The Spatial and Social Network Dimensions of Mobile Communication:

A Test of the Social Stratification and Social Diversification Hypotheses

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Abstract

Studies have shown that ethnic segregation is conducive to social segregation. With the advent of information and communication technologies, mobile communication can support non-local social interactions and reconfigure the network composition of ethnic groups. This study focused on the similarities and differences between ethno-national groups in the structure of their cell phone communications. Data for this study includes a sample of 9,099 business customers' mobile phone calls from an Israeli mobile operator and tested two theoretical explanations. The social stratification approach predicts that mobile communication will reflect the patterns of spatial and social stratification that exist in society. On the other hand, the social diversification hypothesis expects that residentially and socially segregated minority groups will take advantage of mobile communication to diversify their social contacts and to engage in mobile communications with non-local and out-group ties. The findings suggest that in the information society both structural conditions (the stratification approach) and social incentives (the diversification approach) are relevant for the understanding of inter-ethnic mobile communication and structural conditions reduced inter-group mobile communication patterns. The Arab Israeli minority was more likely than the Jewish Israeli majority to engage in mobile communication with non-local ties and out-group members. Yet, structural conditions reduced inter-group mobile communication patterns. The theoretical implications of the findings for inter-group mobile communication are discussed.

Keywords: mobile communication, ethnic social segregation, minority status and ICT, network diversification

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Sociological studies have shown that in multicultural societies, ethnic origin, ethnic inequality and spatial segregation intertwine with each other and create social networks with a high level of ethnic similarity (Massey, 2007; Massey & Eggers, 1990; Musterd & Winter, 1998; Portes & Bach, 1985; Sampson, 2012). Network similarity may inhibit the ability of minority groups to access information and ultimately reduce their social capital (James, 2000; Marsden, 1987; McPherson, Smith-Lovin & Cook 2001). However, with the advent of information and communication technologies (I.C.T.), social interactions are no longer restricted to face-to-face interactions, and new forms of technologically based communication have emerged (Castells et al., 2007; Katz & Aakhus, 2002; Ling, 2008). Mobile communication can support social interactions even when individuals are not in physical proximity (Ling, 2008). Therefore, mobile communication can re-configure the social network composition of ethnic groups and diversify its composition (Dutton, 2005; Mesch & Talmud, 2006, 2010; Wellman, 2001, 2002).

During the last decade, the use of mobile phones for communication purposes has increased worldwide, changing social interactions and supporting new forms of coordination and social connections (Campbell & Kwak, 2010). Scholars describe the use of mobile phones as an example of micro-coordination, a term used to denote real-time changes of plans that were already underway (Ling & Yttri, 2002). Mobile communications create perpetual contact and the personalization of social networks (Campbell & Park, 2008; Katz & Aakhus, 2002). Perpetual contact implies that communication is conducted all the time, everywhere. Perpetual connection is likely

to support personal relationships and in-group communication at the expense of out-group communication (Campbell & Kwak, 2010; Ling, 2008).

In multicultural societies, ethnic social and spatial segregation their negative implications for access to social opportunities have been central topics of research. Mobile communication provides a fresh opportunity to investigate the extent to which cell phone use reflects or provides a potential venue for overcoming the spatial and social dimensions of segregation. In this article, we use a large and unique data set of actual patterns of cell phone communications that identifies the ethnic origin of the communicators. The data set is from Israel, a multicultural society characterized by a high level of social and residential segregation between the two major ethnic groups (Jews and Arabs), making it an appropriate setting for the study.

Therefore, this study asks, does mobile communication reflect spatial and social segregation or integration among ethnic groups? In doing this we make a number of contributions to the existing literature. First, to test this question we rely on the social stratification and social diversification perspectives that present conflicting expectations about the role of I.C.T. on patterns of inter-ethnic communication. Testing in a single study these perspectives contributes to the understanding of their relative contribution to the explanation of inter-ethnic mobile communication in the information society. Second, to investigate this question, we compare the actual patterns of mobile communication between a majority group (Jewish Israelis) and a minority group (Arab Israelis) in the business sector. The use of actual patterns of communication (metered data) gives us an important corrective to the more common use of self–reported data (Boase & Ling, 2011). In sum, this study contributes to the understanding of the role of mobile communication among social networks in deeply divided, ethnically diverse societies.

Mobile communication and social stratification

The stratification hypothesis argues that the adoption of information and communication technologies reflects patterns of existing inequalities in the society (Anderson & Kennedy, 2002; Norris, 2001; Van Dijk & Hacker, 2003; Warren, 2007). According to this approach, varying levels of I.C.T use mirror differences in social inequality and social capital. The majority group with higher socio-economic status and more economic resources seeks to maintain its social capital. Thus, its use of I.C.T will be directed toward strengthening associations and bonds within the ethnic group. By using this strategy, its preserves its high levels of social capital, access to information and social relations within the majority group. Furthermore, as the ethnic enclave theory posits, intra-ethnic relationships may increase as a minority's reaction to social exclusion. Minorities often respond to social discrimination by expanding their in-group ties and reducing their out-group ties (Portes & Bach, 1985). There is some disagreement with this conclusion (Junco, Merson & Salter, 2010; Hampton, Lee & Her, 2011). We will elaborate on alternative arguments later on, when we present the diversification perspective and some recent evidence about the role of mobile phones in social network diversification.

