of public transport in suburban areas with massive railway systems that adapt better in central areas for everyday trips. Santiago's public transport system nowadays operates in this way as it combines the Underground Metro with bus services. The interest of this investigation relies in the space required for the combination of these modes.

4. FROM THE RADIO-CONCENTRIC CITY TO AN INTERMODAL SYSTEM

In 1960, the modernist urbanists of the time proposed the Metropolitan Intercommunal Plan for Santiago (PRIS 1960), which intended to organize a fast growing city with a clear road structure on the ground and a railway public transport system underground (the Metro). The plan considered 15 subcentralities that would alleviate the traditional center and shorten the trips for the population. It is interesting to note that the planned sub-centralities were located at the main road intersections, radius and rings, and not necessarily coincided with Metro stations (see Figure 1). However, in the following years only a few of these subcentralities developed and during two decades only two Metro lines were built, which remained independent from the surface's transport system, a highly deregulated bus network.

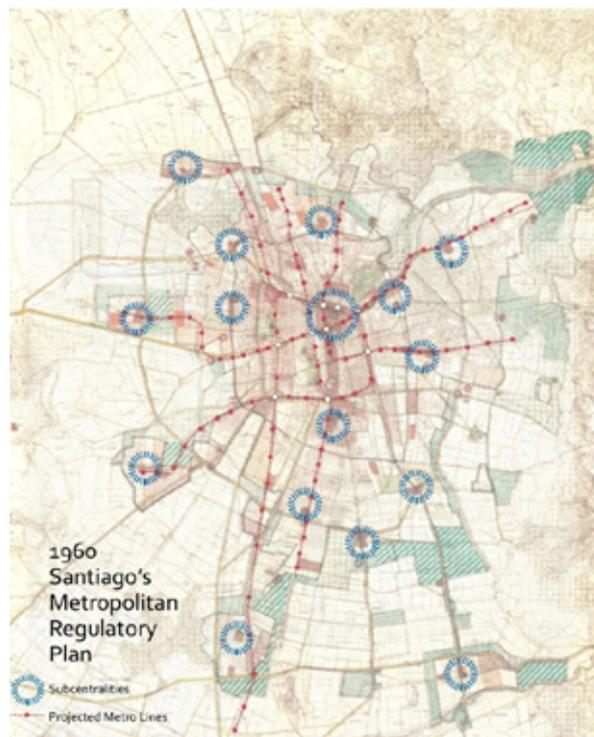


Figure 1 - Metropolitan Regional Plan for Santiago 1960 (PRIS 1960) with Metro plan superimposed and underlined subcentralities

Although during the 90's the government made an attempt to regulate the bus system and built a third metro line, it wasn't until 2007 that Santiago's public transport was convincingly re-structured, when the railway network was almost duplicated and Transantiago was implemented.

This ambitious integrated public transport plan pretended to rationalize the excessive bus routes by dividing the territory in ten zones attended by local buses (feeder services) which would connect to the Metro and to a metropolitan bus network (trunk services) in segregated roads (BRT) (Figure 2). An integrated fare system, was implemented, so that the bus and Metro would be incorporated in one unique payment (Forray and Figueroa, 2012).

This system allowed to universalize the access to intermodal change by reducing the cost of a three-step trip to one price, and so added a million passengers to the million and half that used Metro daily. Nevertheless, the plan started without the necessary buses to run the system nor road infrastructure, and wasn't able to resolve operational or physical integration effectively (Moreno, 2009). One of the most criticized aspects by the users was precisely the modal shift, as these were carried out under precarious conditions.



Figure 2 - Trunk and Feeder Transantiago System

Successive governments have since improved the system (lengthening the bus routes, minimizing transfers, building segregated roads and bus stops, adding Metro lines and suburban trains); however, the few built intermodal stations remain without a clear role in the city (Cortés and Figueroa, 2013). In fact, legally they are defined as real estate buildings, which inhibits the possibility to generate sub-centralities.

Nevertheless, this new structural system reactivated some Metro station surroundings attracting movement flows. Figure 3a represents the origin and destiny points in Santiago's work and study trips, and the passenger card transactions in each bus stop (not including Metro), showing their concentration in the central and eastern cores of the city, which is the richest part of the city.

However, some important bus stop points can be detected in pericentral zones, as those coincide with the passengers shift to the Metro network. In this study we consider these nodes -mainly where radius roads converge with the city's ring- as potential places to offer the possibility of chaining activities, and thus helping to satisfy the user's necessities and increasing their mobility range. The three selected cases for the present study can be identified in Figure 3b.

