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THE AGENCY OF JERUSALEM LIGHT RAIL:

A 'conflict infrastructure' beyond its representation

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ABSTRACT

The Jerusalem Light Rail (JLR), while used by all groups to commute between the northern parts and central Jerusalem, has been seen as a 'conflict infrastructure'. The article studies to what extent the JLR has exacerbated the conflict between different ethnic-cultural groups because of the way in which it frames people's everyday experience in the city. Through reading the work of Keller Easterling's (2014), it is argued that that infrastructure possesses agency and thus may not perform according to the declared intent. In the case of the JLR, it was intended to portray an image of a 'united city' based on the Jewish-Israeli narrative (Nolte and Yacobi, 2015). The work will focus on how the JLR has performed in the transportation network of Jerusalem independent of this stated intent rather than how it represents the space and accumulates meaning through this declared intention. The spatial and statistical analysis, with the aid of the GPS tracking data derived from Raanan and Shoval's (2014) work, are used to test to what extent the JLR, combined with the bus network, has reshaped the space and people's mobility, and potentially the social relations among different ethnic-cultural groups, namely secular Jews, ultra-orthodox Jews and Arabs. The work finds that while the JLR has not significantly changed the spatial configuration of Jerusalem, it suggests three hypotheses according to the analysis results. First, the JLR has probably brought more people to the existing shared space. Secondly, the topology of the street network may draw passengers into ultra-orthodox Jewish neighbourhoods. Thirdly, the JLR has very likely increased the mobility of Jews and Arabs unevenly because of the unequal services between the Israeli and Palestinian bus system. Consequently, due to the way in which the JLR frames daily experience, such as daily routines and human co-presence, it has intensified the multi-ethnic/cultural conflict not only thanks to its declared intent.

KEYWORDS

Jerusalem, Light Rail, Bus, Infrastructure, Conflict

1. INTRODUCTION

Infrastructure space is used by Keller Easterling (2014) to describe contemporary urban phenomena that are generated by repeatable formulas of infrastructure. In Jerusalem, being a contested city with deep-rooted conflicts between Jews and Arabs, infrastructure space is more notable in a way that 'produce[s] and reproduce[s] its own national space by means of segregation and its containment of ethnic minorities' (Nolte and Jacoby, 2015, p. 30). One of the reasons is that the re-organisation of spatial forms can potentially reshape the patterns of movement and co-presence, and subsequently the integration and segregation patterns (Hillier and Vaughan 2007).

For Easterling (2014), infrastructure space behaves like software, which is operated by the interplay of 'active forms', instead of 'object forms' like iconic buildings or master plans. Active forms can be organisational, act as social stories or both. Organisational active forms include the notions of the 'multiplier', 'switch/remote', 'wiring/topology', and 'interplay/governor'. 'Multipliers' like cars and elevators change the urban environment as well as society dramatically through propagation. 'Switches' suppress and redirect to modulate a flow of activities, such as a terminal in a transportation network. Multipliers and switches are assembled in relative position and sequence in a network, which is the 'wiring/topology' of an organisation, while the 'interplay/governor' can modulate the flow of information in infrastructure space by a set of instructions for the interplay between active forms (*Ibid.*). The operation of infrastructure space is unlike static objects and volumes in urban space which usually perform according to the designers' or politicians' desire.

These active forms prevail in Jerusalem. The local buses, most of which are operated by an Israeli company and Palestinian companies separately, running on the street network, and the Israeli neighbourhoods in East Jerusalem are the omnipresent examples of 'multipliers'. The light rail stations act as 'switches' between the bus network and the Jerusalem Light Rail (JLR), which started connecting Mount Herzl in West Jerusalem to Pisgat Ze'ev, the largest Israeli neighbourhood in East Jerusalem, in late 2011 (Figure 1). At the same time, the JLR has reshaped the 'topology' of the network because of its massive passenger capacity and unique routing that passes through neighbourhoods of different ethnic-cultural groups in Jerusalem.



Figure 1 - Aerial photo of Jerusalem with the JLR and boundaries

Through interplaying with the active forms, the JLR has reshaped Jerusalem. Various forms of infrastructure in Jerusalem are believed to perform politically as assigned by architects, planners, urban designers and transport engineers, as recognised by urban theorists (Barghouti, 2009; Yacobi, 2012). As Nolte and Yacobi (2015) discern, the JLR is a tool of enforcing the Israeli authorities' vision of the 'united city' through both spatial practice and in its 'public discourse, depiction and symbols'. Their vision of Jerusalem is portrayed in the 'hegemonic Jewish-Israeli narrative of a "united city"' and 'the Palestinian national claims to the city' are ignored (*Ibid.*, p. 33). In their point of view, it is actually a 'conflict infrastructure' (Pullan, 2013, p. 17) which 'connects the city physically and segregates it politically at the same time' (Nolte and Yacobi, 2015, p. 32). Through the routeing, naming of stations, and regime of security around the JLR, the one-sided narrative embodied in the JLR has intensified the conflict between Israeli Jews and Palestinian Arabs (Nolte, 2016).

The extension of the route beyond the Green Line to East Jerusalem (Figure 1), where is considered to be part of the future Palestinian state by Palestinians and the international community, has been considered as a gesture of permanent annexation of the land over the Green Line. Naming of the stations is another mean that reinforces the Israeli territorial dominance in East Jerusalem. Their names link historical and biblical narrative to Hebrew names while in Arabic, they are only named according to the geographic locations (*Ibid.*). This is very critical in a city of religious conflict because both Palestinians and Israelis 'make extensive use of religious texts in an effort to substantiate their claims to sovereignty over the area' (Cohen, 2013, p. 135). The last critical point is the regime of security around the JLR. For instance, if a circumstance is identified as a potential security threat, security personnel can check identity cards and request people to get off the JLR (Nolte, 2016). Hanna Baumann (2014) also discerns the Israeli territorial supremacy on a representational level through her observation in Shuafat. In her description, the JLR is like an Israeli enclave passing through the Arab neighbourhood, and it is so visible that it becomes a part of the everyday life of Palestinians. Because of the representation used with the infrastructural system and the symbols attached to it, the JLR has eventually become a target of attack when a conflict between the two groups broke out in 2014.

While urban theorists recognise these urban phenomena through empirical observations and policy review, the complex re-organisation of space on the ground brought about by the JLR may not be able to be detected through discursive techniques and people's perception only. Owing to the immanent nature of facilitating and mediating interaction (Tonkiss, 2013), infrastructure possesses agency due to its relative position in networks. Infrastructure may not behave as declared by decision makers. This paper will look into the agency of the infrastructure space in Jerusalem. The JLR will be the main focus of the study as it significantly alters the topology of Jerusalem by linking various active forms in this infrastructure space.