Studies conducted on I.C.T. communication have found that individuals' social associations tend to be with others who share similar characteristics with them such as age, gender, marital status, ethnicity and nationality (McPherson et al., 2001; Mesch & Talmud, 2006). Studies about the formation of social relationships have also emphasized the importance of homophily, which maintains that contacts and friendships are formed between similar individuals more often than between dissimilar individuals (McPherson et al., 2001). As a result, residential and social

segregation prevents members of minority groups from interacting with members of other ethnic and status groups (Mesch, 2012).

This rationale has been validated in research about networks mediated by the use of mobile phones. The literature claims that mobile phone communication reflects patterns of communication within a given geographical area. This approach argues that mobile communication is not only portable, but is also used more and more frequently to communicate with those nearby who live in close proximity to us (Fortunati, 2005). Consistent with this view, a study conducted in ethnic minority neighborhoods found that the Internet was more integrated into the communication infrastructure of white neighborhoods (the ethnic majority) than ethnic minority neighborhoods. Communication infrastructure refers to the various forms of media (both mediated and interpersonal) available to residents that are conducive to residents perception of neighborhood attachment. The study suggests the possibility that in ethnic minority neighborhoods, only those people who already have connections to the communication resources benefit from the addition of I.C.T. communication (Matei & Ball-Rokeach, 2003).

Thus, the stratification approach implies that both majority and minority groups use mobile phones to enhance their local and in-group ties, so mobile phone use reflects the residential and social segregation of these ethnic groups. Why would we expect that the use of mobile communication would be directed toward strengthening local associations and bonds within the ethnic group, as the stratification hypothesis implies? A potential answer lies in the structural theory of heterogeneity and inequality (Blau, 1977). Structural conditions that provide opportunities for social relationships and patterns of mobile communication might be affected by the variation in opportunities for in-group and out-group communication.

Blau's theory is concerned with the implications of the social structure for social integration. Its basic assumption is that social associations depend on the opportunities for social contact. Thus, the greater the opportunity for these contacts, the greater the likelihood that meaningful relationships will be established.

One structural condition is the size of the group. The probability of social contacts between any two different social groups depends on the availability of members of an out-group to connect with in-group members. Of course, the larger the size of the out-group, the better the likelihood of some of them establishing relationships with members of the in-group (Blau & Blau, 1982; Marsden, 1987; Mayhew & Levinger, 1976; South & Messner, 1986). However, the theory also emphasizes that group size as a condition for social association is constrained by social heterogeneity and inequality. Heterogeneity reflects the distribution of the members of the population across social groups. Heterogeneity is directly related to the probability of intergroup relationships because it reflects the likelihood of random contacts and the establishment of associations. The degree of heterogeneity will be positively related to the likelihood of intergroup relationships (Blau, 1977). In addition, Smith (1985) found that ethnic heterogeneity increases the chance of economic transactions between members of different ethnic groups. Nee (1994) added that the greater the level of ethnic heterogeneity in an advanced industrial society, the greater the probability of intergroup contact, the larger the size of the mixed economy, and the more porous the social boundaries of the ethnic groups participating in it (Nee et al., 1994).

Another dimension of Blau's theory is inequality, namely, the differences between groups in terms of income, wealth and prestige. When membership in different groups is associated with differences in social status, opportunities for

contact are likely to be infrequent. Most relevant for our study is the dimension of segregation, which is related to ethnic inequality (Massey, 2007; McPherson et al., 2001). Opportunities for contact clearly vary along with the location of people in physical space. Individuals who are physically separated from one another will be less likely to have opportunities for making social connections. Consequently, we expect that

H1: The greater the spatial segregation between ethnic groups, the smaller the percentage of non-local ties.

H2: The greater the spatial segregation between ethnic groups, the smaller the percentage of out-group ties.

Mobile communication and social diversification

A different expectation derives from the concept of the networked society. In this view, mobile communication redefines the geographical space and does not necessarily reflect it (Castells et al., 2007). According to this view, mobile phones create new social arrangements between the "time-space" arenas including flexible "time-place" arenas crossing a given geographical space (Castells et al., 2007; Green, 2002). Castells (2007) used the expression "the mobile network society" in order to highlight the proliferation of mobile communications in every aspect of our lives. In the mobile network society, mobile communication enhances the autonomy of individuals, allowing them to bypass the limitations of space and build new communication and association ties. Castells (2007) explains that the dimension of place does not disappear in mobile communications. Instead, such communication redefines the meaning of the space that the individual chooses to call, even if the places are home or work. Mobile phones reduce the need to meet face-to-face in order to create and maintain social bonds (Ling, 2008).

Nevertheless, some empirical studies seem to contradict this argument. Cell phone communication appears to be more common for communication with nearby contacts, implying that the total duration of cell phone calls and the number of calls decline with distance (Calabrese et al., 2011; Mok et al., 2010; Quan-Haase, 2007). However, these studies did not consider ethnic residential segregation and the communication patterns between ethnic groups in segregated societies. A recent study in South East Asia based on cell phone data found that while the distribution of spatial segregation is bimodal, the distribution of cell phone communication indicates a disproportionate likelihood of the ethnic minority and ethnic majority communicating with the majority group (Blumenstock & Fratamico, 2013). This study suggests that mobile communication is likely to facilitate inter-group communication.