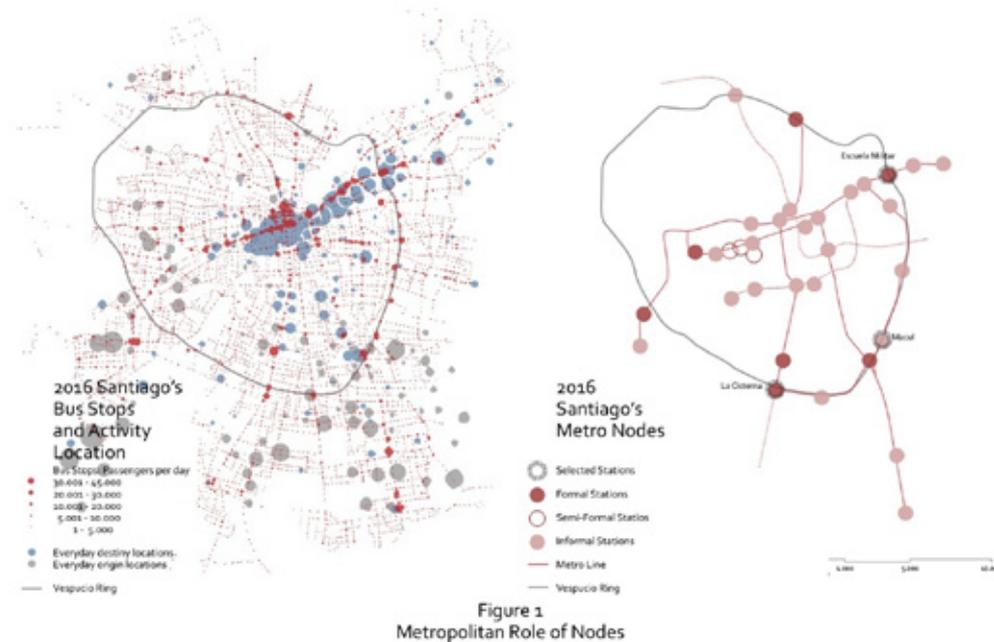


Figure 3 - Origin and destiny locations and bus transactions compared to Santiago's Nodes (Ministerio de Transportes y Telecomunicaciones, 2015)

5. INTERMODAL SPACE: NODE AND PLACE

From the transport field point of view, the intermodal space is a node: it represents traffic discontinuities (terminals, bus stops, street intersections and transfer stations), that together with the arcs -continuous traffic segments- make up a transport network. On the other hand, intermodal space can also be understood as a place.

The notion of place, in the social sciences field, has mainly been associated with the western culture concept of *Genius Loci*: the idea of a desired sensations manifested in the design of affable spaces, which can be related to anywhere in the urban. However, as cities develop and industrialize in the last century, Marc Augé (2004) set this notion in crisis when denouncing the appearance of non-places in the present cities: installations of accelerated traffic of people and goods, transit points, and temporal occupations such as airspace, railways, highways and other means of transport.

The author considers that these spaces are non-identitary -as they deny a collective meaning to those who inhabit them-, non-relational -as they prevent a participative acknowledging-, and non-historic -as they encourage a minimal stability between the space and time references that are common to everyone. Thus Augé defines place as a signified, historic and publicly-referable space.

Nevertheless, other authors differ on how this notion applies to transport nodes. Hannerz (1998) for example states that the constitution of place relies mainly in the street, as it is where habitants become not only city spectators but principal actors of the everyday social life as well. Sheller (2006), on the other hand recognizes in airports -major intermodal spaces- a 'transition space' which allows global shrinking to happen and travellers to meet. Contrary to the idea that people coexist or cohabit without living together, the author distinguishes a highly complex social organization where people do activities together in order to make travels happen.

According to Lange (2011) everyday mobility eases the constant transit between different fields of social interaction: (i) the intimate, constituted from the subject in relation with them self and their desires, (ii) the private, made by social bonds of primary character from the most immediate environment, (iii) the communitarian, built from the particular social networks -such

as religious or professional-, and (iv) the public, controlled by the unknown, the individuality and above all anonymity.

The author declares that the juxtaposition of these fields allows ways of 'hybrid sociability': in this sense, staying and moving are not selective ways of using urban space, but complementary. Thus urban mobility promotes the configuration of new types of places of sociability between the public and the private. In this manner, place is understood as where private and public social relations happen in a qualified space.

