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Ethnic Differences in Activity Spaces: A Study of Out-of-Home Nonemployment Activities with Mobile Phone Data

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The need to examine the entire scope of everyday activities of individuals in segregation studies has recently been recognized by social scientists and policy makers. To bring forth new insights into ethnic segregation through investigating the activities and movement undertaken by different population groups, we used mobile phone positioning data to compare the activity spaces of out-of-home nonemployment activities over a one-year period in Estonia and abroad. The results show that ethnicity has a significant influence on the activity spaces of individuals. The biggest differences between the two population groups occur in Estonia outside the respondents’ home city of Tallinn, where the Russian-speaking minority was found to visit 45 percent fewer districts than Estonians. Moreover, they exhibit a preference for districts that are more heavily populated by a Russian-speaking population. With respect to international travel, the Russian-speaking minority visits fewer countries and are 3.6 times more likely to visit former Soviet Union countries than Estonians. The activity spaces of out-of-home nonemployment activities have fewer differences between the two groups in the respondents’ home city of Tallinn. Overall, our results show that ethnic differences have less effect on the everyday activity space and a greater influence on the choices made regarding long-distance travel. Key Words: activity space, ethnic segregation, leisure segregation, mobile positioning, out-of-home nonemployment activities.

Recientemente se ha reconocido por científicos sociales y hacedores de políticas la necesidad de examinar en estudios sobre segregación todo el espectro de las actividades cotidianas de los individuos. Con la intención de generar nuevo entendimiento en la segregación étnica al investigar las actividades y movimiento emprendidos por diferentes grupos de población, usamos los datos posicionales de los teléfonos móviles para comparar los espacios de actividad utilizados para el desempeño de oficios extra-hogareños no asociados con empleo durante un año, en Estonia y en el extranjero. Los resultados indican que la etnicidad tiene una influencia significativa sobre los espacios de actividad de los individuos. En Estonia, las más grandes diferencias entre los dos grupos de población ocurren por fuera de Tallin, ciudad de los entrevistados, donde se descubrió que la minoría ruso-parlante visitaba 45 por ciento menos distritos que los estonianos. Más aún, aquellos muestran una preferencia por distritos que están mayoritariamente habitados por una población hablante de ruso. Respecto a viajes internacionales, la minoría hablante de ruso visita menos países y tienen 3.6 veces de mayor probabilidad que los estonianos de visitar países de la antigua Unión Soviética. Los espacios de actividad en oficios fuera del hogar no asociados con un empleo tienen menores diferencias entre los dos grupos en la ciudad de residencia de los entrevistados, Tallin. En general, nuestros resultados muestran que las diferencias étnicas tienen menos efecto sobre el espacio de actividad cotidiano y una influencia más grande sobre las escogencias hechas en relación con viajes de larga
With globalization leading to increasing migration flows and escalating ethnic tensions in a number of regions, ethnic segregation remains a significant social issue. Because effective solutions for the successful integration of migrants into the host society have yet to be found, the number of publications emphasizing the need to adopt new approaches to the study of segregation has grown over the last decade. One approach, which is highlighted by researchers and policy makers alike, relates to the need to include the entire scope of activities undertaken by individuals to gain a fuller understanding of the phenomenon (Schnell and Yoav 2001; Wong and Shaw 2011; Wang, Li, and Chai 2012; Kwan 2013). This could be seen as a critique of the excessive attention that researchers in this field have paid to places of residence and workplaces in recent years at the expense of investigating people’s entire activity space.

Segregation based on places of residence has been a topic of debate since the early twentieth century and remains so today. Studies of residential segregation have primarily sought to highlight ethnic differences in terms of housing and living conditions (Massey and Denton 1993; Musterd and van Kempen 2009; Semjonov and Glikman 2009; Kährrik and Tammaru 2010; Marcinczak 2012) and have examined the effects of such segregation (van Kempen and Özüekren 1998). Several studies have shown that residential segregation affects people in a number of areas of life (Friedrichs, Galster, and Musterd 2003; Blasius, Friedrichs, and Galster 2007; Fong and Chan 2010)—from access to schools, shops, and workplaces (Abramson, Tobin, and VanderGoot 1995; Ellis, Wright, and Parks 2004) to fostering contact between neighbors (Peach 2007). In addition to this form of segregation, there is also segregation in the workplace. Studies have revealed that there is more intermingling of people from different backgrounds and less segregation in workplaces than in places of residence (Ellis, Wright, and Parks 2004; Aslund and Skans 2010). It is also possible, however, that people experience more segregation in places other than their residence (Kwan 2013).

To understand segregation in terms of people’s entire activity space, it is important to study ethnic differences in people’s out-of-home nonemployment activities, including leisure activities. Whereas activities related to living and working are often spatially restricted by typically routine activity spaces (Golledge and Stimson 1997; Kwan 2000; Schönfelder and Axhausen 2004), in their leisure activities people might have more spatial choices and are subject to less stringent constraint (Goodin et al. 2005). One hypothesis that has been proposed is that people have more choices when it comes to leisure activities and thus leisure has a greater potential to lead to interethnic contact (Floyd and Gramann 1993; Schnell and Yoav 2001; Williams 2002; Dougherty 2003; Shinew, Glover, and Parry 2004). In contrast, based on ethnicity theory, it has also been argued that individuals often self-segregate in leisure activities (Washburne and Wall 1980). In other words, people with similar values, ethnicity, and identity prefer to spend leisure time with members of their own group (Floyd and Gramann 1993; Gobster 2002; Dixon and Durrheim 2003; Dougherty 2003). Indeed, a review of the literature on this topic clearly shows that leisure activities are significantly influenced by interpersonal relationships and social networks (Larsen, Urry, and Axhausen 2005; Carrasco and Miller 2006).