Consistent with the network society view, the diversification hypothesis underscores the unique uses of I.C.T among minority groups and assumes that this group will use I.C.T to diversify its social network to overcome geographical and social barriers (Mesch & Talmud, 2010). The need for the diversification of social ties emerges from the nature of ethnic segregation in multicultural societies (Lin, 2001). In societies that reward individuals differentially according to income, prestige and power, stratification systems result in the varying ability of individuals to gain access to residential locations (Massey, 2007; Semyonov & Glikman, 2009). Spatial segregation implies that the association choices available to minorities are limited to the ones that exist in their residential locations (Britton, 2011; Massey, 2007). According to the diversification hypothesis (Mesch, 2007, 2012) information and communication technologies provide a platform for overcoming the limited opportunities for inter-ethnic interaction that result from residential segregation. Therefore, the diversification perspective maintains that disadvantaged groups will

use information and communication technologies to diversify their sources of information and social networks. At the same time, majority groups will use information and communication technologies more to maintain their existing contacts and associations (Mesch, 2007, 2012).

Diversification is a concept that can be linked to social capital. Although there are several accepted definitions and operationalizations of this concept, it is agreed that social capital refers to network ties that provide mutual support, a shared language and norms, social trust, and a sense of mutual obligation from which people can derive value (Huysman & Wulf, 2004). Based on these qualities, networks provide differential access to resources that include opportunities, skills, information, social support and sociability. In the diversification perspective, I.C.T is conceived as a social arena of shared activities for achieving differential "bridging" and "bonding" social capital (Mesch, 2012). We can explain the use of I.C.T. to diversify out-group ties as an attempt to increase bridging social capital. In contrast, we can assume that the use of I.C.T. to maintain in-group ties arises from the desire to retain and increase social capital (Putman, 2000; Rainie & Wellman, 2012).

Consistent with the diversification perspective, studies have reported that disadvantaged groups tend to use I.C.T. to expand their business and occupational contacts, whereas members of the majority group are more motivated to use I.C.T. to maintain existing family and friendships ties (Mesch, 2012). As for the role of mobile phones in the structure of social ties, recent studies support the view that mobile phones expand the size of the users' core networks of discussion and have a positive effect on their diversity (Hampton et al., 2009; Hampton, Lee & Her, 2011). A study of American college students found that mobile phone use and texting is higher among African Americans than whites (Junco, Merson & Salter, 2010). Using data

from a representative national sample of the US population, Hampton et al. (2011) found that the association between mobile phone use and network diversity is mediated through visits to semi-public spaces, religious institutions and voluntary associations. Thus, individuals who do not own a mobile phone have a less diverse network than those who do (Hampton et al., 2011).

Therefore, based on the diversification approach, we expect that:

H3: Arab Israelis (the minority group) will use mobile phones more frequently for non-local calls than Jewish Israelis.

H4: Arab Israelis (the minority group) will use mobile phones more frequently than Jewish Israelis to communicate with members of the out-group (Jewish Israelis).

We test the expectations that arise from both the stratification and diversification theories using data from the inter-ethnic mobile communications of business market customers. In the last two decades, the minority labor market has changed in developed countries, with a shift away from employment in firms to self-employment (Barrett et al., 1996, 2001). In light of these trends studies are focusing on local opportunity structures for ethnic entrepreneurs (Li 1998, Light & Bonacich, 1988; Portes 1987). Mobile phone companies distinguish between private and business customers. However, they indicate the customer's language only in the case of business customers. The data on language together with the place of residence provides an ethnic identifier and a unique opportunity to test the expectations that arise from the stratification and diversification theories.

Other Factors Explaining Mobile Communications

Other variables that may explain differences in mobile communications include city, industrial and mobile operator characteristics.

City characteristics. The population size, density and socio-economic status of the cities in which people live may affect their mobile communications. Durkheim (1933) emphasized that the large "volume" of people and their "material density" lead to "dynamic density." Growing urbanization and the concentration of large numbers of individuals in one place lead to high rates of social association. Therefore, Blau (1977) argued that the opportunities for association increase with population size and density. In Israel, cities with a Jewish majority have larger populations and businesses, and are more densely populated than those of Arab Israelis (Ali, 2006; see Table 1). Thus, following this argument, we would expect Jewish Israeli business groups to associate with local businesses more than with Arab Israeli businesses (see H3).

A city's socio-economic status may also be related to patterns of mobile communication. Previous studies have found that higher socio-economic status explained access to I.C.T (Kim, Jung & Ball-Rokeach, 2007) and its use (Ono & Tsai, 2008). Arab Israeli communities have a lower level of socio-economic status than Jewish Israeli towns (Mesch & Talmud 2010; Semyonov, 1988; Smooha & Kraus, 1985). As the effect of city socio-economic status is unclear, we control for this variable in our analysis.

Industry characteristics. Given that the Arab Israeli minority group is generally employed in blue-collar industries such as construction and transportation (Lewin- Epstein & Semyonov, 1992; Mesch & Talmud, 2010; Schnell et al., 1999; Semyonov, 1988) and that these businesses work mostly outside the cities in which the Arab Israelis live, we expect that the Arab Israeli minority group would be more likely than the Jewish Israeli majority group to diversify their ties outside their cities (see H3).