On the other hand, there are several authors that have recognized the importance of carrying out everyday activities as part of their mobility patterns. Le Breton (2006) states that mobility impacts in social life in such a way that society members have gotten used to having a 'double residence', when performing every day an activity in somewhere other than home - labour or study, for instance-. However, nowadays many people fulfil more than one activity before or after their everyday destiny, which has lead other authors to refer to some places as 'anchors' and obligatory, flexible or optional activities (Stopher et al., 1996).

Primerano (2007) affirms that the optimum method is to consider home as the only 'anchor' place, from which the subject moves to perform different activities 'chained' in one or more trips. In addition, he declares that chaining is resolved in different manners according to the means of transport used: it is easy to travel to different destinies located in disperse low-density areas in an automobile, while public transport doesn't allow such path flexibility, but enables to chain activities by foot in high-density areas.

This walkable practice of chaining activities is observed as well in intermodal change, as passengers have to become pedestrians when shifting from one transport mode to another and a relatively significant amount of transactional, social and recreational possibilities are available during the interval. Thus, performing an activity in the intermodal space -although it means a pause in a trip- can increase the subject's mobility, as it maximizes their access to satisfaction of needs through movement. In order for this to happen, it is necessary that transport nodes develop into mobility places.

6. THE THREE CASES

As shown in Figure 4, the three analyzed cases show very different realities regarding their integration to city's grid structure and bus system. Figure 4a shows the global integration map of the whole city, identifying the planned sub-centralities and the three analyzed cases over Santiago, and Figures 4b, 4c and 4d show the bus and Metro routes related to each station .

The figures show that from both the perspective of global integration and public transport supply , Escuela Militar works as a public transport hub for the northeast part of Santiago, which the richest part of the city and where most daily destinations are located (as shown in Figure 3). In fact, it can be described as the gateway to the segregated rich residential area. On the contrary, in La Cisterna, the local buses feed the south sector of the city and rarely cross the Vespucio ring barrier. Both of these two cases were planned subcentralities due to their strategic location in the Metropolitan grid structure.

The case of Macul differs from the others as it was not planned as a subcentrality in the 60's, nor has been formalized as an Intermodal Station and almost all buses are trunk routes. However, although it has less transfers per hour than the other two stations, due to the importance of La Florida axis and the Metro Line 4, 62.000 people shift between transport modes each hour during peak time, compared to 83.000 and 91.000 in the previous cases (MTT, 2015). Therefore Macul station has become an opportunity to be part of the Santiago's formal Intermodal Stations.

When analyzing the surroundings of each station, differences arise in terms of street structure, land use and public space (see Figure 5).

Escuela Militar station was originally a middle class residential area built under the garden city model, which after the construction of the metro station in the sixties, densified with office and

residential high rise buildings. In an attempt to improve the area's connectivity, the main road -Apoquindo- was elevated over the city's ring road -Vespucio- segregating the four quarters of the intersection even further. After several renovations the underground Metro station has managed to integrate the parts, complementing the ground services, and nowadays forms an integral part of the sub centrality serving the area.

In La Cisterna sector the Vespucio ring operates as a sunken highway and the main street -Gran Avenida- absorbs the majority of the integration. Most of the activity is located in this street in small shops, while the inside blocks are mainly residential. The area has very little walkable public space and almost no green area, and most formal intermodal activities are carried out inside the station building, having little or no effect on public space.

Macul station is also in the Vespucio ring road, but here it is an elevated highway. This suburban area is marked with metropolitan axes leaving major sized plots of land occupied with mega supermarkets, furniture outlets or car selling. The radial road La Florida connects the node with poorer residential areas. In terms of occupation, the large scale of the open space discourages pedestrian activity.



Figure 4 - Metropolitan role of the three cases. Global Integration and Public Transportation (FONDECYT Project 1141096 "Densificación e integración social en torno al Metro")