The formation of social bonds takes place according to the homophily principle—network ties are far more likely to be fostered between similar people (McPherson, Smith-Lovin, and Cook 2001). Spatial vicinity is also an important factor in the formation of social relationships (McPherson, Smith-Lovin, and Cook 2001).

Given the contrasting findings with respect to the relationship between segregation and leisure activities, this study seeks to examine two distinct population groups in Estonia to gain further insights into this relationship. We studied the out-of-home nonemployment activities of ethnic Estonians as the majority population (68 percent) and the Russian-speaking minority (31 percent) in Estonia. We used passive mobile (cell phone) positioning data (Ahas and Mark 2005; Ahas et al. 2008) for our analysis. Although this is not a usual source of data for segregation studies, we believed that it would help us to gain new insights into the research topic. Our research questions are as follows:

1. What kind of ethnic differences can be observed in the geographic extent of the out-of-home nonemployment activity spaces in Estonia and abroad?
2. What kind of ethnic differences can be observed in the geography of movement and in the population structure of visited places?
Theoretical Background

Activity Space and Social Networks

A range of factors influence people's activity spaces, which unfold in a spatially and temporally delimited area (Hägerstrand 1970). A significant proportion of people's space–time behavior is routine and repetitive, and this can be categorized into activity spaces that consist of places that are regularly visited, such as the home and the workplace (Golledge and Stimson 1997; Kwan 1999; Golledge and Gärlin 2002; Schönfelder and Axhausen 2004; Schwanen, Kwan, and Ren 2008). In addition, people's activity space includes places that are visited less regularly or randomly, and these places might be more often connected to their leisure activities. The latter spaces (i.e., those not associated with home and work routines) are gaining increasing importance with respect to the issue of segregation because of the overall rise in spatial mobility and the spread of information and communication technology. People are now often able to work from home or while traveling and can, conversely, take care of household matters while at work or traveling (Urry 2003; Larsen, Urry, and Axhausen 2005; Kwan 2007).

Spatial mobility that is associated with household or work activities is characterized by a person-to-activity connection. In this case, the geographical distribution of urban opportunities like jobs and housing determines the destination. In the case of social activities, social ties and relationships among individuals can become more important than the geographic distribution of opportunities for these activities. This type of activity travel is characterized by a person-to-person connection and by the location of social networks (Stutz 1973, cited in Carrasco and Miller 2009; Carrasco, Miller, and Wellman 2008). Destinations for social activities are selected on the basis of a personal or emotional meaning and often related to people's homes (Carrasco and Miller 2006; Carrasco, Miller, and Wellman 2008).

In today's society, in general, social relationships among people tend to be a significant determining factor of activity space when compared to location and distance. The size of a social network (number of contacts) and its geographical scope play a major role in determining a person's mobility (Axhausen 2005; Carrasco and Miller 2006; Silvis, Niemeier, and D'Souza 2006). Compared to everyday activities, movements related to social activities often cover a greater distance and extend beyond the everyday activity space (Urry 2003; Silvis, Niemeier, and D'Souza 2006). Study results show that emotional closeness between individuals in a social network does increase the interaction and spatial mobility between them (Carrasco and Miller 2009). It is also important to understand that children often inherit social networks and activity spaces from their parents (Axhausen 2005). As such, older generations play a part in molding the leisure-related spatial mobility of younger generations. In addition to the locations of social activities, some places also have an emotional meaning for people and this could also influence the geographical scope of leisure activities.

Ethnic Differences in Leisure Activities

Most leisure-related segregation studies have been carried out in the United States. They compare white Americans and other ethnic groups in terms of their religious (Dougherty 2003), gambling (Deepak 2007), and outdoor recreation activities (Gramann 1996; Floyd 1999; Weber and Sultana 2013). Studies show that white Americans do more outdoor recreation activities, such as camping and hiking (Mueller and Gurin 1962, cited in Floyd 1999; Aizlewood, Bevelander, and Pendakur 2006), whereas African Americans tend to undertake more urban recreation, such as picnicking (Gobster 2002) and church attendance (Krause and Tran 1989). In the national parks studied, visitors from different ethnic backgrounds were found to prefer different activities (Washburne and Wall 1980; Dwyer 1994; Floyd 1999). White Americans are more likely to undertake individual activities such as walking or dog walking, cycling, and running, whereas other groups tend to favor more passive social activities like picnicking, sightseeing, getting together with friends, and going to festivals and parties (Gobster 2002).

Leisure spaces are frequently delimited along both racial and ethnic lines (Johnson et al. 1998; Floyd and Shinew 1999; Gobster 2002; Weber and Sultana 2013). Johnson et al. (1998) highlight that black and white Americans have unwritten rules about the use of wildlife recreation areas. Racial and ethnic minorities are less frequent visitors to national parks (Washburne 1978; Dwyer 1994; Scott and Munson 1994; Floyd 1999), and there are more people among (nonwhite) minorities who have never visited one (Gramann 1996). A study conducted by Dixon and Durrheim (2003) reveals that although different ethnic groups do sometimes use the same areas—in this case beaches—they tend to keep to separate parts of them, with little contact between groups.
Differences between the majority and minority populations in their leisure activities are primarily explained through two dominant theories: marginality and ethnicity (Washburne and Wall 1980; Floyd et al. 1994; Deepak 2007). The marginality theory attributes racial and ethnic differences to socioeconomic factors—poverty and discrimination. The more limited involvement of minorities in leisure activities is connected to income, employment status, occupational status, level of education, and the availability of transport and information (Washburne 1978; West 1989; Scott and Munson 1994; Johnson et al. 1998). Discrimination is viewed as a barrier that has a negative impact on the participation of minorities in leisure activities. The focus of attention is on contemporary (rather than historical) sources of discrimination arising from interpersonal contact (Floyd 1999).