The characteristics of the customers and the mobile operators. Factors associated with the customers and mobile operators both affect mobile communication patterns. Corrocher and Zirulia (2009) determined that people choose a mobile operator based on three factors: the quality of their call connections, the size of the company and the pricing bundles they offer. Other research has emphasized the link between type of handset and usage patterns. The new handsets, especially 3G phones, increase usage (Lee et al., 2002). We expect that cheaper airtime prices and new handsets will increase mobile usage patterns, and extend the size and composition of a business' social network. In addition, a larger number of customers in a city will increase local ties.

The Israeli Setting

Israel is a multicultural society (Peres, 1971; Yaar & Shavit, 2003) in which there is an ethno-national division between Jewish Israelis (the majority group) and Arab Israelis (the minority group). About 21 percent of Israel's residents are Arab Israelis (Central Bureau of Statistics, 2010). Both groups differ in terms of their language, religion and culture (Smooha, 1997). Since the establishment of the state of Israel, Jewish Israelis and Arab Israelis have generally lived in separate cities (Ali, 2006; Falah, 1999). The ethno-national split is also reflected in socio-economic differences. Arab Israelis have lower levels of education and income, and generally hold blue-collar jobs (Haberfeld & Cohen, 2007; Mesch & Talmud, 2010). Most of the Arab Israeli population resides in small cities located in the periphery of the country in which they are the majority of the population and in mixed cities in which residential segregation is high (Ali, 2006; Semyonov & Lewin-Epstein, 1993). Before the Internet age, several studies demonstrated that Arab Israeli entrepreneurs tend to search for inter-ethnic economic networks (Semyonov & Lewin-Epstein, 1993;

Schnell et al., 1995). Previous studies about Internet use found that Arab Israelis who reside in their own villages and cities and are spatially isolated from the majority have a strong motivation for using the Internet to diversify their existing social networks (Mesch, 2012). In light of this level of residential and social segregation, it is interesting to study the patterns of mobile phone use and to explore the extent to which they reflect these spatial and social dimensions or reconfigure them.

The penetration of the Internet and mobile phones has been very rapid in Israel, with the penetration of the latter coming at a much faster rate than the Internet. The number of mobile phones increased from 4.2 million at the beginning of 2000 to 9.9 million in 2010, this in a country with a population of less than 8 million. While in 1999, 45.5 percent of the population had a mobile phone, in 2010 that number rose to 91.3 percent. However, the penetration of mobile phones differs according to ethno-national origin. While 93 percent of Jewish Israeli households report owning a mobile phone, only 72 percent of Arab Israeli households have one (CBS, 2010).

There are about 490,000 businesses in Israel that employ 2.9 million individuals. Half of the market is made up of sole proprietorships, a third employ up to 5 workers, 7 percent employ between 6 and 10 employees, and 8 percent have more than 10 employees. In fact, small businesses employing up to five employees represent 85 percent of the business sector in Israel. Arab Israeli entrepreneurs account for only 11 percent of the businesses, which is an underrepresentation if one takes into account that this group comprises 21 percent of the population of Israel (Central Bureau of Statistics, 2010).

Methodology and data

The data for this study are based on two sources. The first data set is the aggregation of social ties mediated by mobile communications among business

customers as measured by one of Israel's mobile phone operators in April 2010. The database includes 9,099 Israeli business customers, divided into 3,018 businesses from the Arab Israeli sector and 6,081 businesses from the Jewish Israeli sector. In addition, we created a data set about the social and geographical characteristics of 103 Israeli cities from the published statistics of the Central Bureau of Statistics. Both data sets were merged according to the place of residence of each customer.

Measures

We estimated the social ties of business customers by the frequency of their mobile connections with other business customers. Social ties were calculated as the aggregated number of calls out from one business user to another business user during a given month. After this calculation, we restricted the network size to the 10 phone numbers that were most frequently called by the mobile phone user.

We also calculated the composition of the subscribers' mobile social ties and aggregated them at the customer level. We created the aggregation because the unit of the analysis was the business, and many businesses have more than one user. As some customers have more than one user, we averaged all of the calculations of the ties by the number of users within the business customer.

Non-local ties (%): The rate of non-local ties is the percentage of overall connections per customer made outside his or her own city.

Out-group ties (%). The rate of out-group ties is the percentage of overall connections per customer made to users outside his or her own ethnic group.

Ethnic group's relative size. We calculated this number as P_{ai}, where P_{ai} is the proportion of Arab Israeli (*a*) businesses in a given city *i*.

Ethno-national heterogeneity index. We followed Blau's approach (Blau, 1977; Messner & South, 1986) and defined this index as $1 - (P_{ai}^2 + P_{ji}^2)$, where P_{ai} is the

total proportion of Arab Israeli businesses in a given city, and P_{ji} is the total proportion of Jewish Israeli businesses in a given city. When a population is divided into dichotomous categories, the heterogeneity index can range from .00, when one group constitutes the entire population, to .50, when each group constitutes exactly half of the total population in a given city.

Ethno-national dissimilarity index. We computed this index using the following equation:

$$D = 1/2 \sum_{i=1}^{K} | a_i/ A - j_i/J |$$

where a_i = the number of Arab Israeli businesses in a given city and j_i = the number of Jewish Israeli businesses in a given city; A = total Arab Israeli businesses and J = total Jewish Israeli businesses in the study. K denotes the total number of cities in the study (Cortese et al., 1976; Duncan & Duncan, 1955; Van Valey et al., 1977). The index can range from .00, indicating totally integrated cities, to 1.00, indicating totally segregated cities.