The study area of this work will be Metropolitan Jerusalem. It covers about 125km² inside the municipal boundaries (Figure 1). Around 829,900 people live in the area, including different ethnic-cultural groups, with secular Jews, ultra-orthodox Jews and Arabs being the major ones. In analysing the way in which the JLR transforms the spatial pattern with other active forms in Jerusalem, syntactic analysis and geographic information system (GIS) analysis are adopted. The analytical nature of space syntax and the propositional nature of Easterling's (2014) argument are complementary to each other in this work. Syntactic analysis is used because Easterling's notion of active forms is a concept which is so abstractly and metaphorically defined and explained merely through written language.

To explore how the JLR performs independent of its stated intent and its representation, the paper is divided into three parts:

- The first part explores the spatial background of Jerusalem by looking into the relationship between the configurational structure of the street network and the movement patterns of different ethnic-cultural groups.
- The second part studies how the JLR has reshaped the topology of the street network.
- In the third part, the interplay between the JLR and the bus system and how the JLR stations have modulated the flow between the two systems are examined.

The agency of the JLR is expected to be revealed through analysing how it frames people's daily experience with other forms of infrastructure by reshaping the spatial pattern of Jerusalem. It is also important to note that this work uses configurational data and academic sources. As a result, the study of these elements accounts only for the potential of space to affect mobility and social relations.

2. DATASETS AND METHODS

Space syntax analysis is the main method in studying the impact of the JLR, while GIS analysis helps study the interplay between the bus services and the JLR. In comparing the spatial information with the empirical data, Raanan and Shoval's (2014) source provides the movement patterns of different ethnic-cultural groups.

The segment model of Jerusalem is the major model used for the space syntax analysis. The segment model is generated from an axial model prepared by tracing the longest straight lines (axial lines) through every convex space bounded by buildings or road barriers. Normalised Angular Integration (NAIN) and Normalised Angular Choice (NACH) are the two measures used in the analysis. Integration and Choice represent the to-movement and through-movement potential respectively (Hillier *et al.*, 2012). Values are normalised for the advantage of being able to compare across cities statistically (Ibid.). By comparing the spatial pattern and values of the system with and without the JLR, the influence of the infrastructure on the configurational properties of the network can be tested.

Metric depth and angular step depth analysis will find out the catchment of the JLR stations. Angular step depth is measured by the shortest angular path from the segments (those represents the stations in this work) to all other segments within the system (Turner, 2004). Metric depth analysis can help test how well residents of different neighbourhoods are served by the JLR because they are familiar with their territories and choose their routes based on the shortest distance between the origin and destination. On the other hand, angular step depth can help examine whether and in which locations the JLR has brought more people who are not familiar with the particular areas since human movement is better explained by the angular distance rather than the metric distance (Hillier and Iida, 2005). Therefore, it can also reveal the areas of high natural movement, and subsequently the potential of these areas to attract movement-seeking activities, such as retail (Hillier, 1996).

The theory of natural movement is robust but only if everyone has more or less the same level of mobility. However, in Jerusalem, where bus services support Israelis and Palestinians exclusively, then the theory will become relatively incapable of holistically explaining the phenomena. The analysis of the interplay between the JLR and the two separated bus systems can further reveal how the JLR has reshaped the movement patterns of these two passenger groups beyond the light rail route.

The data analysis of the bus network is mainly conducted through GIS. The details of the route and daily frequency of the Israeli bus system is built from the Israel's Public Transportation Info Centre (<http://www.bus.co.il>), with an aid of Jerusalem Bus Map (<http://www.jlmbusmap.com>), while the data of the Palestinian bus system is collected from the map and timetable provided by the bus companies. Since a considerable number of bus routes do not run on the same streets in two directions, most routes will be represented by two lines in different directions in this work.

In studying Jerusalemites' movement patterns, four groups of territories are mapped based on Raanan and Shoval's (2014) work. They studied the relationship between perceived territorial boundaries and actual spatial activity of different ethnic-cultural groups in Jerusalem. In their experiment, 18 female university students with six in each ethnic-cultural group, namely secular Jews, ultra-orthodox Jews and Palestinian Muslims, were interviewed to examine their perceived territories, while also their daily movements were spatially tracked. Their results prove that the territories indicated in the residential ethno-cultural division map highly correlate with the participants' perceived personal territories and activity space. The four territories and their corresponding dominant ethnic cultural groups are listed in Table 1

Territory	Arab residence	Jewish residence	Jewish ultra-orthodox residence	Abu Qatada
Ethnic-cultural groups	Arabs	Secular Jews	Ultra-orthodox Jews	Mixed population of the two major religious groups of Jews

Table 1 - The major ethnic-cultural territories and their corresponding dominant ethnic-cultural groups.

However, it does not mean people are only active within their own territories. The residential ethno-cultural division map rather indicates the residential space of the respective ethnic-cultural groups. Secular Jewish territory is perceived as a shared space by the ethnic-cultural minorities, ultra-orthodox Jews and Arabs. By looking into where people go outside their residential territories, the locations in which there is multi-ethnic/cultural co-presence can be identified.

3. RESULT 1: COMPARING MOVEMENT PATTERNS & SPATIAL STRUCTURE

Raanan and Shoval's (2014) study shows that there are apparently distinctive daily movement patterns among different ethnic-cultural groups. They found that secular Jewish individuals appeared to operate within their own territories while participants of the minority groups, ultra-orthodox Jews and Palestinian Muslims, were very active within the secular Jewish territories when they were outside their homes, due to the fact that minorities depend on the employment and services in the majority's territory (Ibid.).

The spatial model of Jerusalem explains the society in a way that is different from other cities where people choose certain routes largely because of natural movement. In Jerusalem, the spatial model only projects a potential movement pattern that would be valid if the citizens would feel comfortable to visit any neighbourhood. However, it still effectively depicts movement patterns in another way in this contested city. Most routes chosen by the minority groups in secular Jewish territories are those with high NACH values. By extracting the GPS tracks which are outside the participants' own ethnic-cultural territories, they mostly coincide with the 1.3 and 1.4 structure, except a few neutral spaces like university campus and shopping centres (Figure 2).