Ethnicity theory underscores the importance of cultural factors among groups—differences in traditions, values, beliefs, norms, and socialization practices (Hutchinson 1987; Allison 1988; Walter, Brown, and Grabb 1991; Floyd 1999). Cultural differences affect not only people’s choices of leisure activities but also the location of those activities. Ethnic groups might choose to undertake specific activities and choose specific locations for them to set themselves apart from other groups and to maintain their ethnic identity and heritage (Washburne and Wall 1980; Karlis and Dawson 1995). Leisure activities play an important role in the preservation of the identity of minorities in a multicultural society (Floyd and Gramann 1993).

A number of authors have shown that differences in the recreational use of space are influenced by a combination of marginality and ethnicity factors (Floyd and Gramann 1993; Johnson et al. 1998). Leisure activities are also often related to social networks (Stodolska 2000). Race and ethnicity have the strongest impact on the composition of social networks in ethnically diverse societies (McPherson, Smith-Lovin, and Cook 2001). Interracial friendships are an exception rather than the norm (Kao and Joyner 2004). Even if the ethnic barrier is overcome and friendships are formed, fewer joint activities are undertaken with interethnic friends than with friends from the same ethnic group (Kao and Joyner 2004). Moreover, people from minorities who are not sufficiently integrated into the social network of the majority population might lack knowledge about recreational opportunities in the first place (Stodolska 1998).

Residential segregation has also been identified as a factor influencing people’s leisure activities. Interethnic contact during leisure activities is more common among people from less segregated areas (van der Laan Bouma-Doff 2007). According to Edwards (1981), the dominant ethnic group in a residential area describes 14 percent to 43 percent of the variations in recreational preferences. Conversely, Putnam (2007) claims that in ethnically heterogeneous areas, people—including those from minorities—have fewer contacts because there is a lower level of trust and understanding in a heterogeneous community, even among people from the same ethnic group.

The impact that a residential area has on the fostering of contacts also varies from case to case. It also depends on the life cycle stage of the individual. For example, children and the elderly are more based in their home neighborhoods, whereas working-age people are much more mobile. Also, women form close relationships in the areas in which they live more frequently than men because they are geographically more sedentary and have fewer contacts through work and social activities (Moore 1990).

Ethnic Groups in Estonia

The majority of the population in Estonia consists of ethnic Estonians (68 percent) who speak the Estonian language. The largest minority group consists of various nationalities from different parts of the former Soviet Union (Russia, Ukraine, Belarus, etc.), who mostly speak Russian. For the sake of simplicity, we refer to this group as the Russian-speaking minority.

Estonian society is segregated both socially and spatially. The majority and minority populations tend to work in different sectors of the economy, go to different schools, and live in different areas (Tammur and Kulu 2003; van Ham and Tammur 2011). The spatial segregation of the Russian-speaking minority was significantly influenced by the residential and labor market policies of the former Soviet Union, whereby the bulk of the immigrants who came to Estonia from elsewhere in the former Soviet Union settled in larger cities and industrial areas. According to the 2000 census, 42 percent of the Russian-speaking population live in the capital city, Tallinn, and a further 31 percent live in the industrial towns of northeast Estonia. The Russian-speaking population forms 46 percent of the overall population of Tallinn, and 86 percent or more of the population in the towns in the northeast of the country (notably 97 percent in the case of Sillamäe). The Russian-speaking
population is clearly a minority elsewhere in Estonia, however (Figure 1).

Because spatial segregation is based on place of residence, a certain proportion of the Russian-speaking minority population lack opportunities that could have fostered contact with the majority population and therefore this has limited, and continues to limit, their integration into Estonian society (Võormann and Helemäe 2003; Korts 2009). A general low level of Estonian language skills among the minority population is both the cause and the effect of this limited contact. During the Soviet era, Estonia had a linguistically separate school system, so the Estonian language skills of the Russian-speaking population remain poor for migrants and subsequent generations and opportunities for interethnic contact are limited. One of the consequences of this policy is that the social networks of Estonians and the Russian-speaking minority in Estonia today are different depending on their linguistic ability (T. Vihalemm 2007). The number of interethnic contacts that people have is a key factor that influences their spatial mobility outside the residential area.

Contact between Estonians and the Russian-speaking minority population is dominated by employment-related interaction (with colleagues and clients) and fleeting contact in the service sector and on the street (Korts 2009). Although a third of Estonians (and half of Estonians in Tallinn) and half of the Russian-speaking population in Estonia come into contact with people from the other ethnic group in the workplace, contact is rare in their private lives (Korts 2009). Personal and family networks are highly segregated along ethnic lines (T. Vihalemm 2007). Even in the capital city, the number of friends and acquaintances from the other ethnic group that people communicate with regularly is very small (Korts 2009). This is also reflected in the small number of marriages between members of the minority and majority populations (9 percent; van Ham and Tammaru 2011).

The Russian-speaking minority is strongly connected to its cultural roots as exemplified by their use of various forms of Russian media based in Russia. For instance, 82 percent of the Russian-speaking minority
watches the TV channel Pervõi Baltiskii Kanal (PBK) and 75 percent watch other Russian channels several times a week. Approximately 75 percent of Estonians do not watch Russian channels at all and only 10 percent watch them several times a week (P. Vihalemm 2011). Thus, the media consumption of Estonians and the Russian-speaking population differs greatly in Estonia.