Despite its widespread use, the index of dissimilarity as a measure of residential segregation has been the subject of considerable debate. It does not provide information about the residential clusters (neighborhoods) of different groups in the city, nor does it include blocs of cities (Cortese, Falk & Cohen, 1976; Falk, Cortese & Cohen, 1978; Lieberson, 1981; Lieberson & Carter, 1982; Massey, 1978; Massey & Denton, 1988). However, given that we are interested in summary measures of residential segregation rather than neighborhoods and regions, the index appears to be appropriate for our purposes (Van Valey et al., 1977). Furthermore, following South and Messner (1986), while we do not claim that it is the only appropriate measure of segregation, there is no agreement on an alternative to the index of dissimilarity.

Business size. The total number of businesses in a given city.[1]

Business density. The number of businesses per square kilometer in the city (CBS, 2010).

Number of customers. The total number of mobile phone company customers in a given city.

City's socio-economic standing. We used the standard socio-economic status of each city calculated by the Israeli Central Bureau of Statistics. The index is calculated based on the city's average income, percentage of large families and population density (CBS, 2010).

Customer size. The number of subscribers per business customer.

Industry. When businesses sign up with a mobile operator service, they indicate the industry in which the company operates. We introduced a control for the type of industry using a dummy variable indicating the extent to which the customer operates in blue-collar industries - the car industry, transportation and construction. These industries were coded 1, and all other industries were coded 0.

Airtime price (effective price). The total revenue generated from airtime use divided by total minutes of use in a given month.

Percentage of new handsets. The percentage of handsets that a given business customer has that are less than 18 months old.

Length of use. We calculated this number by subtracting the year of the data collection from the year when the business customer signed up with the cell phone company. The price of airtime, the type of the handset and the length of time of being a customer can influence usage patterns. Less expensive airtime, newer handsets and longtime patronage will probably increase mobile usage patterns and extend the size

[1] Data from Dun and Bradstreet and the Yellow Pages.

and the composition of the social network of a given business customer. Therefore, we also controlled for these factors.

Customer's ethnicity. A dummy variable that was coded 1 for Arab Israeli business customers and 0 for Jewish Israeli business customers. The source of this indicator is based on the records of the mobile phone operator. The mobile operator's records the "mother tongue" spoken in order to improve the quality of service by adjusting the customer's service language to the customer's native language.

Results

Table 1 presents the descriptive statistics of the Jewish and Arab Israeli populations, and the population as a whole. From it we learn that the Jewish population is located in larger cities than the Arab population and has more businesses than the cities of the Arab Israeli sector. In addition, Jewish Israeli businesses are more likely than Arab Israeli businesses to be located in cities with higher business densities. Jewish cities also have higher socio-economic status than Arab cities. On average 87 percent of Arab Israeli businesses are located in Arab cities, and 94 percent of Jewish Israeli businesses are located in Jewish cities. Actually, 13 percent of Arab Israeli businesses and only 6 percent of Jewish Israeli businesses are located outside their cities. In addition, Jewish Israeli businesses are more likely than Arab Israeli businesses to be located in heterogeneous cities. However, the Arab Israeli sector is more likely than the Jewish Israeli sector to be spatially segregated. The overall dissimilarity index that measures spatial segregation is 0.85. This index indicates that there is a high level of spatial segregation between Arab Israeli businesses and Jewish Israeli businesses.

[INSERT TABLE 1 ABOUT HERE]

As for the characteristics of the business customers, on average, Jewish Israeli businesses have slightly more handsets than Arab Israeli businesses; 4.0 in the Jewish sector compared to 3.8 in the Arab Israeli sector. Blue-collar industries (the car industry, transportation and construction) represent a small portion of the entire business organizations in both sectors: 8.6 percent of the Arab Israeli businesses compared to 16.5 percent of the Jewish Israeli businesses. About half of the businesses had newer handsets, but the length of use within the Jewish Israeli sector is higher than that within the Arab Israeli sector. Finally, the airtime price per minute in the Jewish sector is 0.06 NIS (about 2 cents) more than that in the Arab sector.

In terms of the dependent variables of the study, we found no differences between Arab Israeli customers and Jewish Israeli customers with regard to their non-local ties (66 percent within both groups). However, Arab Israeli customers had a higher percentage of out-group ties than Jewish Israeli customers (20 percent and 12 percent, respectively).

[INSERT TABLE 2 ABOUT HERE]

Thus, it appears that Arab Israeli customers are more likely than Jewish Israeli customers to use mobile communications to maintain relationships with out-group ties. This finding appears to be consistent with the diversification hypothesis. However, we found no differences between Arab Israeli customers and Jewish Israeli customers with regard to their use of mobile phones to create and maintain relationships with non-local ties. At this point, the picture is not clear, because other indicators such as the extent of heterogeneity and dissimilarity may influence the spatial and social compositions.

Table 3 presents the bivariate Pearson correlation coefficients between the customer's ethnicity, the indexes of heterogeneity and dissimilarity, and spatial and

social composition (non-local and out-group ties)[2]. We found a negative correlation between heterogeneity and dissimilarity (spatial segregation). In addition, we found a positive correlation between ethnic-national heterogeneity and percentage of out-group ties. Dissimilarity also has an opposite effect on the percentage of out-group ties. Furthermore, from the findings, we learn that there is a positive connection between non-local ties and out-group ties.