The results show that the streets with high NACH values are rich fields of potential encounter and the interface between different groups. In most cities, these spaces lead to the appearance of new social relations (Hillier and Vaughan, 2007). In Jerusalem, it may not be the case and they may possibly turn into spaces of conflict. On the other hand, the background network with low NACH values remains residential areas dwelled with homogeneous ethnic-cultural groups. In Jerusalem, the participants did not normally pass through the background network of other ethnic-cultural groups. Potential conflicts between groups is less likely to happen in these segregated spaces.

In comparing the daily use of space by different ethnic-cultural groups and the spatial structure in Jerusalem, the dynamics between space and society is presented. The spatial structure is only an agent of potential encounter (Hillier and Vaughan, 2007). The map shows that the participants chose their routes according to both intuition and their social understandings of space.

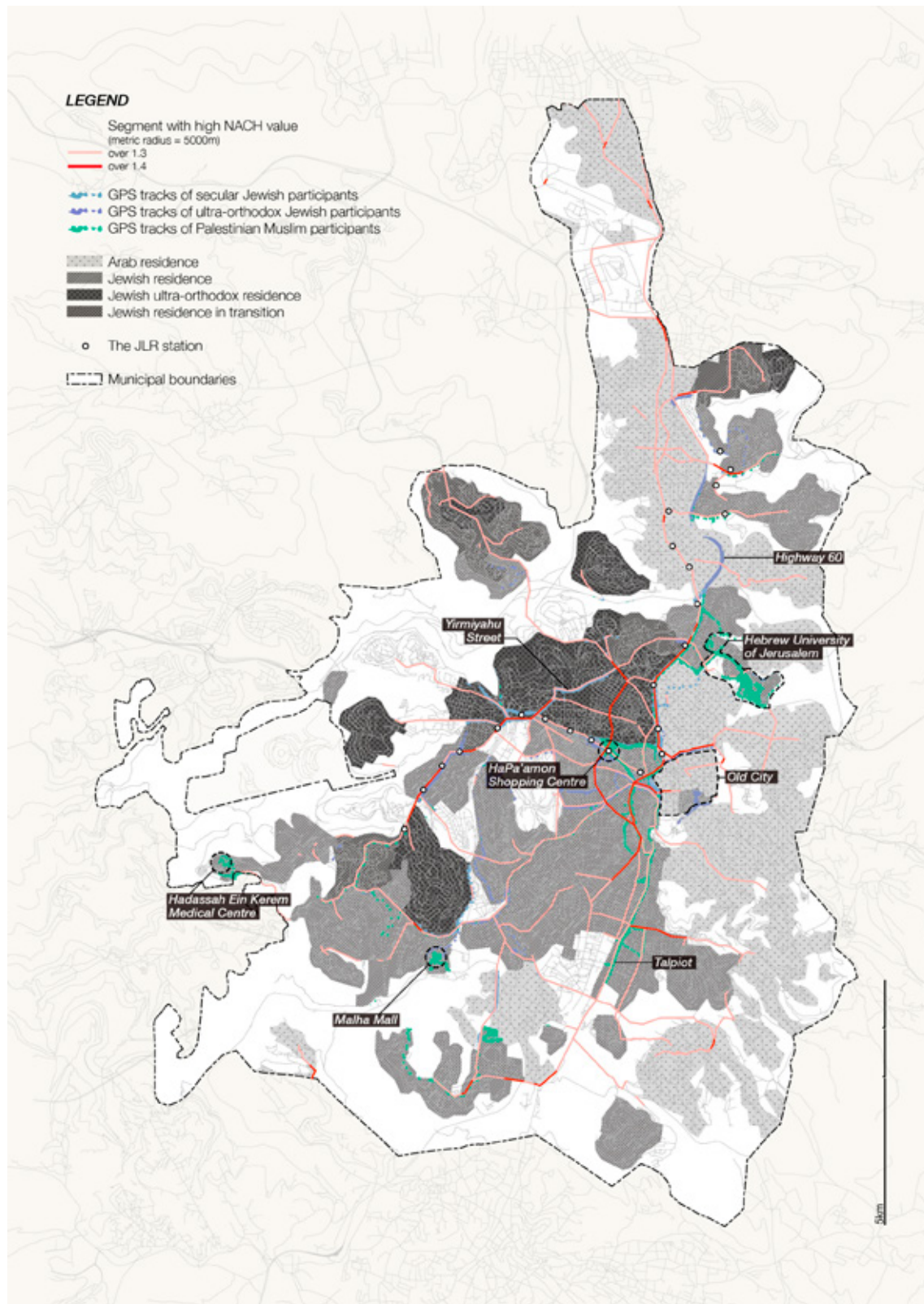


Figure 2 - NACH global, segment angular analysis (radius = 5000m), including the highlighted 1.4 & 1.3 structure, the location of ethnic-cultural territories and GPS tracks

4. RESULT II: THE JLR

The influence of the JLR is first tested with the bi-modal segment angular analysis by connecting the JLR system to the segment model (Figure 3a). Both NACH and NAIN values do not change significantly both in terms of the entire city and in each ethnic-cultural territory (Table 2). The JLR has not changed the configurational properties of the spatial structure because the tracks are on the segments which were already with comparatively high NACH and NAIN values before the implementation of the JLR.