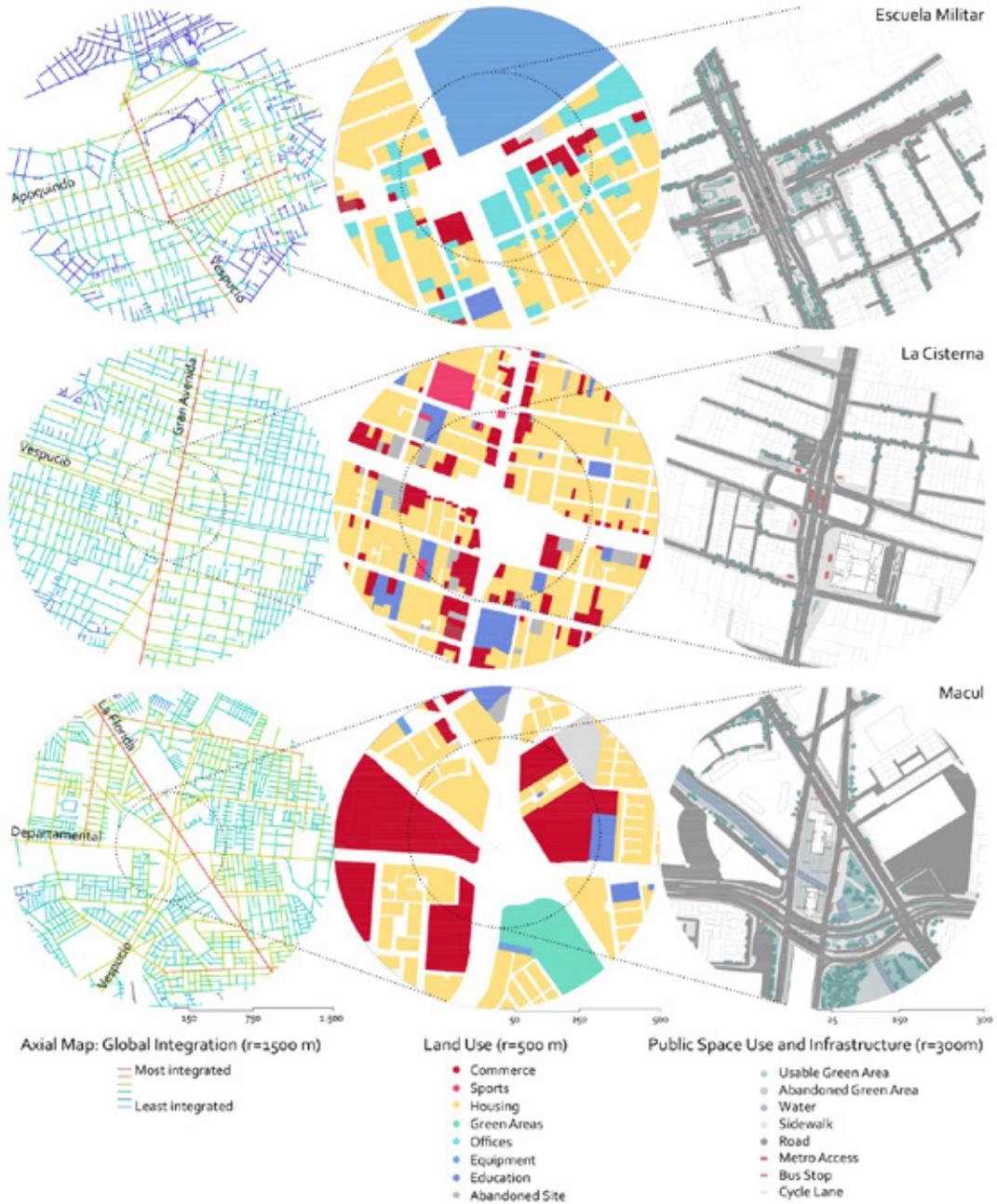


Figure 2
Space Analysis

Figure 5 - Spatial analysis of the three cases

6.1 ESCUELA MILITAR

Although Escuela Militar is not any longer a terminal Metro station, in many senses it still feels as one. It is dominated by car usage with a strong presence of local buses, taxis and picking up which take the travellers to their final destiny. The Vespucio road, with 12 uninterrupted traffic lanes, is impossible to be crossed on ground; but the Metro offers two underground parallel galleries -where the formal commerce is located- that connect the station with the urban context. These open up in four sunken plazas, with services, recreational facilities and connections to taxis and picking up. However, the station itself has no space for buses, which operate on the street system.

The observation of the transfers showed that shifts are faster and shorter during morning and afternoon peak times, than in midday where more activities are carried out. During the morning peak, passengers carry out almost no banking or eating activities, while in the afternoon they carry a more diverse set of them. This is in part due to the opening times of the formal station shops, which open after 9:00 AM, and the lack of informal commerce. Activities carried out by gender and age group also differ: women tend to do more diverse activities while men dedicate to more pragmatic ones (shopping and banking), young people generally stop for eating, and elders use more specific stores (laundry, shoe repair). The elder-women group is the one that leads the usage of supply stores or minimarkets during the afternoon, probably since they fulfil a more traditional role in the domestic sphere.

The shops more intensely used are the two corners located closest to the Metro, these are located in the underground galleries administration, yet have the virtues of open space: greenery, sunlight, open air and direct relation with the city. There is very little informal commerce, primarily because it is not allowed and is surveyed regularly. The external commerce to the station is sometimes used by passengers, but only when it is in the same sidewalk of the bus stop.

