HUMANS AND DOMICILE TYPE - A COMMUNITY ECOLOGY APPROACH

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Abstract Life history theory suggests that there are fitness trade-offs between survival and reproduction when an individual is exposed to environmental stress. Stress present in both physical and social environments can trigger physiological, behavioral, and developmental responses in an individual, impacting their health. Research has also shown that the lack of social connectedness has a negative impact on health. In this independent analysis of data from the European Social Survey European Research Infrastructure Consortium (ESS ERIC), a cross-national longitudinal survey from 2002-2018 that included over thirty (30) countries in Europe (n=106,320) suggests that domicile type may be used as a predictor of health. Stressors such as being a victim of burglary or assault, living with a partner, being divorced, having a parent that is absent or deceased, or having a mother that is self-employed tend to have poorer health outcomes. Social involvement in the community through voting has a significant effect on positive health outcomes. Data from the study also suggest that respondents' perceptions of safety and happiness may act as a proximate mechanism with a significant effect on health outcomes. The data has been adapted to fit a human community framework to better understand if health outcomes may be predicted at a community level. Linking social connectedness to the physical environment will allow researchers, architects, and policy makers to better understand the important relationship between these social dimensions in the built environment and health outcomes.

Introduction

Arguably, the human species could be the most important driver of ecological communities on the planet, with human behavior attributed to major climate change. Not only are humans driving the next mass extinctions in the Anthropocene, according to Tilman et al. (1997), they are changing the identities and diversity in communities. If age, gender, and spatial distributions are common factors analyzed in community and population ecology, why has there been less work on human communities (McKenzie, 1924)? Defining populations by age and gender is a common practice in community ecology that can easily be applied to humans, treating our societies as ecological communities. Dreiss et al. (2010) used a similar method in defining lizard populations to examine sexual selection. Polis (1984) found that the functional differences of feeding patterns between age and gender is significant enough to represent different "ecological species." This study will synthesize data from a longitudinal study to define "species" within a human community framework where age and gender determine species.

Examining health through an ecological lens in context of spatial distribution, social connections, and perception measured as happiness has been studied to a lesser degree. Winterton et al. (2015) found that diversity within a community can impact health outcomes. It has been found that functional diversity among the plant community can produce higher abundance and biomass (Tilman et al., 1997). From these studies, one might expect environmental variables to be significantly correlated to each other, with domicile type positively related to health, happiness, and social connectedness. Diversity across sites (country-by-domicile-type) is expected to be significantly and positively correlated to all of the environmental variables: domicile type, country, happiness, health, and social connectedness. Planchuelo et al. (2020) has found that cities are rich in biodiversity, and likely in different ages and types of people as well. As such, it is expected that Shannon diversity and effective number of species will be highest in cities. Using community ecology methods and analysis, site and species will be measured for diversity while environmental data will be analyzed within and across sites.

This study takes a deeper dive into existing data to better understand the correlations and linear relationships, using a community ecology framework where country-by-domicile-type are sites and age-by-gender are "species". Domicile type is broken into five categories: a big city, a country or village, a farm or home in the countryside, the suburbs or outskirts of a big city and a town or small city. Thirty-eight countries were included in this analysis, including Albania, Austria, Belgium, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Kosovo, Latvia, Lithuania, Luxembourg, Montenegro, Netherlands, Norway, Poland, Portugal, Romania, Russian Federation, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine, and the United Kingdom. This analysis will analyze site and "species" as well as environmental data such as health, happiness, and social connectedness related to country and domicile type through a community ecology framework.

Methods

My project methodology analyzed existing data from the European Social Survey European Research Infrastructure Consortium (ESS ERIC), a cross-national longitudinal survey from 2002-2018 that included over thirty (30) countries in Europe (n=106,320). This particular study was unique to my area of research in that it included information on domicile type, health, quality of life, and questions about social connectedness. In addition, the data was accessible free of charge, relatively unrestricted for further analysis and interpretation by researchers as well as provided a multi-year database, spanning more than a decade of responses. This information is critical in setting the groundwork for my own research, which may indicate a temporal permanence trend in the relationship between domicile type, social connectedness and perception to health outcomes.

Surveys were conducted every two years, separated into nine data sets. They were downloaded from the European Social Survey website at https://www.europeansocialsurvey.org/data/round-index.html. The following data fields were extracted from each survey and compiled together in Table 1.