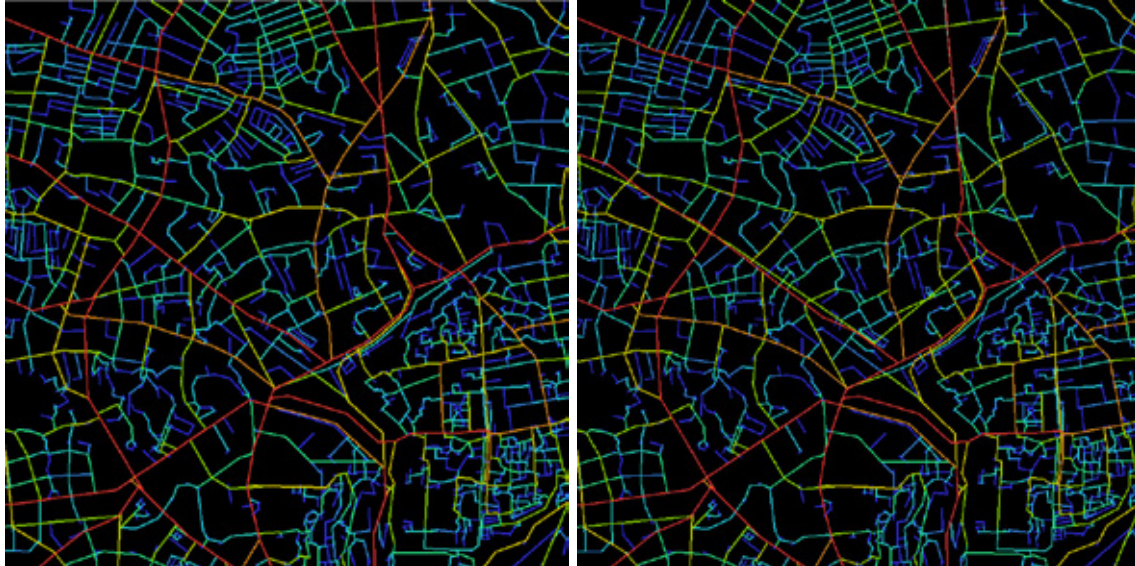


Figure 3 - NACH global, segment angular analysis in 500m radius, with (right) and without (left) the JLR, in Damascus Gate Area.

While the JLR has not significantly changed the spatial structure of Jerusalem, its huge passenger capacity and its unique routeing which passes through all ethnic-cultural territories should exert a greater impact than the spatial model illustrates. Its capacity is considered to be huge as it carries 130,000 passengers every day by only one route with 292 journeys per day, while 69 Israeli bus routes with 7,029 journeys per day only move 441,019 passengers every day (Jerusalem Institute for Israel Studies, 2015). It means that one light rail journey can transport 445 people while a bus journey can only handle 67 people.

Ethnic-cultural territories	Radius	Statistical measure	NACH			NAIN		
			Without JLR	With JLR	% change	Without JLR	With JLR	% change
Arab residence	800	mean	0.763	0.763	0.04%	0.761	0.762	0.09%
		max	1.543	1.543	0.00%	2.219	2.219	0.00%
	2000	mean	0.736	0.736	0.05%	0.633	0.634	0.20%
		max	1.484	1.484	0.00%	1.301	1.301	0.00%
	5000	mean	0.705	0.705	0.05%	0.572	0.573	0.26%
		max	1.453	1.453	0.03%	1.089	1.094	0.49%
Jewish residence	800	mean	0.797	0.798	0.08%	0.774	0.775	0.18%
		max	1.477	1.477	0.00%	1.768	1.768	0.00%
	2000	mean	0.772	0.773	0.08%	0.701	0.703	0.25%
		max	1.468	1.468	0.00%	1.536	1.545	0.64%
	5000	mean	0.741	0.741	0.08%	0.660	0.662	0.26%
		max	1.473	1.473	0.02%	1.168	1.173	0.40%
Jewish ultra-orthodox residence	800	mean	0.833	0.833	0.02%	0.856	0.857	0.03%
		max	1.537	1.537	0.00%	1.633	1.633	0.00%
	2000	mean	0.813	0.813	0.03%	0.826	0.826	0.03%
		max	1.472	1.472	0.00%	1.553	1.553	0.00%
	5000	mean	0.776	0.777	0.03%	0.734	0.734	0.02%
		max	1.451	1.451	0.00%	1.156	1.156	0.00%
Jewish residence in transition	800	mean	0.760	0.760	0.05%	0.674	0.675	0.12%
		max	1.447	1.447	0.00%	1.489	1.489	0.00%
	2000	mean	0.743	0.743	0.04%	0.619	0.621	0.17%
		max	1.427	1.427	-0.05%	1.348	1.352	0.27%
	5000	mean	0.714	0.714	0.04%	0.575	0.577	0.24%
		max	1.416	1.417	0.03%	1.051	1.056	0.48%
All segments inside Municipal boundaries of Jerusalem	800	mean	0.777	0.777	0.03%	0.766	0.767	0.04%
		max	1.552	1.552	0.00%	3.104	3.104	0.00%
	2000	mean	0.753	0.754	0.05%	0.675	0.675	0.03%
		max	1.590	1.590	0.00%	2.571	2.571	0.00%
	5000	mean	0.722	0.722	-0.01%	0.625	0.624	-0.19%
		max	1.473	1.473	0.02%	1.168	1.173	0.40%

Table 2 - The influence of the JLR on NACH and NAIN values in Jerusalem and different ethnic-cultural territories.

While the JLR has not significantly changed the spatial structure of Jerusalem, its huge passenger capacity and its unique routeing which passes through all ethnic-cultural territories should exert a greater impact than the spatial model illustrates. Its capacity is considered to be huge as it carries 130,000 passengers every day by only one route with 292 journeys per day, while 69 Israeli bus routes with 7,029 journeys per day only move 441,019 passengers every day (Jerusalem Institute for Israel Studies, 2015). It means that one light rail journey can transport 445 people while a bus journey can only handle 67 people.



Figure 4 - Proportion of segments within 800m catchment of any JLR station in different ethnic-cultural territories.

The JLR therefore can possibly bring plenty of people to the surrounding areas of the stations. However, as discussed, it should be noted that the JLR only creates potential encounter fields around the stations. People also choose their routes based on their social understandings of space. Through metric depth and angular step depth analysis, catchment areas of the JLR and potential encounter fields can be revealed. Metric depth analysis shows how well the JLR serves the residents (Figure 4). First, by comparing the total length of segments in each territory, the ultra-orthodox Jewish residence is the one with the highest proportion of segments in length within 800m radius of any JLR station ((4) in Table 3). Secondly, while the segments in the ultra-orthodox Jewish residence only accounts for 11.6% of all segments in length within the municipal boundaries ((8) in Table 3), they contribute to nearly a quarter of all segments in length within the 800m catchment of any JLR station ((9) in Table 3). If the context of the whole Jerusalem is not considered, then Jewish residence makes up of the highest proportion of segments in length inside the catchment area ((9) in Table 3).