Data and Methods

Conceptual Framework

The aim of this study is to assess ethnic differences in out-of-home nonemployment activities, including leisure activities undertaken outside of or away from the home district. Previous research has shown that, in general, due to the socioeconomic barriers described in marginality theory (Washburne 1978; West 1989; Scott and Munson 1994; Johnson et al. 1998) and a lack of contacts (Stodolska 1998; McPherson, Smith-Lovin, and Cook 2001), the leisure-related spatial mobility of an ethnic minority might be a lot less than that of the majority population. To assess the extent of the activity spaces of the two main ethnic groups in Estonia, we used passive mobile positioning data of the location and timing of call activities of individuals during the year 2010. In our previous studies we showed that the locations of the call activities recorded during the course of a long observation period (at least one calendar month) could be used to describe the activity space and important anchor points (residence, work) of an individual rather well (Ahas et al. 2010; Silm and Ahas 2010). Using these data and for the purposes of this study, we define activities undertaken in areas outside people’s places of residence and work as out-of-home nonemployment activities that include maintenance activities and leisure activities (Kwan 1999; Wen and Koppelman 2000). Out of the total number of calls made by all respondents in our sample, 41.6 percent were made from the home district and 19.7 percent were made from an area identified as a workplace district. The remaining 38.7 percent of calls formed the basis of this study.

In addition to the need to assess ethnic differences in the extent of people’s activity space, previous studies highlight the importance of taking social networks into account (Larsen, Urry, and Axhausen 2005; Carrasco and Miller 2006) and ethnicity theory (Washburne and Wall 1980; Karlis and Dawson 1995), in that the people belonging to a minority often spend their leisure time with people from their own ethnic group and in related locations. In light of this, to learn how the activity spaces of minorities are related to people from their own ethnic groups, we measured the proportion of the Russian-speaking population in the districts visited as a second variable. In the case of visits to foreign countries, we determined the probability of travel to countries of the former Soviet Union.

The spatiotemporal behavior of people has often been studied in a limited spatial and temporal frame and has also often depended on the data available. Geographers and health researchers have recognized the need to more precisely delineate the temporal and spatial configuration of geographic context for analyzing the health impacts of various social and environmental variables (Matthews 2008; Kwan 2009; Diez-Roux and Mair 2010). As this study seeks to examine segregation in terms of people’s entire activity space and over the course of a long period of time, it is to a certain extent in line with attempts to address the uncertain geographic context problem (UGCoP; Kwan 2012). As Kwan (2012) argued, the mobile positioning data used in this study are particularly suitable for addressing the UGCoP because they allow researchers to identify more precisely where and when people undertake their daily activities and to better represent the true geographic context.

Passive Mobile Positioning Data

The data used for this study comprise passive mobile positioning data—this is a relatively novel source of information in ethnic segregation studies but one that has been used in a number of studies on transport and space–time behavior (Asakura and Hato 2004; Ahas and Mark 2005; González, Hidalgo, and Barabási 2008; Silm and Ahas 2010; Calabrese et al. 2011; Yuan, Raubal, and Liu 2012). Passive mobile positioning data are automatically stored in the memory or log files held by mobile phone operators. The mobile positioning data consist of call detail records (CDR), billing memory, handover between network cells, and so on (Ahas et al. 2008).

This study uses the CDR database of the biggest Estonian mobile operator, EMT. In 2010, the market share of EMT was estimated to be 45 percent in Estonia and approximately 96 percent of the population of Estonia use mobile phones (TNS EMOR 2010). EMT’s network covers 99.9 percent of the country.
We analyze two types of passive mobile positioning data in this study:

1. Call activities of the residents of Estonia when they were in Estonia. The database consists of the locations of outgoing call activities (outgoing calls and text messages sent) on mobile phones in the EMT network. For each item of call activity the database includes the following information: the randomly generated ID number of the phone used, the time of the call activity (with accuracy of one second), and the location (network cell ID). The accuracy is greater in more densely populated areas (100–500 m in cities) or in areas with denser networks of roads, whereas accuracy is lower (500–5,000 m) in more sparsely populated areas (Ahas et al. 2008).

2. Call activities of the residents of Estonia when they were abroad (i.e., traveling outside of Estonia). The database contains the incoming and outgoing call activities made abroad via the roaming service of EMT. The database contains the ID number of the phone used, the time of the call activity (with accuracy of one second), and the location (country) for each call activity.

The ID numbers of the mobile phones of the users held in both databases are identical, which enables us to connect the two databases. The assigned ID ensures anonymity and cannot be associated with a specific individual or phone number. In addition to call activities, the sex, birth year, and user language of the mobile phone users were provided by EMT for research purposes only. It is assumed that the user language selected as the language of communication with the operator is the user’s first language. In addition, the CDR data are used to identify the home and work time anchor points for each user. Anchor points are determined using a special model based on the location and the timing of the call activities of each user over a one-month period (Ahas et al. 2010).

The collection, storage, and processing of the data obtained from EMT complied with European Union (EU) requirements regarding the protection of personal data in EU directives on handling personal data (European Parliament 1995) and the protection of privacy in the electronic communications sector (European Parliament 2002). Separate approval was also obtained from the Estonian Data Protection Inspectorate.

**Methods**

The study covers the one-year period from January to December 2010. The sample of 6,250 Estonian- and 6,250 Russian-speaking people was randomly selected from the passive mobile positioning database of individuals over eighteen years old with a permanent residence in Tallinn. Similar to the sample, the actual divide between Estonian- and Russian-speaking people in Tallinn is fairly equal, with Estonian-speaking people making up 54 percent of the population and Russian-speaking people 46 percent (according to the 2000 census). As shown in Table 1, the sex distribution of the sample by ethnic group is slightly different from that of the residents of Tallinn: According to 2000 census data, 45 percent of both the Estonian- and Russian-speaking populations are men, whereas the percentage share of the men in the sample is 40 percent in the case of Estonians and 46 percent in the case of the Russian-speaking minority. When compared to the age distribution of Tallinn residents recorded in the 2000 census, the study sample is underrepresented in the youngest (eighteen to twenty-nine) and oldest (sixty and older) age groups and overrepresented in the thirty to fifty-nine age group. This same tendency can be seen in both the Estonian- and Russian-speaking samples. The highest number of Estonian speakers in the sample is found in residential districts where the proportion of the Russian-speaking population is smallest (0–39 percent), whereas the highest number of Russian speakers in the sample is found in districts where they form the majority population (60–79 percent).