From the 100 people followed, 83 were intermodal transfer and 17 were arrivals to Escuela Militar as a destiny, with an average of 185 meters covered and 4,3 minutes of walking. This gives an average of 2,65 km/hr - a speed that might be considered low for a mobility hub-however it is also showing the recurrence of stops carried out by the passengers, and positive conditions for chaining activities. This information is shown in Figure 6, where the observed paths are presented according to gender, age and schedule differences, as well as the average time, distance, and activity ratio of each category.

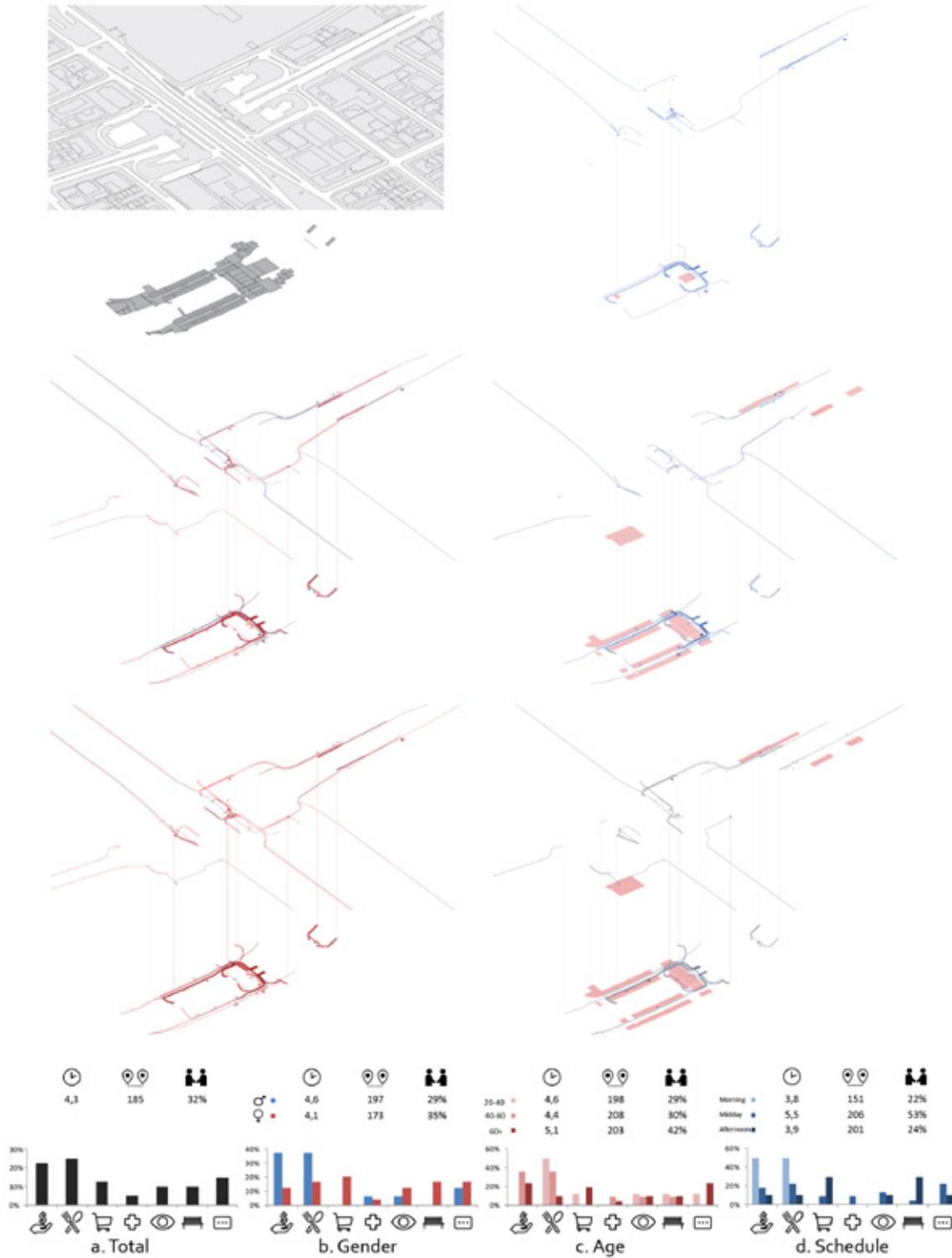


Figure 6 - Paths and Activities in Escuela Militar

6.2 LA CISTERNA

La Cisterna station receives two Metro lines and 22 bus services in a five story building. The first floor has only shops and fast food restaurants, while in the underground, passengers connect with Metro and wait for buses in a platform surrounded by commerce.