Ethnic-cultural territories		Arab residence	Jewish residence	Jewish ultra-orthodox residence	Jewish residence in transition	Other areas	All areas
(1)	Total no. of segments	13,171	17,520	5,651	3,551	7,265	47,158
(2)	Total length of segments	497km	619km	206km	119km	338km	1,779km
(3)	No. of segments with metric depth						
	< 800m away from any JLR station	2,264 (17.19%)	3,638 (20.76%)	2,383 (42.17%)	449 (12.64%)	486 (6.69%)	9,220 (19.55%)
	(% compared to (1))						
(4)	Total length of segments with metric depth < 800m away from any JLR station	74.7km (15.04%)	121.9km (19.70%)	72.2km (35.10%)	16.5km (13.85%)	15.6km (4.61%)	301.0km (16.92%)
	(% compared to (2))						
(5)	No. of segments with angular step depth						
	< 3 away from any JLR station (% compared to (1))	598 (4.54%)	1,319 (7.53%)	751 (13.29%)	158 (4.45%)	146 (2.01%)	2,972 (6.30%)
(6)	Total length of segments with angular step < 3 away from any JLR station	32.6km (6.55%)	56.0km (9.06%)	28.5km (13.86%)	8.8km (7.37%)	10.4km (3.07%)	136.3km (7.66%)
	(% compared to (2))						
(7)	% of segment in total no. of segment						
	in Jerusalem	27.9%	37.2%	12.0%	7.5%	15.4%	100%
(8)	% of length in total length of all segments						
	in Jerusalem	27.9%	34.8%	11.6%	6.7%	19.0%	100%
(9)	% of length in total length of all segments with metric depth						
	< 800m away from any JLR station	24.8%	40.5%	24.0%	5.5%	5.2%	100%
(10)	% difference						
	(9) compared to (8)	-11.1%	16.4%	107.4%	-18.2%	-72.7%	
(11)	% length in total length of all segments with angular step						
	< 3 away from any JLR station	23.9%	41.1%	20.9%	6.4%	7.6%	100%
(12)	% difference						
	(11) compared to (8)	-14.5%	18.2%	80.9%	-3.9%	-59.9%	

Table 3 - The proportion of segment with low metric depth and angular step depth away from any JLR station in different ethnic-cultural territories.

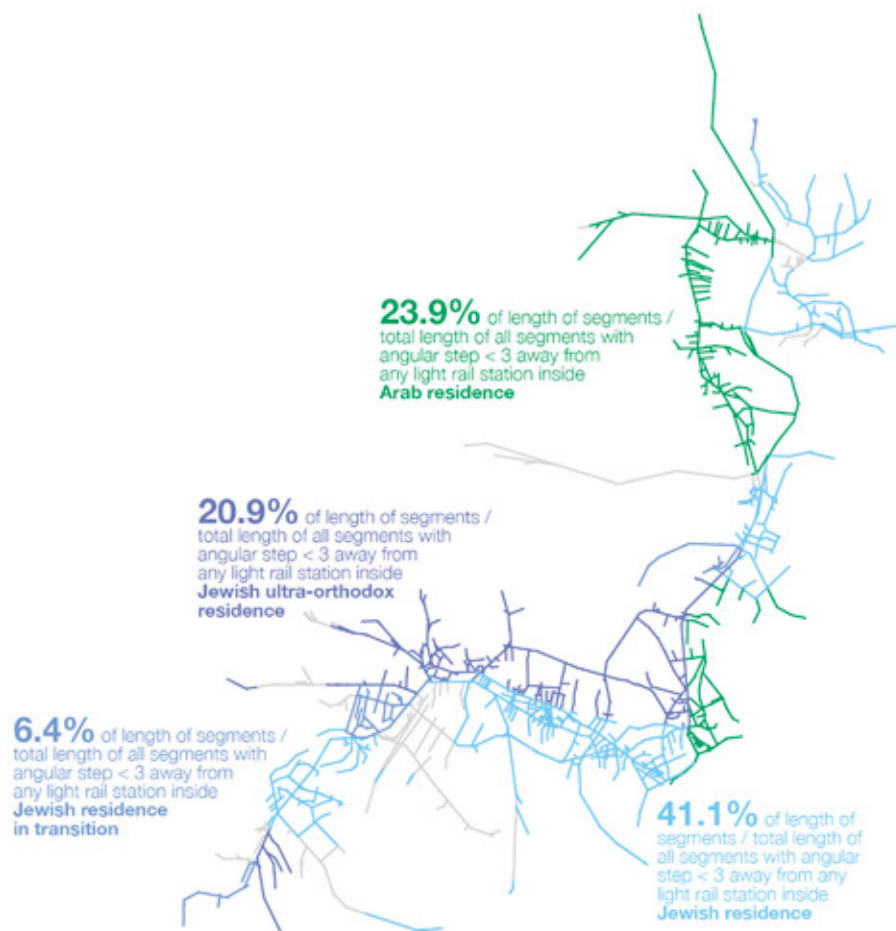


Figure 5 - Proportion of segments with lower than three angular steps away from any JLR station in different ethnic-cultural territories.

Angular step depth analysis tests the potential encounter fields and areas to attract movement-seeking activities. By overlaying the GPS tracks, which are outside the participants' own ethnic-cultural territories in Raanan and Shoval's (2014) experiment, with the segments located in less than three angular steps away from any JLR station, the analysis further reveals the potential encounter fields between different ethnic-cultural groups (Figure 6). Since Arabs and Jews are not familiar with each other's spaces (*Ibid.*), angular step depth analysis will be more accurate than metric depth analysis in showing how people choose their routes outside their own territories.