On average, over the course of the year (2010) the members of the sample made an average of 1,592 call activities (approximately 133 per month) in Estonia. Through these call activities we examined people’s activity spaces based on calls made outside home and work districts. The districts visited are those in which a person made at least one call activity during the study period (2010).

The analysis focuses on call activities in three distinct geographical areas: (1) in Tallinn; (2) in Estonia (excluding Tallinn), and (3) in foreign countries (outside Estonia). The spatial units used for the analysis are defined as study districts as follows. There are twenty-five study districts in Tallinn, each of which is made up of an area containing similar buildings and functions. In areas outside Tallinn in Estonia, there are 227 study districts made up of local municipalities. It should be noted that local municipalities in which there was no mobile antenna (twelve) were excluded from the
Table 1. Percentage distribution of characteristics of the sample compared to Tallinn residents based on 2000 census data

<table>
<thead>
<tr>
<th></th>
<th>Sample</th>
<th>Tallinn residents (2000 census)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estonians</td>
<td>Russian-speaking minority</td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>40</td>
<td>46</td>
</tr>
<tr>
<td>Female</td>
<td>60</td>
<td>54</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18–29</td>
<td>15</td>
<td>11</td>
</tr>
<tr>
<td>30–39</td>
<td>29</td>
<td>27</td>
</tr>
<tr>
<td>40–49</td>
<td>24</td>
<td>26</td>
</tr>
<tr>
<td>50–59</td>
<td>16</td>
<td>24</td>
</tr>
<tr>
<td>&gt; 60</td>
<td>16</td>
<td>12</td>
</tr>
<tr>
<td>Percentage of Russian speakers in residential district</td>
<td>58</td>
<td>24</td>
</tr>
</tbody>
</table>

a In the case of the census data, the age group is 20–29.
b Place of residence distribution is based on 2000 census data.

analysis. Outside Estonia, countries form the study units. There was no correlation between the number of visits and the area of districts, but there was a correlation of 0.6 between the number of visits and the number of inhabitants in a district outside of Tallinn.

To analyze differences in the extent of activity space among the two different ethnic groups, the number of districts visited in Tallinn, in Estonia (excluding Tallinn), and abroad were first assessed using a linear regression model

\[ Y_i = \alpha + \sum_{k=1}^{K} \beta_k X_{ik} + \epsilon_i \]  

(1)

where \( Y_i \) is the number of districts visited in Tallinn by individuals \( i = 1, \ldots, I \); \( \alpha \) is a constant; \( X_{ik} \) is the value of the variable for an individual; \( \beta_k \) is the parameter describing the impact of this variable, with \( K \) variables, and \( \epsilon \) is the error term. First, we used a model with only language as a variable. Then we used the full model, which also included the other variables listed in Table 1 (sex, age group, percentage of Russian speakers by residential district). Similar models were also constructed to assess the number of districts visited in Estonia (excluding Tallinn) and the number of foreign countries visited.

Second, the proportion of the Russian-speaking population in the districts visited in Tallinn and Estonia (excluding Tallinn) were assessed using the linear regression model

\[ Y_i = \alpha + \sum_{k=1}^{K} \beta_k X_{ik} + \epsilon_i \]  

(2)

where \( Y_i \) is the proportion of the Russian-speaking population in the districts visited in Tallinn \( i = 1, \ldots, I \). First, we used the model with only the language variable included. Then we used the full model, which includes the same variables as Equation 1. A similar model was constructed to measure the proportion of the Russian-speaking population in the districts in Estonia (excluding Tallinn).

In the case of travel abroad, the probability of travel to countries of the former Soviet Union was assessed using the binary logistic regression model

\[ \log \frac{p(Y_i = 1)}{p(Y_i = 0)} = \alpha + \sum_{k=1}^{K} \beta_k X_{ik} \]  

(3)

where \( p(Y_i = 0) \) is the probability of individuals \( i = 1, \ldots, I \) traveling to countries other than those of the
Ethnic Differences in the Extent of Activity Space

There are significant differences between the extent of activity space of the majority population—Estonians—and that of the Russian-speaking minority. Russian speakers visit a smaller number of districts than Estonians when traveling in Tallinn, in Estonia, and abroad (Table 2). The difference between the number of districts visited by Estonians and Russian speakers is higher in Estonia (excluding Tallinn) than in Tallinn and abroad. Estonians visit an average of 19.3 non-Tallinn districts in Estonia per year, whereas Russian-speaking people visit 10.6. Hence, Russian-speaking people visit 45.1 percent fewer districts, and the difference is statistically significant \( (p < 0.01) \) even when other variables (sex, age, percentage of Russian speakers in residential district) are included in the model.

The total number of foreign countries visited by the Russian-speaking minority is also lower than that visited by the majority population. Estonians visit an average of 2.04 different countries per year, whereas Russian-speaking people visit 1.68 different countries; the difference is statistically significant \( (p < 0.01; \text{Table 2}) \). When we add other variables to the model, the effect of ethnic difference on the number of visited countries decreases but remains statistically significant \( (p < 0.05) \). Estonian-speaking people visit a total of 115 countries per year, whereas Russian-speaking people visit 97. It should also be noted that 43.2 percent of Russian-speaking people and 39.3 percent of Estonians did not go abroad at all in 2010.