Database Field Name	Description
essround	ESS round
idno	Respondent's identification number
aesfdrk	Feeling of safety of walking alone in local area after dark
agea	Age of respondent, calculated
brncntr	Born in country
cntry	Country
crmvct	Respondent or household member victim of burglary/assault last 5 years
ctzcntr	Citizen of country
domicil	Domicile, respondent's description
dvrcdev (dvrcdeva in rounds 5-9)	Ever been divorced
Empl (emplrel in rounds 2-9)	Employment status
emprf14	Father's employment status
emprm14	Mother's employment status
facntr	Father born in country
gndr	Gender
happy	How happy are you
health	Subjective general health
hhmmb	Number of people living regularly as member of household
Inmdisc (inprdsc in rounds 6-9)	Anyone to discuss intimate and personal matters with
mocntr	Mother born in country
Partner (icpart1 in rounds 5-8, rshpsts in round 9)	Lives with husband/wife/partner
rlgdgr	How religious are you
sclmeet	How often socially meet with friends, relatives or colleagues
vote	Voted last national election
yrbrn	Year of birth

Table 1. Terms and descriptions

Before merging the surveys, I had to recode two variables. Where the field description "anyone to discuss intimate and personal matters with" (inprdsc) was used in rounds six through nine, 0 indicated "no" and 1-6 indicated "yes" whereas the same field description (inmdisc) in the other rounds only had "yes" (1) and "no" (2). To match, I recoded the fields in rounds six through nine using 1-6 as "yes" (1) and 0 to "no" (2). Where the field description "lives with husband/wife/partner" (rshpsts) was used in round nine, 3-4 indicated "living with a partner" whereas 1-2 and 5-6 indicated "does not live with a partner". The same field description "lives with husband/wife/partner" (partner) in rounds one through four, only had "lives with partner" (1) or "does not live with partner" (2). To match, I recoded the field in round nine using 3-4 as "lives with partner" (1) and the rest to "does not live with partner" (2). All of the other fields with conflicting field names and same descriptions were coded the same and simply merged under universal database names as indicated in Table 1. It was important to maintain consistent coding before merging surveys to avoid discrepancy in interpretation.

After merging the surveys, additional fields were generated with categorical variables. Utilizing data from the field describing "feeling of safety while walking alone in local area after dark" (aesfdrk), a "feeling of safety, derived" (calc_safe) categorical field was generated where "very safe" or "safe" meant "safe" (1) and everything else meant "not safe" (0), unless missing. If data was missing, I derived safety from the original survey question description "respondent or household member victim of burglary/assault last 5 years" (crmvct) where responses indicated "yes," they were categorized as "not safe" (0). Where responses indicated a "no," they were categorized as "safe" (1). Utilizing data from the original survey question description "subjective general health" (health) field, a "Subjective general health" (calc_health) categorical field was generated where "very good" or "good" health meant "good health" (1) and everything else meant "bad health" (0), unless missing. Creating categorical variations of safety and health made preliminary logistic regression analysis possible in IBM SPSS Statistics (SPSS) software, but was not necessary using R.

The merged survey data set required additional clean-up before running any statistical analyses. Another new field "household size" (Calc_household_size) was added to simplify the continuour field "Number of people living regularly as member of household" (hhmmb) where anyresponses of seven people or over were categorized to "seven and over". Any cases with missing values were excluded from this study. Equal distribution across domicile types were randomly selected for each category including "big city", "suburbs or outskirts of a big city", "town or small city", "country village", and "farm or home in countryside". This final data set was where the data and metadata in this analysis were extracted from.

Since this project applies analyses used in community ecology to the built environment, the datasets have to be set up as sites and "species" and relevant metadata must be compiled. From SPSS, I exported the data to a comma delimited (csv) file. In Excel, I was able to combine the country with the domicile type description to generate a site field. The respondent's age and gender were combined to generate the species field. A pivot table was used to generate a matrix of the total number of species in each site. This data was saved as a comma delimited (csv) file to be imported into R. The metadata was generated in a very similar fashion where site, country, domicile type, happy, health, and social (sclmeet) data were exported into a new comma delimited (csv) file. This time a pivot table was used to derive the average happy scale, health scale and social scale by each site. That data was then saved as the metadata comma delimited (csv) file to be imported into R for analysis. The data is now set up as community ecology data for analysis in R.

The linear regressions and community ecology diversity methods were used to answer the questions set out in this paper. I ran multiple linear regression models to check if domicile type is significantly correlated to health, happiness or social connectedness. Similarly, I ran multiple linear regression models to check if happiness or social connectedness significantly correlated to health. Finally, I analyzed alpha diversity within each site by calculating species number, Shannon diversity, and the effective number of species, and effective number of species (rounded) as well as beta diversity across sites using Bray-Curtis and Jaccard methods to determine which sites are most similar and dissimilar.

Data Disclaimer

Some of the data applied in this analysis is based on the ESS Data Rounds 1-9. The data is provided by `https://www.europeansocialsurvey.org/data/round-index.html` and prepared and made available by NSD - Norwegian Centre for Research Data. Neither `https://www.europeansocialsurvey.org/data/round-index.html` nor NSD are responsible for the analyses and/or interpretation of the data presented in my independent analysis.