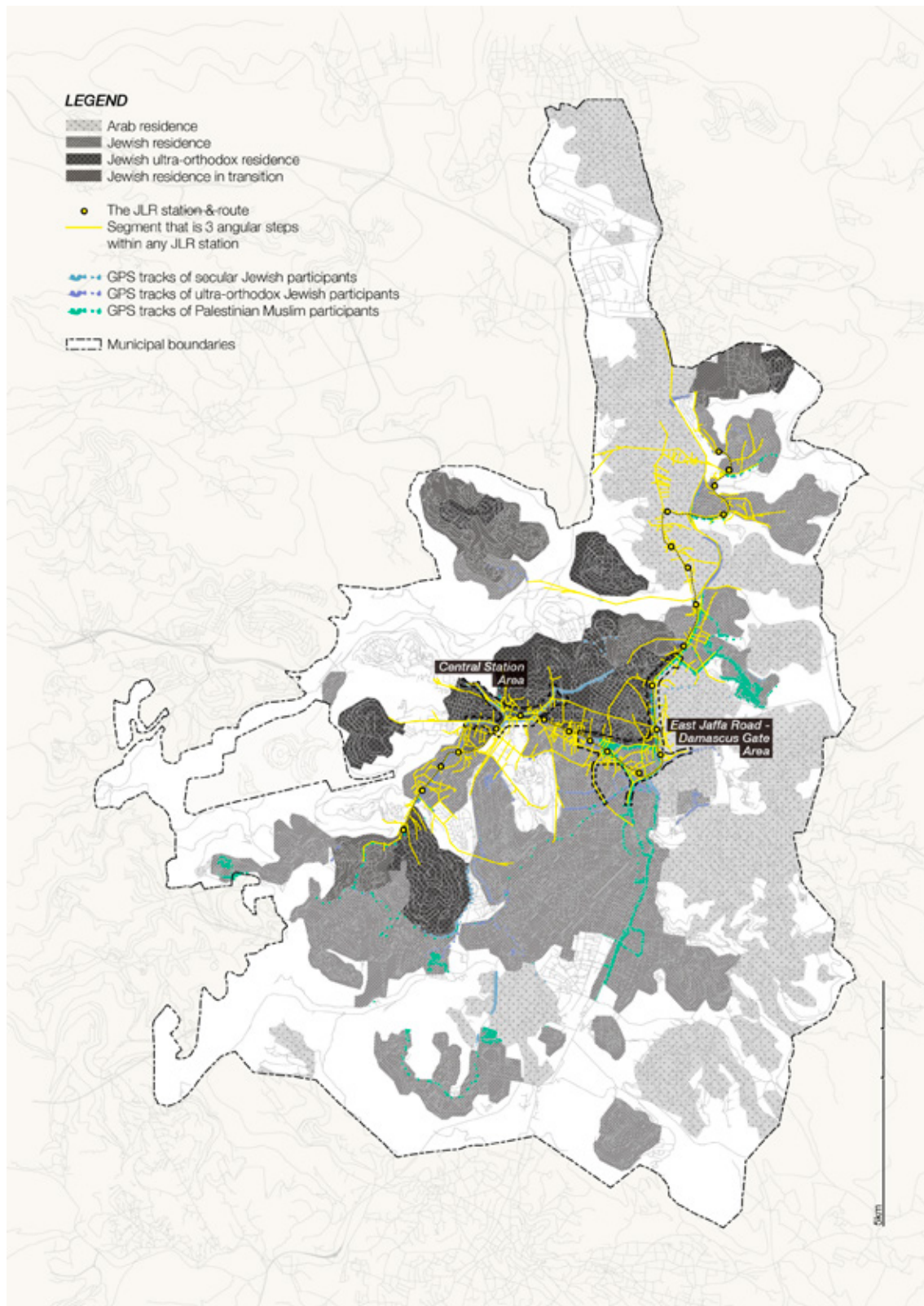


Figure 6 - The segments with lower than three angular steps away from any JLR stations, the location of ethnic-cultural territories, and GPS tracks which are outside the participants' own ethnic-cultural territories.

The result shows that a considerable proportion of GPS tracks scatter on the identified segments, even though the experiment was conducted before the implementation of the JLR. It suggests that the JLR has very likely intensified these spaces by bringing more people to these locations. There are two areas with notably high densities of both low angular step segments and GPS tracks outside the participants' own ethnic-cultural territories. These are the Central Station area and East Jaffa Road - Damascus Gate area. These areas are where the major bus terminals of the Israeli and Palestinian bus systems are located respectively. The East Jaffa Road - Damascus Gate area is more interesting to investigate because it is the junction of three ethnic-cultural territories and people crossed the 'borders' and entered the neighbourhoods of other groups actively in Raanan and Shoval's (2014) experiment. The map also suggests that the JLR may have introduced new spaces of potential multi-ethnic/cultural encounters along the tracks, especially the area with dense identified segments inside secular Jewish territories, which the Palestinian Muslim participants did not define as being part of any ethnic-cultural group (Ibid.). The secular Jewish area in the middle of the Central Station area and East Jaffa Road - Damascus Gate area is possibly a new potential encounter field between different ethnic-cultural groups.

The statistical study of the angular step depth analysis presents a similar result as that of the metric depth analysis. The ultra-orthodox residential areas are also the ones benefited most from the JLR ((6) and (12) in Table 3). Similar to the result of the metric depth analysis, the Jewish residence constitutes the highest proportion of segments with lower than three angular steps away from any JLR station ((11) in Table 3 and Figure 5).

These results help to conclude that ultra-orthodox and secular Jews are the two groups that can gain the highest level of accessibility more than Arabs do in different ways because of the JLR. It should also be noted that the areas around two major bus terminals, which serve Israelis and Palestinians exclusively, are the most prominent potential multi-ethnic/cultural encounter fields. Moreover, it is quite common among Jerusalemites to take the bus and interchange to the JLR in their journeys (Estrin, 2012). Therefore, because of the extensiveness of the bus network, the impact of the JLR should be beyond its route and the empirical observations on the train and around the stations.

5. RESULT III: THE JLR & THE BUS SYSTEM

The map shown in Figure 7 investigates the number of bus lines operated by the Israeli company and Palestinian companies. The extensive bus service network is represented on the map, and more importantly, a clear separation pattern is unfolded. The only segments with the buses run by both bus systems are in the Hebrew University of Jerusalem, Talpilot and around the Old City. The three locations are also identified in Raanan and Shoval's (2014) experiment. The GPS tracks of Palestinian Muslim participants are so dense in the university and rest along the main road in Talpilot and the tracks of the participants of all ethnic-cultural groups scatter around the Old City (Figure 2 and 6). They not only lay along but also scatter around the identified segments. So the identified segments are probably not only the places where there is co-presence of the buses of two systems. They are likely the interfaces consisting of co-presence between people that takes place when they get off and get on the buses.

Since people are actively switching between two transportation modes, how the JLR is differently integrated with the two bus systems should also be studied. Generally, it is easier to interchange between Israeli buses and the JLR because more Israeli buses stop near the JLR stations. Over 90% of Israeli bus lines stop within 400m radius of any JLR station, while only less than two-thirds of Palestinian bus lines stop within the 400m catchment area of any JLR station (Table 4). It can be attributed to the fact that a considerable number of Israeli bus routes have been re-adjusted when the JLR was implemented to serve as the feeder network to the JLR. For instance, Route 48 has been changed from a circle route inside the campus of the Hebrew University of Jerusalem to a route that connects to Ammunition Hill station. Moreover, there are seven JLR stations with Israeli buses terminating within their 400m catchment areas, while Damascus Gate is the only station where Palestinian buses terminate within the catchment, even though the last stops of seven Palestinian bus lines have been relocated to a new bus terminal adjacent to Damascus Gate station.

In studying the JLR and the bus network together, it appears that the Israeli bus system is more integrated to the JLR than the Palestinian one. Still, because of the huge passenger capacity of the JLR, it is likely that more Arabs have come to the city centre, as identified in Figure 6, from the JLR stations in Shuafat and the extensive bus network that terminate in the Damascus Gate area.