The differences in the extent of the activity space in Tallinn, the sample’s home city, were smaller. Estonians visit 16.7 different districts in Tallinn per year, whereas Russian-speaking people visit 16.6 \( (p < 0.05) \). When other variables are added to the model in addition to language, the difference between the extent of the activity space in Tallinn of Estonians and that of the Russian-speaking minority is not statistically significant \( (p < 0.1) \).

\[ p(Y_i = 1) \] is the probability of individuals \( i = 1, \ldots, I \) traveling to countries of the former Soviet Union. Travel to the following countries of the former Soviet Union was considered: Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Lithuania, Latvia, Moldova, Russia, Ukraine, and Uzbekistan. As with the previous models, we first included only a language variable, and then we used all of the variables.
Table 3. Ethnic differences in the proportion of the Russian-speaking population in the districts visited in Tallinn and in Estonia (excluding Tallinn), and in the probability of traveling to former Soviet Union countries

<table>
<thead>
<tr>
<th></th>
<th>Linear regression model</th>
<th>Binary logistic regression model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tallinn B, significance</td>
<td>Estonia (excluding Tallinn) B,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>significance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Foreign countries(^a) Exp (B),</td>
</tr>
<tr>
<td></td>
<td></td>
<td>significance</td>
</tr>
<tr>
<td>Model with only language as a variable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Language (ref.: Estonian)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Russian</td>
<td>1.618**</td>
<td>8.639**</td>
</tr>
<tr>
<td>(R^2) adjusted</td>
<td>0.002</td>
<td>0.038</td>
</tr>
<tr>
<td>(N^b)</td>
<td>208,184</td>
<td>187,212</td>
</tr>
<tr>
<td>Full model</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Language (ref.: Estonian)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Russian</td>
<td>1.772**</td>
<td>8.266**</td>
</tr>
<tr>
<td>Sex (ref.: Male)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Female</td>
<td>-0.355**</td>
<td>0.474**</td>
</tr>
<tr>
<td>Age (ref.: 18–29)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>30–39</td>
<td>-0.020</td>
<td>-0.447**</td>
</tr>
<tr>
<td>40–49</td>
<td>-0.071</td>
<td>-0.474**</td>
</tr>
<tr>
<td>50–59</td>
<td>0.151</td>
<td>-0.114</td>
</tr>
<tr>
<td>&gt; 60</td>
<td>-0.249</td>
<td>0.042</td>
</tr>
<tr>
<td>Percentage of Russian speakers in residential district (ref.: 40–59)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0–39</td>
<td>0.621**</td>
<td>-0.656**</td>
</tr>
<tr>
<td>60–79</td>
<td>0.063</td>
<td>0.602**</td>
</tr>
<tr>
<td>(R^2) adjusted/(-2LL)</td>
<td>0.002</td>
<td>0.038</td>
</tr>
<tr>
<td>(N^b)</td>
<td>208,184</td>
<td>187,212</td>
</tr>
</tbody>
</table>

\(^a\)The reference category is a destination in countries other than former Soviet Union countries.  
\(^b\)Sum of all districts visited by each individual in the sample.  
\(*\)Significant at 0.05.  
\(**\)Significant at 0.01.

Ethnicity remains the most important variable influencing the spatial extent of out-of-home nonemployment activities even when other variables are added to the model. It was also found, though, that women visit a lower number of districts in Tallinn and in Estonia, and a lower number of foreign countries, than men (Table 3). The extent of the activity spaces of out-of-home nonemployment activities also decreases with age: Older people visit a smaller number of districts than younger people. Those who live in districts where the percentage of Estonian-speaking people is higher visit a higher number of districts per year than those living in districts dominated by Russian-speaking people. This is similar for all three geographical areas studied, in Tallinn, in Estonia (excluding Tallinn), and abroad.

**Ethnic Differences in the Visited Districts**

The activity space of out-of-home nonemployment activities of the Russian-speaking minority is significantly connected with districts more heavily populated by Russian-speaking people. In contrast, Estonians visit districts that have different ethnic compositions (Table 3). Based on census data from 2000, the average proportion of the Russian-speaking population in all of the districts in Estonia (excluding Tallinn) visited by Russian speakers is 20 percent, whereas the average proportion of the Russian-speaking population in those districts visited by Estonians is 11.4 percent, equating to a difference of 8.6 percentage points, which is statistically significant \((p < 0.01)\). In the case of Tallinn, the average proportion of the Russian-speaking population in districts visited by Russian speakers is 38.9 percent and it is 37.3 percent in districts visited by Estonians. The difference in the case of districts visited in Tallinn is small at 1.6 percentage points but nevertheless is statistically significant \((p < 0.01; Table 3)\). Scatter diagrams clearly show the correlation between the percentage of Russian-speaking minority in the residential districts (by census data) and the districts visited outside home and work districts (by mobile positioning data; Figure 2). The correlation is 0.63...
Figure 2. Correlation between the proportion of the Russian-speaking minority in residential districts by census data and districts visited outside the residential and work district according to mobile positioning data for (A) Tallinn and (B) Estonia (excluding Tallinn). (Color figure available online.)

(p < 0.05) in Tallinn (Figure 2A). In the case of Estonia (excluding Tallinn), the correlation is 0.66 (p < 0.05; Figure 2B).

Differences in the activity spaces of the majority and minority populations are also clearly apparent in the case of destinations abroad. The results of the binary logistic regression analysis show that Russian-speaking people have 3.6 times higher odds of visiting a former Soviet Union country than Estonians (Table 3). The neighboring country of Russia is the destination most visited by Russian-speaking people; it was visited by 23.4 percent of the Russian-speaking people in 2010. In contrast, Russia is a destination for just 5.8 percent of Estonians. The difference between the two ethnic groups is 17.6 percentage points. The second most visited destination country for both Estonians and Russian-speaking people is Latvia; approximately 17 percent of both ethnic groups traveled there in 2010. Finland is the main destination country visited by Estonian-speaking people; 33 percent visited the country that year. Finland is the third most visited destination country for Russian speakers, but proportionally far fewer Russian speakers (15.3 percent) visit the country than Estonians. In addition to Russia, Latvia, and Finland, the top five destinations of the Russian-speaking minority include Sweden (8.6 percent) and Turkey (7.2 percent). The top five destinations of Estonians are Finland, Latvia, Sweden (14.8 percent), Germany (6.9 percent), and Lithuania (6.1 percent).