[INSERT TABLE 3 ABOUT HERE]

In the light of these findings, we computed regression equations in order to investigate the net effect of the differences between ethnic groups and structural factors on the differences in the percentage of non-local ties, while controlling for city and customer characteristics. Table 4 presents the results of a multivariate analysis for the percentage of non-local ties, when controlling *additively* for customer's ethnicity, city and customer characteristics, and structural factors (heterogeneity and dissimilarity). Adding customer's ethnicity, city and customer characteristics, and Blau's structural factors one at a time resulted in three models.

[INSERT TABLE 4 ABOUT HERE]

Model 1 presents the results of an OLS regression predicting non-local ties (in relative values) as a function of the customer's ethnicity (1= Arab Israelis, 0= Jewish Israelis), city characteristics, business size and density in a given city, the city's socio-economic status, and customer characteristics - customer size, blue-collar industry, customer's length of use, airtime cost and percentage of new handsets. The results indicate that Arab Israeli business customers have a larger percentage of non-local ties than Jewish Israeli business customers. In addition, the larger the business and the

[2] Given the overlap between customer ethnicity (1= Arab) and the relative size of Arab businesses in the city (r=.90), we excluded the latter from the model.

more customers in the city, the smaller the percentage of non-local ties. However, the higher the business density in the city, the higher the percentage of non-local ties. Actually, the larger the number of businesses in the city, the higher the rate of local ties.

Furthermore, the city's socio-economic status is important as well. The higher the city's socio-economic status, the higher the percentage of non-local ties. These findings support those in previous studies, which found that higher socio-economic status explained access to and uses of I.C.T (Kim, Jung & Ball-Rokeach, 2007; Ono & Tsai, 2008). In addition, blue-collar industries have a larger percentage of non-local ties than other industries. Finally, the larger the customer size, the higher the percentage of non-local ties. These city and customer characteristics and the customer's ethnicity explain 20.0 percent of the variance in the percentage of non-local ties.

Model 2 investigates non-local ties (in relative values) as a function of the customer's ethnicity, city and customer characteristics, and the city's heterogeneity index. From this model we learn that Arab Israeli customers have a larger percentage of non-local ties than Jewish customers. In addition, as Blau's approach predicted, ethnic-national heterogeneity is associated with the percentage of non-local ties. Including the city's heterogeneity in the model improves the explanation of the variance in the percentage of non-local ties by 1.8 percent.

Finally, in the next step (model 3), we also included the city's dissimilarity in the model. H1 expected that the greater the spatial segregation, the smaller the proportion of non-local ties. Our findings support this hypothesis. However, we found no statistically significant differences between a city's heterogeneity and the percentage of non-local ties. Spatial segregation is more likely than a city's

heterogeneity to affect the percentage of cell-phone supported non-local ties. H3 expected that Arab Israeli customers would have a larger percentage of non-local ties than Jewish Israelis. The findings in model 3 support the hypothesis. Arab Israeli customers have a larger percentage of non-local ties than Jewish Israeli customers. These findings are consistent with the diversification approach. Whereas the Arab Israeli minority group diversifies its non-local ties, the Jewish Israeli majority group expands its local ties.

Table 5 presents the results of a multivariate analysis for out-group ties, in relative values, when controlling *additively* for the customer's ethnicity, city and customer characteristics, and the structural factors of heterogeneity and dissimilarity. Once again, adding these categories successively to the analysis resulted in three models.

Model 1 presents the results of an OLS regression predicting out-group ties (in relative values) as a function of the customer's ethnicity (1= Arab Israelis, 0= Jewish Israelis) and city and customer characteristics. The results also indicate that Arab Israeli customers have a larger percentage of out-group ties than Jewish Israeli customers. In addition, the larger the business size, the higher the percentage of out-group ties. However, the higher the business density in the city and the higher the number of customers in the city, the lower the percentage of out-group ties. The larger the number of businesses in one place, the higher the rate of in-group ties**.** Furthermore, the larger the customer size and the longer the length of use, the higher the percentage of out-group ties. These city and customer characteristics, and the customer's ethnicity explain 4.4 percent of the variance in the percentage of out-group ties.

Model 2 investigates out-group ties (in relative values) as a function of the city and customer characteristics, customer's ethnicity and the city's heterogeneity. From it we learn that Arab Israeli customers have a larger percentage of out-group ties than Jewish Israeli customers. In addition, as Blau's stratification approach predicted, less ethnic-national heterogeneity means a smaller likelihood of out-group ties. Including the city's heterogeneity in the model improves the explanation of the variance in the percentage of out-group ties by 4.5 percent.

In model 3, we also included the measure of the city's dissimilarity. H4 expected that the minority group (Arab Israelis) would have a higher percentage of cell phone communications with members of the ethnic out-group than the Jewish Israelis. We found that Arab Israeli customers have a larger percentage of out-group ties than Jewish Israeli customers. This finding is consistent with the diversification approach. Arab Israelis are likely to communicate with out-group members (with Jewish Israelis), whereas Jewish Israelis are more likely to communicate with themselves. In addition, as Blau's stratification approach predicted, the less heterogeneous the city, the smaller the likelihood of out-group ties.