As in Escuela Militar, formal commerce opens mostly after 9:00 am, not attending the morning peak hour passengers. Nevertheless, midday passengers carry out a significant amount of activities -with a 37% of pauses in their transfers- and non transactional activities such as window shopping (mostly middle aged women) and leisure (mostly middle aged men).

A majority of the middle age group carry out one or more activity during their transfer (61% of them paused during their path); while a significant 48 % of the elder women group shop for groceries and a 38% of young people carry out eating activities (the last, to the same degree as in Escuela Militar). The most repeated and extended pauses occur in the supermarket and in the outside corners where informal vendors sell coffee and fried food, mostly during winter when the first and last transfers occur, both without daylight.

Transfers represent an 89% of the total observed paths, as could be expected, since the station was designed as a transfer node and the area lacks special destiny attractors (infrastructure, work, study). However, given that a multi-level building was build with the purpose of organizing pedestrian transfers, the average path is surprisingly long -225 meters in average (40 meters more than the previous case) while the amount and duration of activities is similar. This difference might relate to the disperse infrastructure in the open space, where pedestrian routes have been extended in order to accelerate bus and automobile flows.

Moreover, in the open space several practices against regulations were observed: pedestrians skip fences from central road platforms or walk through vehicle-dedicated infrastructure, specially when they can see the access to the intermodal building. In addition, it is noticed that when transferring in the underground platform, passengers tend to walk through the backside of commerce even though it is a place that has less environmental comfort -non acclimatized and exposed to bus gases- only to maintain visual control of the bus. Pedestrian routes are depicted as in the previous case in Figure 7.