In addition to ethnic differences, there are also statistically significant differences in terms of sex with respect to the proportion of the Russian-speaking population in the districts visited (Table 3). The proportion of the Russian-speaking population is smaller in districts visited by women in Tallinn than it is for men; in Estonia (excluding Tallinn) the situation is reversed. In the case of traveling abroad, women have lower odds of traveling to former Soviet Union countries than men (Table 3). In terms of age group, statistically significant differences in districts visited only emerge in the case of Estonia (excluding Tallinn). The districts visited by young people (aged eighteen to twenty-nine) contain a higher proportion of Russian-speaking people than those visited by all the other age groups. In the case of traveling abroad, however, the odds of traveling to a former Soviet Union country generally increase with age. Finally, people living in districts where Russians predominate tend to visit districts in Estonia (excluding Tallinn) that are home to a larger proportion of Russian speakers (Table 3).

Geographical Differences

The geography of the out-of-home nonemployment activities of the two ethnic groups is also different. The distribution of the districts visited by Estonians and the Russian-speaking minority differs more in Estonia than in the city of Tallinn itself. Many people of both groups visit districts close to Tallinn. This is a logical extension of the activity space from the core city to its outlying areas (Figure 3). When we look at Estonia (excluding Tallinn) as a whole, it can be seen that Estonians travel more to the west and south of the Tallinn urban region and further afield in Estonia—these districts are predominantly populated by Estonians (Figure 3A). In contrast, Russian-speaking people visit more districts to the east of the Tallinn urban region and in northeastern Estonia, as well as the cities of Tartu and
Pärnu in southern Estonia (Figure 3B). These are all districts where large Russian-speaking communities can be found.

The distribution of the districts visited by Estonians and the Russian-speaking minority is more similar in Tallinn, the sample’s home city. The districts in the city center are visited intensively by both Estonians and the Russian-speaking minority and there is no notable difference or evidence of segregation (Figure 4). This result shows that the city center, which has a diversity of functions, has good potential for interethnic contact. Outside the city center, the districts visited more by Russian speakers tend to be in the east of the city (Figure 4B), where there is a higher proportion of the Russian population in residence. The districts visited more by Estonians tend to be in the southern part of the city (Figure 4A), where there is a higher proportion of Estonians.

Discussion

Studies dealing with leisure-related segregation show that these activities are conducive to freedom of choice in terms of activities and networks, and in theory this presents more opportunities for contact to arise between different groups (McPherson, Smith-Lovin, and Cook 2001; Shinew, Glover, and Parry 2004). Many studies, though, have revealed that people's nonemployment
activities (including leisure and social activities) are often performed in relation to their own social networks, including minority group networks, and therefore might be conducive to segregation (Floyd and Gramann 1993; Gobster 2002; Dixon and Durrheim 2003; Dougherty 2003). Due to the specific nature of our data, the results of the analysis cannot be directly related to specific leisure activities. Movements outside the home and work district reflect movements to out-of-home nonemployment activities, however, and probably fall outside the daily routines of the sampled individuals. Based on this assumption, this study shows how mobile phone data can be used to provide a more complete picture of the activity spaces of different ethnic groups.

Our results show that the activity spaces of the Russian-speaking minority outside their home city are significantly segregated, corroborating similar findings of several recent studies discussed in Kwan (2013). The Russian-speaking minority visits fewer districts than the majority population. Moreover, their visits tend to occur in districts that are predominantly populated by the Russian-speaking minority. In contrast, the Estonians in our sample visit a wide range of districts across the whole of Estonia.

These results can, to some extent, be described by marginality theory, where, in Estonia, marginality is represented primarily by the language barrier (Lauristin 2009; Tammaru and Kontuly 2011; Vetik and Helemäe...
Among the Russian-speaking minority, there is a high proportion of people with a lower occupational status and lower incomes than the national average, and there is also a higher rate of unemployment (Tammaru and Kulu 2003; Lindemann and Voörmann 2010; Voörmann and Helemäe 2011). These factors could be important causes of the limited activity spaces of the Russian-speaking minority, especially in making visits to the rest of Estonia, because despite the number of attractive recreational sites in various locations throughout Estonia, the Russian-speaking minority only visit northeastern Estonia and districts that are more heavily populated by Russian-speaking people.

Ethnicity theory also offers a potential explanation of the results. That is to say, people prefer to live and spend leisure time with people of the same language group. This is also true for Estonia’s Russian-speaking minority, who usually spend time with their fellow Russian speakers and primarily consume media in the Russian language (P. Vihalemm 2011). This preference is reflected in the existence of Russian-language cultural events and the location of Russian-oriented recreational venues in districts with larger Russian-speaking populations. At the same time, though, the Russian-speaking minority accesses media sources that are based in Russia and is in close contact with the social networks in Russia, so being together and maintaining their culture is probably not a central activity in the life of the community. Therefore, we would suggest that the ethnicity theory cannot really explain the segregation of the Russian-speaking minority in Estonia.

The results of the study can be partly explained by social network and homophily theories (McPherson, Smith-Lovin, and Cook 2001). When they are not in their home or work districts, the Russian-speaking minority tend to visit districts that contain a predominance of Russian speakers. The social networks of the Russian-speaking population in Estonia are centered on Russian-speaking people (T. Vihalemm 2007; Korts 2009). Clearly, “with whom” activities and a person-to-person connection are important in their activities outside their home and work areas (Stutz 1973, cited in Carrasco and Miller 2009; Carrasco, Miller, and Wellman 2008).