H2 expected that the greater the spatial segregation, the smaller the likelihood of out-group ties. According to the findings, there is a negative correlation between a city's dissimilarity and the likelihood of out-group ties. In addition, a city's heterogeneity is more likely than spatial segregation (the city's dissimilarity) to affect out-group ties ($\beta = .185$ and $\beta = -.074$, respectively). Thus, hypothesis 2 was supported. Including Blau's structural characteristics in the model improved the explanation of the variance in the percentage of out-group ties by 0.1 percent, without reducing the impact of the customer's ethnicity on out-group ties, as the diversification approach expected (H4).

[INSERT TABLE 5 ABOUT HERE]

Discussion

This research focused on the similarities and differences between ethno-national groups in the structure of their social networks based on communications conducted in the Israeli business arena via mobile phones. Taking advantage of the specific characteristics of the Israeli society, we investigated the composition of both local and non-local mobile phone ties as well as ethnic in-group and out-group mobile phone ties. The study tested two theoretical explanations for these patterns: the social stratification hypothesis and the social diversification hypothesis. The social stratification approach expects that mobile communication will reflect the patterns of spatial and social stratification that exist in society, so communication will be conducted within the limits of local and in-group ties. On the other hand, the social diversification hypothesis expects that residentially and socially segregated minority groups will take advantage of mobile communication to diversify their social contacts and will be more likely than the majority group to engage in mobile communications with non-local and out-group ties.

Our findings indicate the need for a more nuanced approach that perceives non local and inter-ethnic mobile communication as dependent on both structural opportunities and constrains and mobile phone affordances and group motivations. Space still matters and the structural conditions that are conducive to social segregation have some effect on mobile communication patterns. As the stratification approach predicted, the less ethnically heterogeneous the population, the smaller the likelihood of intergroup ties. In addition, the greater the degree of spatial segregation, the smaller the likelihood of intergroup ties.

In addition, the findings indicate that despite the contextual constraints, even when controlling for structural conditions, mobile communication facilitates both non-local and inter-group communication. As the diversification approach predicted, the Arab Israeli minority was more likely than the Jewish Israeli majority to engage in mobile communication with non-local ties. Furthermore, regardless of their place of residence, Arab Israelis were likely to communicate with out-group members (with Jewish Israelis), whereas Jewish Israelis were more likely to communicate with members of their own group.

By analyzing social ties via the mobile communication patterns of distinct ethnic groups, we learn that these social ties reflect existing patterns of social and spatial segregation. We also learn that mobile communication provides an avenue for inter-group communication. Moreover, the disadvantaged minority is more likely than the majority group to engage in inter-ethnic communication. Thus, it seems that social inequality and residential segregation are an incentive for the disadvantaged minority to expand and diversify its social ties. In addition to overcoming distance, Arab Israelis are more likely to communicate with Jewish Israelis, using mobile technology to diversify the ethnic composition of their contacts.

Ethnic residential segregation is viewed as a major structural feature of most Western societies. Many studies have been conducted on the extent and consequences of spatial segregation in the US (Massey & Eggers, 1990; Sampson, 2012). The massive influx of immigrants into European countries that has changed the ethnic composition of many countries has prompted similar studies there (Semyonov & Glikman, 2009). Spatial segregation in multicultural societies has consequences for differential access to social services, medical facilities and social networks. As in Israel, in ethnically heterogeneous countries, spatial segregation has significant

consequences for the development of inter-ethnic interactions, ties and contacts. In this study we found that as the stratification approach suggests, spatial segregation reduces opportunities for interaction between members of minority populations and members of the majority group population.

Our study contributes to the study of inter-ethnic relationships in that it shows that this pattern is not replicated entirely in mobile communication ties. In particular, our study demonstrates that in multicultural societies, mobile communication supports inter-ethnic communication, but in a very specific way, one that is consistent with the diversification hypothesis rather than the stratification hypothesis. While previous studies indicated that mobile phone owners in the population tend to have more diverse networks (Hampton et al., 2011), our study shows that ethnic minorities are more likely than the ethnic majority to diversify the composition of their social networks. Such diversification of ties has important implications for the living conditions of ethnic minorities. Inter-ethnic contacts are likely to reduce prejudicial views of minorities, facilitate access to sources of social capital and support their social integration in society.

Our study also contributes to the emerging research field of mobile communication studies. Research into mobile communication has reported that, despite its affordability, mobile communication is likely to be used locally (Campbell & Kwak, 2010; Fortunati, 2005). Our study indicates the need to introduce the variables of ethnicity and race into mobile communication studies and to investigate the differential use of the technology by various social groups.

One other question that remains unresolved is: does mobile communication provide a new avenue for inter-group communication, or did the types of interactions existed previously and are just reflected in the mobile communication data? Given the

data we have, we cannot answer this question. Future research needs to collect the appropriate data to deal with this question of causality.

In sum, in the information society structural conditions (the stratification approach) as well as social incentives (the diversification approach) are at the heart of inter-group social relationships. Future studies should combine both the stratification and diversification approaches in order to improve our understanding of inter-group social relationships. In this context, this study should be extended to investigate the effect of ethnically mixed and homogenous cities on the patterns of inter-group mobile communication. Such studies would improve our understanding of the extent to which mobile communication provides a venue for the acquisition of social capital for ethnically disadvantaged groups.