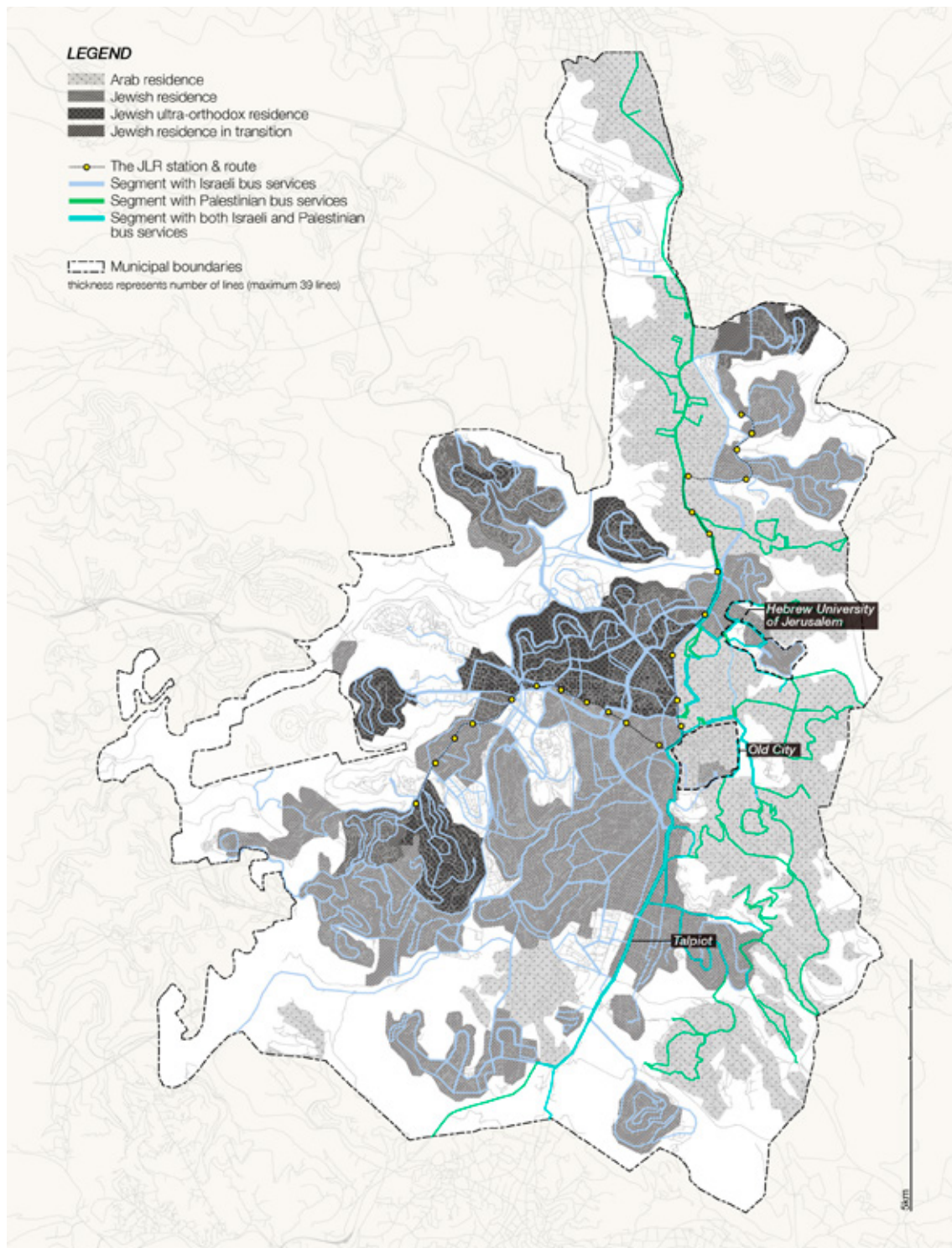


Figure 7 - The segments with bus services and the location of ethnic-cultural territories.

		Israeli bus company		Palestinian bus companies	
(1)	Total no. of routes	69		18	
(2)	Total no. of routes if sub-route counted separately	93		24	
(3)	Total no. of lines if two directions counted separately	158		48	
(4)	Total no. of lines (3) with terminal at any JLR station	29	18.4%	14	29.2%
(5)	Total no. of lines (3) with at least one station next to (within 20m) any JLR station	48	30.4%	16	33.3%
(6)	Total no. of lines (3) with at least one station within 400m radius of any JLR station	70	44.3%	0	0.0%
(7)	Total no. of lines (3) with at least one station within 800m radius of any JLR station	6	3.8%	18	37.5%
(8)	Total no. of lines (3) with no station within 800 radius of any JLR station	5	3.2%	0	0.0%

Table 4 - Comparison of the number of bus lines run by the Israeli company and Palestinian companies in the catchment of the JLR stations.

6. DISCUSSION & CONCLUSIONS

Nearly 12,000 bus and light rail journeys run in Jerusalem every day. They shape people's daily lives as 'multipliers', and at the same time, their routes are determined by the other 'multipliers', the Israeli neighbourhoods in East Jerusalem. Whilst the JLR has not significantly changed the configurational properties of the street network, it has combined with the bus network so that two transportation modes integrate together through the improvement of 'switches', the JLR stations, especially those in Jewish territories. Consequently, a network of both the intensiveness in the city centre and extensiveness in the periphery has emerged. Then, the way in which passengers enter and leave this integrated public transport system is determined by both the 'topology' of the street network and their social understandings of space. Through the interplay between these active forms associated to the JLR, it works in its way that is independent of its symbolic meaning and its declared intent. It possesses an agency and becomes a 'conflict infrastructure'. Three major findings in this paper try to explain how the social consequences have been resulted from the JLR by framing daily experience, such as daily routine and human co-presence.

First, it has probably intensified and created multi-ethnic/cultural co-presence in secular Jewish areas, like Downtown Triangle and Jaffa Road, and Damascus Gate area. More Palestinians are expected to be carried by the JLR to these areas from the stations in Shuafat and Damascus Gate station close to the Palestinian bus terminals. The hypothesis is recognised in the catchment analysis of the JLR (Figures 4-6), the GIS analysis of the bus lines run by two exclusive bus systems (Figure 7), and the application of Raanan and Shoval's (2014) findings on the spatial models (Figures 2 and 6). In most cities, new social relations can appear in these spaces (Hillier and Vaughan, 2007). In Jerusalem, however, it may possibly amplify the conflict between different ethnic-cultural groups. Some right-wing organisations, such as Lehava, have placed posters and stickers warning Palestinians to 'not even think of' approaching Jewish women in these newly shared spaces (Baumann, 2014).