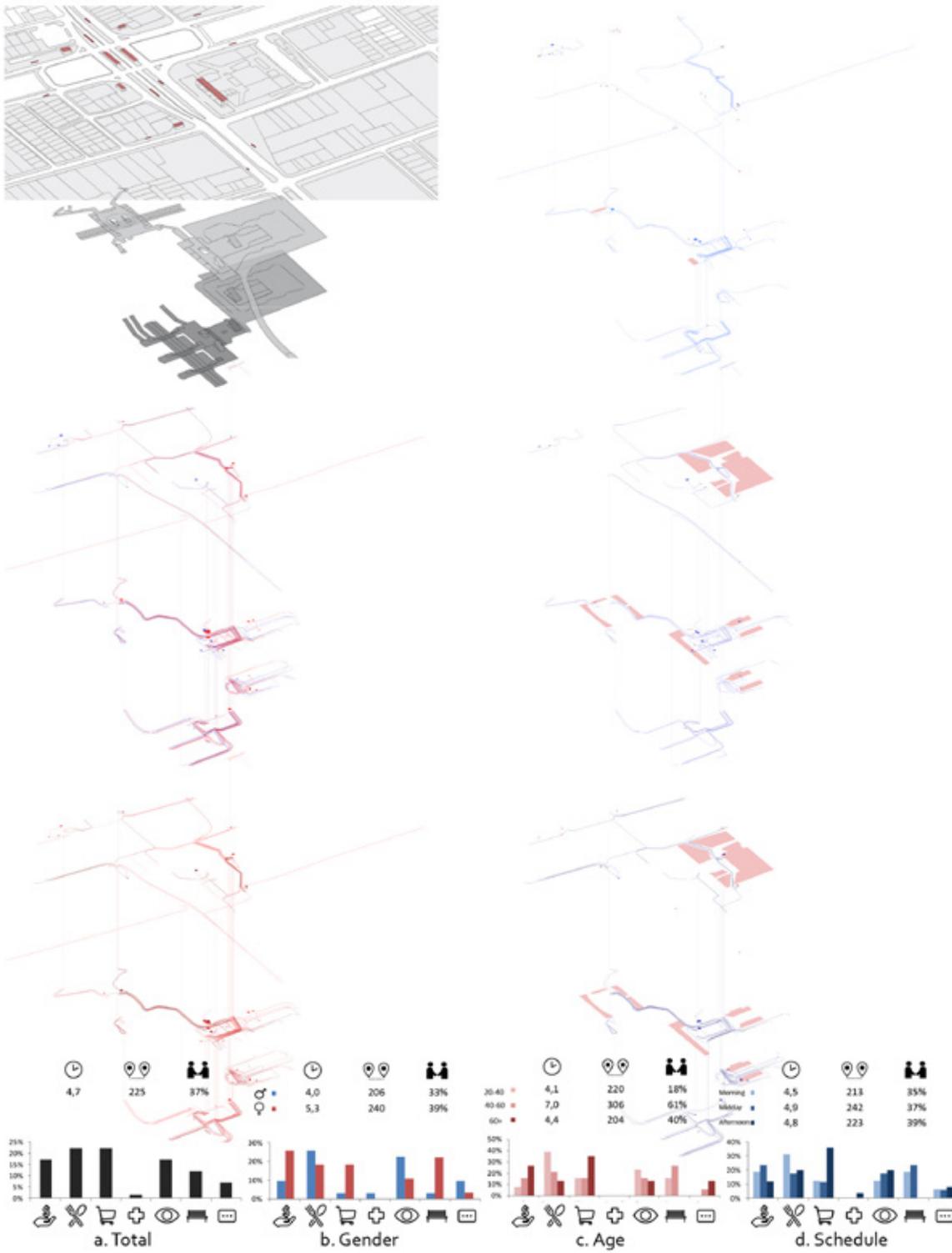


Figure 7 - Paths and Activities in La Cistera

6.3 MACUL

Unlike the other scenarios, the Macul station has no local formal commerce in the area, thus the activities occur as street vendors locate next to the two Metro accesses: the southern access serving Departamental, and the northern access towards La Florida. The majority of the vendors locate themselves under the highway and Metro infrastructure, gathering between the pillars of the flyover, without obstructing pedestrian paths; a few ones locate themselves next to bus stops.

The observations differ considerably to those in the other stations: only 14% of the paths pause with activities, almost solely related to money transactions -transport card charges and cash withdrawal- and buying informal fast food, as well as similar walking distances yet less time spent in transferring: an average speed of 3,88 km/h.

When analyzing the social characteristics of the passengers some patterns repeat: males do more money transactions, young groups concentrate in eating, and elders use other kinds of commerce. Nevertheless, some differences arise: young males are more likely to remain observing and middle-aged females spend more time eating than males.

In regards of time variables, it is noticeable that midday has much less activity than the other stations, as street vendors leave and come back in the afternoon, in which most people carry on transactions and eat less. The most successful hour for vendors is morning peak, when mostly coffee and fried food is sold. As pedestrians trace their paths according to the bus or taxi stops, informal commerce predicts the most intense areas and locates next to the most frequented paths.

Although this is not a formal Intermodal station, 84 out of the 100 tracks observed resulted in transfers. Similarly, to La Cisterna, many paths did not respect regulations, often in acute-angled intersections. Moreover, all the public space below the Highway and Metro lines is not used by pedestrians (regardless of gender, age or schedule, as shown in Figure 8) where no activities are happening and no transport system stops: merely some vehicles park here for free.

The lack of pedestrian activity during transfer can also be related to the large scale of the context, prepared for vehicle movement, which hinders the possibilities of the pedestrian passengers to make transactions or spend leisure time in the open space.