Table 1 Descriptive variables: Structural variables and Customer's Characteristics (Jewish sector, Arab Israeli sector, total population)

	Total Population N=9,099		**Arab Sector N=3,018**		**Jewish Sector N=6,081**		**F**	**Two-tailed t-test (.(sig**
	Mean	S.D.	Mean	S.D.	Mean	S.D.		
City's Characteristics								
Population size	126,583	161,092	48,337	61,231	162,833	190,441	1,332	.000
Business size	6,544	10,564	2,129	4,455	8,516	11,716	1,069	.000
Business density	185.7	212.8	90.8	86.6	278.0	235.6	1,510	.000
Number of customers	241	204	184.9	151.9	272.5	221.4	895	.000
City's S.E.S	4.81	1.8	3.14	1.31	5.5	1.57	622	.000
Structural Characteristics								
Arab Israeli businesses in the city (%)	32%	42%	87%	27%	6%	12%	2,216	.000
City's heterogeneity index	.083	.152	.079	.17	.085	.141	198	.112
City's dissimilarity index	.016	.014	.019	.015	.015	.013	131	.000
Customer's Characteristics								
Customer size	3.89	5.5	3.8	4.8	4.0	6.0	53	.030
Blue-collar industry (core) =1	13%	34%	8.6%	28%	16.5%	37.1%	481	.000
Percentage of new handsets	45%	45%	44%	45%	44%	44%	11	.779
Customer's length of use	5.23	3.90	4.6	3.8	5.6	3.9	9.8	.000
Airtime price	.79	.61	.72	.55	.78	.60	19.7	.000

Table 2. Percentage of non-local and out-group ties

	Total Population	Arab Sector	Jewish Sector	F	Two-Tailed t-test
Average total percentage of non-local ties	66%	66%	66%	398	.154
Average percentage of out-group ties	15%	20%	12%	92	.000
N	9,009	3,018	6,081		

Table 3. Correlation between customer's ethnicity, Blau's structural characteristics, and spatial and social ties

	Customer ethnicity (1=Arab Israelis)	City's dissimilarity index	City's heterogeneity index	Non-local ties (%)	Out-group ties (%)
Customer's ethnicity (1=Arab)	**1**				
City's dissimilarity index	.122**	1			
City's heterogeneity index	-.017**	-.346**	1		
Non-local ties (%)	.015	-.380**	.053**	1	
Out-group ties (%)	.150**	-.161**	.212**	.277**	1

Note: **$p < .01$; *$p < .05$

Table 4. Multivariate results of O.L.S. regressing customer and population characteristics on non-local ties (Relative values)

	Non-local ties (%)			Non-local ties (%)			Non-local ties (%)		
	B	S.E.	β	B	S.E.	β	B	S.E.	β
Customer's ethnicity (1=Arab)	.091	.007	.145**	.082	.007	.129**	.102	.007	.126**
City's heterogeneity index	-	-	-	.263	.018	.139**	.034	.025	.018
City's dissimilarity index	-	-	-	-	-	-	-4.705	.353	-.231**
Business size	-.000	.000	-.256**	-.000	.000	-.265**	-.000	.000	-.229**
Business density	.000	.000	.293**	.000	.000	.330**	.000	.000	.304**
Number of customers	.000	.000	-.254**	.000	.000	-.289**	.000	.000	-.117**
City's S.E.S	.042	.002	.275**	.037	.002	.243**	.030	.002	.193**
Customer size	.003	.000	.050**	.003	.000	.048**	.003	.000	.051**
Blue-collar industry (core)	.024	.008	.028**	.019	.008	.022*	.015	.008	.018*
Customer's length of use	.001	.001	.016	.001	.001	.016	.001	.001	.017
Airtime price	-.003	.005	-.007	-.004	.005	-.007	-.004	.005	-.007
Percentage of new handsets	-.009	.006	-.014	-.010	.006	-.016	-.008	.006	-.013
Constant	.384	.013**		.403	.018**		.448	.018**	
Adjusted R-Square	.200			.218			.232		

Note: **$p < .01$; *$p < .05$

Table 5. Multivariate results of O.L.S. regressing customer and population characteristics on out-group ties (Relative values)

	Out-group ties (%)			Out-group ties (%)			Out-group ties (%)		
	B	S.E.	β	B	S.E.	β	B	S.E.	β
Customer's ethnicity (1=Arab)	.112	.006	.217**	.100	.0076	.192**	.105	.006	.203**
City's heterogeneity index	-	-	-	.347	.016	.224**	.286	.022	.185**
City's dissimilarity index	-	-	-	-	-	-	-1.243	.316	-.074**
Business size	.000	.000	.041*	.000	.000	.026	.000	.000	.038*
Business density	-.000	.000	-.072**	-.000	.000	-.013	-.000	.002	-.021
Number of customers	-.000	.000	-.060**	.000	.000	-.116**	-.000	.000	-.061**
City's S.E.S	.018	.002	.140**	.011	.002	.090**	.009	.002	.074**
Customer size	.003	.000	.081**	.003	.000	.078**	.003	.000	.079**
Blue-collar industry (core)	.009	.007	.013	.002	.007	.003	.001	.007	.002
Customer's length of use	.002	.001	.024**	.001	.001	.024*	.002	.001	.024*
Airtime price	.003	.004	.007	.003	.004	.007	.003	.004	.007
Percentage of new handsets	.001	.005	.008	-.000	.005	-.001	.000	.005	.000
Constant	-.088	.016**		-.062	.016		.050	.016**	
Adjusted R-Square	.044			.089			.090		

Note: $^{**}p < .01$; $^{*}p < .05$

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