Secondly, the catchment analysis also shows that in general the JLR serve a higher proportion of ultra-orthodox areas compared to the other residential territories. Yet whether ultra-orthodox Jews are truly benefited in the political and religious context in Jerusalem is questionable.

Drawing more people of different groups may lead to conflict when strangers, such as tourists, enter the neighbourhood without cultural awareness. For instance, in Mea Shearim, an ultra-orthodox neighbourhood with less than three angular steps away from the JLR, visitors have to wear modest clothing. Additionally, during the Shabbat, cell-phone should not be visible as they might be a source of dispute (Sapir-Witz, 2006). And it is also possible that Arabs may enter these areas because of their lack of knowledge in Jewish spaces. As Raanan and Shoval (2014) recognised, the Palestinian Muslim participants failed to distinguish between ultra-orthodox areas and secular Jewish areas.

The third reason is less about multi-ethnic/cultural co-presence, but more about whether the JLR has supported all residents in Jerusalem as the Israeli authorities claim. If it would have served Palestinians proactively, its symbolic meaning could possibly be thinned out by its functional benefits. Nevertheless, as recognised in the bus network analysis, the Palestinian bus system is not as integrated with the JLR as the Israeli one. The JLR stations modulate the flow of Jewish passengers much more effectively. No facilities support the connection between Damascus Gate station and the two major Palestinian bus terminals. While the architect of the masterplanning consultant of the Damascus Gate area suggested an underground pedestrian connection between the terminals and the JLR station, the municipality insisted on an overland connection which is fenced off from the terminal side on the east (Rokem, 2006). Consequently, the neutral and functional image of the JLR, emphasised by the authorities, has been overwhelmed by its image of multi-ethnic/cultural conflict, because of its symbolic meaning, as identified by urban theorists, and the agency possessed in the public transport network, as studied in this work.

The paper has in general presented an overall picture of the public transport network in Jerusalem and of how various active forms constitute and affect the everyday life of different ethnic-cultural groups. These active forms include the 'topology' of the street network and the JLR; the propagation of buses, light rail trains and the Israeli neighbourhoods in East Jerusalem as 'multipliers'; and the JLR stations that integrate the two modes of public transport as 'switches'. The three major findings reveal how the JLR has intensified the multi-ethnic/cultural conflict by framing the everyday experience of secular Jews, ultra-orthodox Jews and Arabs in this contested city.

REFERENCES

- Barghouti, O. (2009) 'Derailing Injustice: Palestinian Civil Resistance to the "Jerusalem Light Rail"', *Jerusalem Quarterly*, 38, pp. 47.
- Baumann, H. (2014) 'The Heavy Presence of Jerusalem Light Rail: Why Palestinian Protesters Attacked the Tracks', *openDemocracy*. Available at: <https://www.opendemocracy.net/arab-awakening/hanna-baumann/heavy-presence-of-jerusalem-light-rail-why-palestinian-protesters-attac> (Accessed: 28 May 2015).
- Cohen, H. (2013) 'Joint Israeli-Palestinian Political Activity in Jerusalem: Characteristics and Challenges', in Pullan, W. & Baillie, B. (eds.) *Locating Urban Conflicts: Ethnicity, Nationalism and the Everyday*. London: Palgrave Macmillan, pp. 132-150.
- Easterling, K. (2014) *Extrastatecraft: The Power of Infrastructure Space*. Brooklyn: Verso.
- Estrin, D. (2012) 'Taken for a Ride In Jerusalem' in *Vox Tablet*, Podcast, Available at: <http://tabletmag.com/podcasts/97420/taken-for-a-ride-in-jerusalem#tCsSyt4QUA82EUUP.32> (Accessed: 11 June 2015).
- Hillier, B. (1996) 'Cities as Movement Economies', *Urban Design International*, 1(1), pp. 41-60.
- Hillier, B. and Iida, S. (2005) 'Network and Psychological Effects in Urban Movement', in Cohn, A.G. & Mark, D.M. (eds.) *Spatial Information Theory, Conference on Spatial Information Theory Proceedings*. Berlin; Heidelberg: Springer, pp. 475-490.
- Hillier, B. and Vaughan, L. (2007) 'The City as One Thing', *Progress in Planning*, 67(3), pp. 205-230.
- Hillier, B., Yang, T. and Turner, A. (2012) 'Normalising Least Angle Choice in Depthmap: And How It Opens Up New Perspectives on the Global and Local Analysis of City Space', *Journal of Space Syntax*, 3(2), pp. 155-193.
- Jerusalem Institute for Israel Studies (2015) *The Statistical Yearbook of Jerusalem*. Available at: <http://www.jiis.org/?cmd=statistic> (Accessed: 4 June 2015).
- Nolte, A. (2016) 'Political Infrastructure and Politics of Infrastructure: The Jerusalem Light Rail', *City*, 20(3), pp. 441-454.
- Nolte, A. and Yacobi, H. (2015) 'Politics, Infrastructure and Representation: The Case of Jerusalem's Light Rail', *Cities*, 43, pp. 28-36.
- Pullan, W. (2013) 'Spatial Discontinuities: Conflict infrastructures in Contested Cities', in Pullan, W. & Baillie, B. (eds.) *Locating Urban Conflicts: Ethnicity, Nationalism and the Everyday*. London: Palgrave Macmillan, pp. 17-36.
- Raanan, M. G. and Shoval, N. (2014) 'Mental Maps Compared to Actual Spatial Behavior using GPS Data: A New Method for Investigating Segregation in Cities', *Cities*, 36, pp. 28-40.
- Rokem, J. (2006) *The Power of Discourse in Urban Planning Conflict: Jerusalem and the Case of the Damascus Gate Area*. Msc Cities, Space and Society dissertation, The London School of Economic and Political Science.
- Sapir-Witz, K. (2006) 'A Step Away, Another World', *Ynetnews*, 17 December. Available at: <http://www.ynetnews.com/articles/0,7340,L-3340111,00.html> (Accessed: 13 August 2015).
- Tonkiss, F. (2013) *Cities by Design: The Social Life of Urban Form*. Cambridge: Polity Press.
- Turner, A. (2004) *Depthmap 4 - A Researcher's Handbook*. Bartlett School of Graduate Studies, UCL, London.