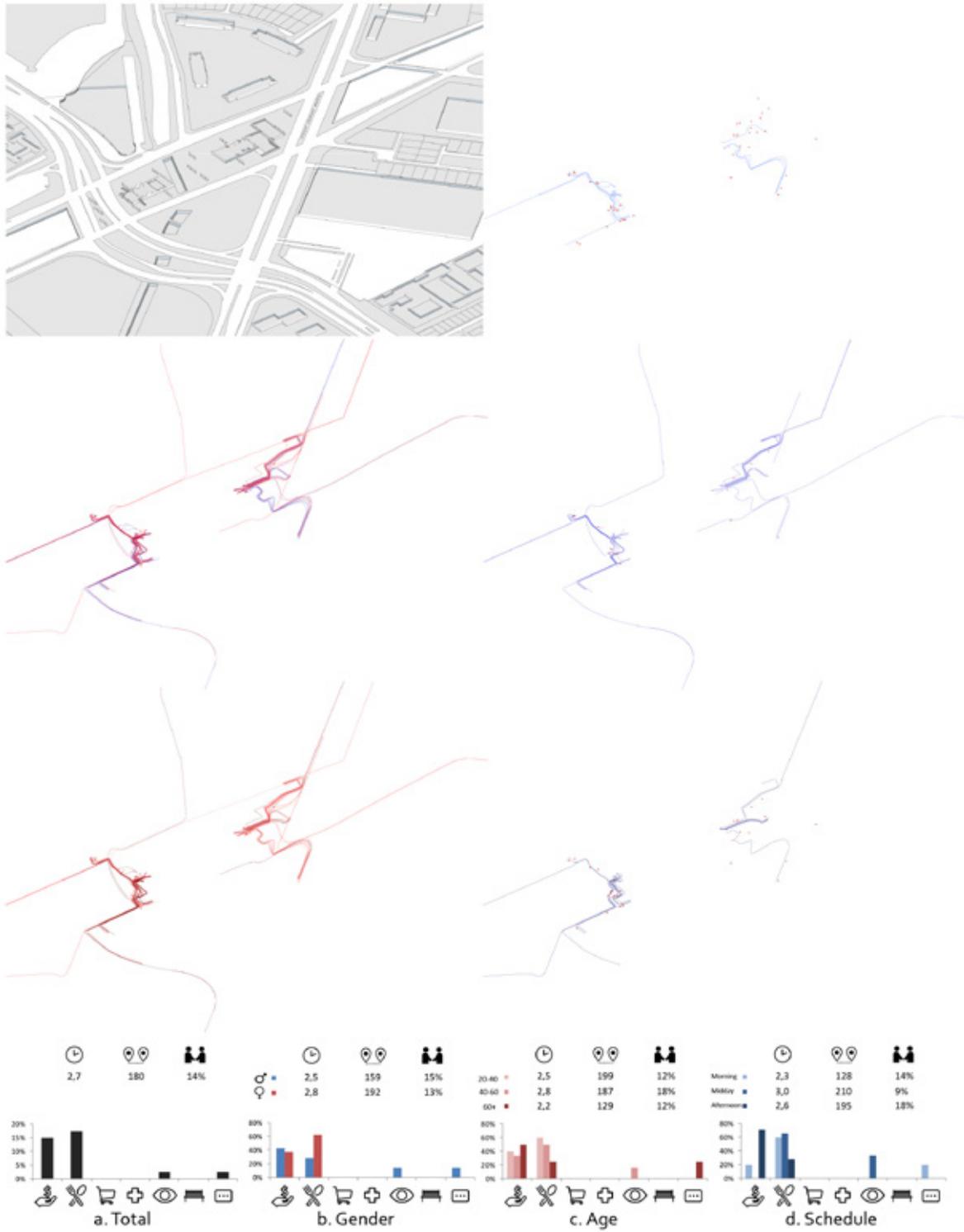


Figure 8 - Paths and Activities in Macul

7. FINAL REMARKS

The most relevant results of the study can be summarized and described at three levels. On the first level, the historical revision of the infrastructure planning and developing of sub centralities in Santiago, reinforced the importance of channelling the public transport flows to activate sub centralities. These have the possibility of attending underdeveloped areas as well as enriching the travelling experience of travelling: the analysis of the three cases shows that it is possible and happens even when the design of the infrastructure or the formal administration schemes (i.e. commerce's opening hours) are not answering to the demand appropriately. As is typical of Latin American culture, in those cases the informal sector complements the formal, responding to the challenge and providing the required services.

In second place, the exercise showed that urban design can transform a 'node' into a 'place', thus enriching the social experience of moving in complex urban settings. The next stage should attempt to formalize these efforts in order to create guidelines for the planning and implementation of intermodal stations. Even more, as many authors have stated in recent literature from the social sciences, this could be a relatively cost efficient way of overcoming or at least diminishing the effects of the traditional socio spatial segregation of Latin American cities. In fact, by increasing mobility, allowing chaining and promoting social encounter in transfer places, the poorer population will increase its possibilities of being integrated and thus having access to the advantages offered by a contemporary metropolis.

Third and lastly, a detailed description of the way people move, chain activities and interact during transfer can enlighten us to design better transfer stations and subcentralities in our cities. Gender and age of the passenger are relevant in their use of space, as are the type of activities offered (everyday commerce, banking, groceries combined with leisure space), the environmental conditions (comfort and security) and the visual fields offering information of the coming transport. Leisure activities can also play an important role to activate the node into a place, as well as the connection with greenery or parks.

Furthermore, it was noted that both formal and informal commerce are possible and complementary: as shown in the last case, street vendors by themselves are not able to sustain social encounter, and for formal shops it is difficult to respond in all schedules nor provide direct contact with the bus stops.

Accordingly, open space itself doesn't encourage activities nor the underground commerce; the most successful place is the one that takes advantages of both: the direct connection with the urban context and environmental qualities of the open (sunlight, fresh air), and the services provided by formal commerce (transaction possibilities, safer perception of the space).

As observed in these stations, the quality of the transfer experience depends, more than in acclimatization or minimizing the paths, in providing well designed pedestrian routes, visual control over buses or the next transport mode, and clear information increasing predictability and feeling of security. Hence a transfer station can use time and distance and still improve the quality of the trip. After all, the city is, above all, a place for encountering the unexpected.

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