It is also likely that social networks influence the types of trips abroad made by Russian-speaking people and explain why the majority of those trips are to countries of the former Soviet Union. It can be assumed that whereas Estonians spend their leisure time with their families in various parts of Estonia, Russian-speaking people need to travel to Russia and other former Soviet Union countries to see their relatives in their leisure time; that is, their lower extent of activity space in Estonia is compensated by their traveling abroad to a Russian-speaking environment. The Russian-speaking population also travel to a lower number of countries overall, however, and this might be partly connected to the circumstances arising from marginality theory. For instance, a minority’s opportunities to travel are fewer due to their poorer economic circumstances and they therefore have less money to spend on more exotic trips abroad.

The reason for fewer ethnic differences in activity spaces in the home city of Tallinn presumably lies in the different nature of people’s daily activity spaces. Activity spaces in the home city tend to relate more to people’s daily routines and are most keenly influenced by the geographic distribution of urban opportunities—workplaces, schools, shopping centers, and entertainment venues. The concentration of different activities is greater at the city center, although they do also take place in other parts of the city. The similarity in the spatial mobility between the two different ethnic groups in Tallinn might also be influenced by the compact nature of the city. In the case of larger cities and greater distances, the differences in the activity spaces of different ethnic groups would be more apparent (Krupka 2007; Singh, Vainchtein, and Weiss 2009).

Outside the home city, the location of urban opportunities does not wield the same influence over the activity space, and instead social networks take on greater importance. This leads us to conclude that the potential for ethnic groups to interact is higher in the home city; that is, in the daily activity space. Away from the home city, there is clear evidence of segregated activity spaces. Thus, there are more possibilities for making interethic contacts in the home city. Increasing the possibilities for integration outside the home city and when traveling abroad must be considered.

It is also interesting to note that the other variables included in the models play a far less important role than ethnicity in influencing the districts visited (Table 3). Gender, age, and the ethnic composition of a residential district do not appear to influence people’s activity spaces as much as ethnicity (i.e., language).

Thus, our findings show that it is possible to gain useful insight about ethnic segregation using secondary data sets such as mobile positioning data in addition to using traditional methods. It should be acknowledged,
though, that there are limitations in using only mobile positioning data because this type of data does not provide us with information on many important socioeconomic variables (e.g., income, occupation, etc.) that might influence the geographic configuration and size of activity spaces. Also, these data do not allow us to address motivation directly, as would be the case when conducting a survey of respondents. A methodological strength of this study, however, is that it gives a more detailed picture of the activity spaces of people outside their home and work districts over a continuous twelve-month period that is derived from impartial third-party data. In previous studies, research on the nature of activity spaces for out-of-home nonemployment activities has been restricted to the examination of individual activities such as going to church (Dougherty 2003), visiting national parks (Gramann 1996; Floyd 1999), or patronizing casinos (Deepak 2007). In only a few cases has the larger picture with respect to the range of activities undertaken or the links between various activities been gained through the single case study approach (Schnell and Yoav 2001; Wang, Li, and Chai 2012).

The same data set as the one used here was also used in the Estonian case to study ethnic differences across the whole activity space, namely, home, work and free-time-related places (Toomet et al. forthcoming). The authors of that study used co-presence data (using mobile phone co-presence) for Estonian- and Russian-speaking mobile phone users, with a focus on the potential for interethnic encounters to take place. Their results showed that places of residence and work are similarly segregated, while free-time activities occur in an environment that is far more evenly mixed. Segregation during leisure time was only weakly related to segregation at home and work places (Toomet et al. forthcoming). These findings are in line with the results of this study, in that we found that the activity spaces of Estonians and Russian-speaking people were only slightly segregated within the home city. Elsewhere, we find different results, probably because of methodological differences related to copresence.

The issue of ethnicity is a sensitive one in any society; hence, undertaking a study on ethnic differences by using the mobile tracking data for a number of individuals touches on complex issues of privacy, surveillance, and data protection—all of which are important aspects to safeguard, and all of which we have endeavored to respect in the design and conduct of our research.

Conclusions

The aim of this research was to study ethnic differences in out-of-home nonemployment activities. The results show that ethnicity has a significant influence on the activity spaces of individuals. The activity spaces of the out-of-home nonemployment activities of the majority population are significantly different from those of the minority with respect to the number and the population structure of the districts visited. Russian-speaking people living in their home city of Tallinn visit a smaller number of districts in Estonia. Moreover, these districts are more heavily populated by Russian speakers. Russian-speaking people also travel abroad less and are more likely to travel to former Soviet Union countries. In the home city, the differences in the activity spaces of out-of-home nonemployment activities of Estonians and the Russian-speaking minority are smaller, and the potential for interethnic contact is greater. These findings clearly show that there is ethnic segregation in out-of-home nonemployment activities.

The results also indicate that the differences in the activity spaces of the minority population cannot be explained only by the marginality and ethnicity theories, but they can, to a significant extent, be explained by social networks. A person’s connections with family and friends in the same ethnic group affect the activity space. Although our data do not allow us to examine these networks and connections directly, the longitudinal data collected over a twelve-month period clearly show that people spend more time in areas that have a predominance of people from the same ethnic group. This would also seem to indicate that people prefer to associate with those that speak the same language. The smaller ethnic-based differences that were found in relation to out-of-home nonemployment activities in Tallinn itself are likely to be the result of the different nature of everyday spatial mobility—going to work, going to the shops, and so on, which is ethnically less delimited. These smaller differences could also be due to the fact that Tallinn is a compact city, which means that there is less opportunity for people to become segregated.

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