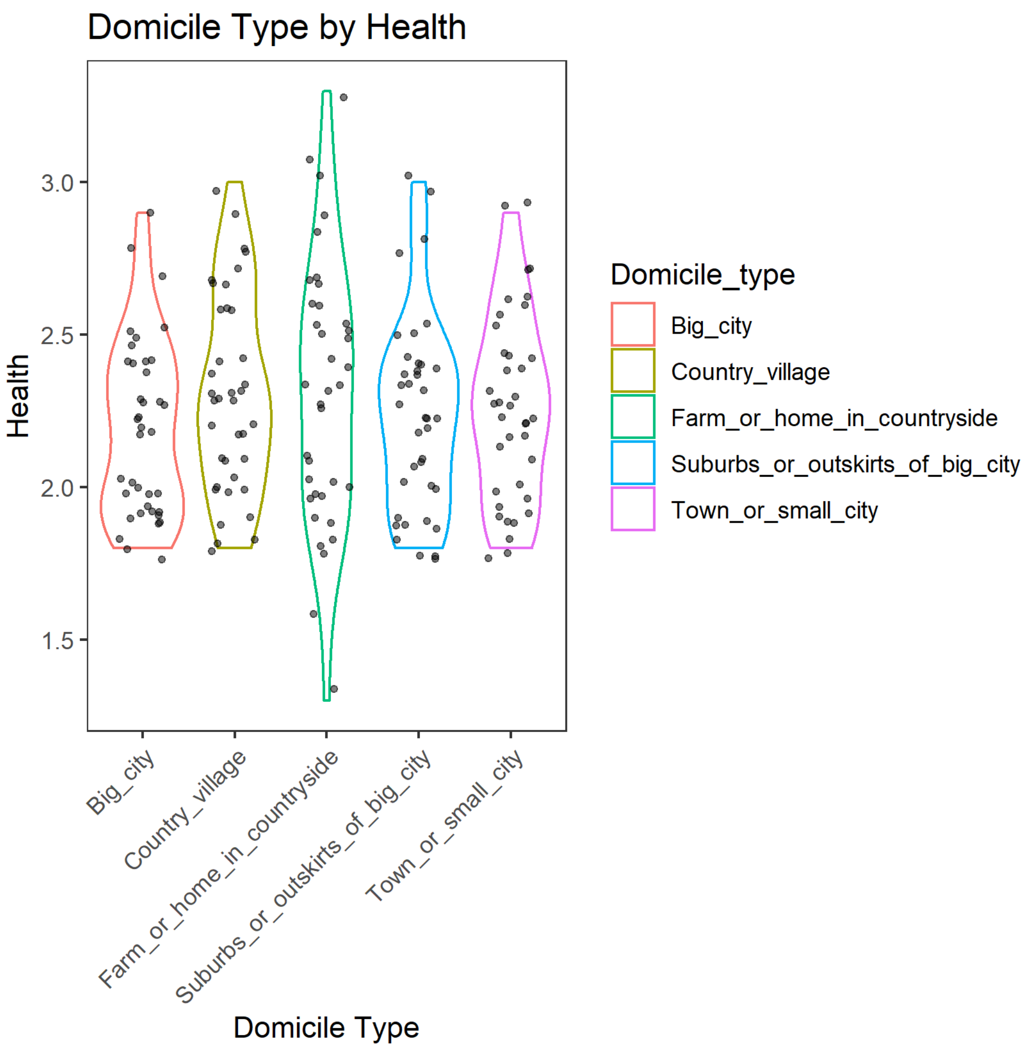

Figure 1: Domicile type by health (1-5 scale, good to poor)

Results

Is domicile type significantly correlated to health? When looking at the relationships among environmental variables, domicile by health (Figure 1), a linear regression analysis and Kruskal-Wallis rank sum test shows that, overall, domicile type is not significantly correlated to health, p = 0.4977 and 0.5162 respectively

Is domicile type significantly correlated to happiness? When looking at the relationships among environmental variables, domicile by happiness (Fig. 2) , a linear regression analysis and Kruskal-Wallis rank sum test shows that, overall, domicile type is not significantly correlated to happiness, p = 0.9117 and 0.9938 respectively.

Is domicile type significantly correlated to social connectedness? When looking at the relationships among environmental variables, domicile by social connectedness (Fig. 3), a linear regression analysis and Kruskal-Wallis rank sum test shows that, overall, domicile type is not significantly correlated to social connectedness, p = 0.9788 and 0.9193 respectively.

Is social connectedness significantly correlated to health? When looking at the relationships among environmental variables, social connectedness by health, a linear regression analysis and Kruskal-Wallis rank sum test shows that, social connectedness is significantly correlated to health, $p < 0.01$ for both. Social connectedness is has a positive relationship to health (Fig. 4), indicating health improves as frequency of socialization increases.

Is happiness significantly correlated to health? When looking at the relationships among environmental variables, happiness by health, a linear regression analysis and Kruskal-Wallis rank sum test shows that, happiness is significantly correlated to health, $p < 0.01$ for both. Happiness has a positive relationship to health (Fig. 5), indicating health improves as happiness increases.

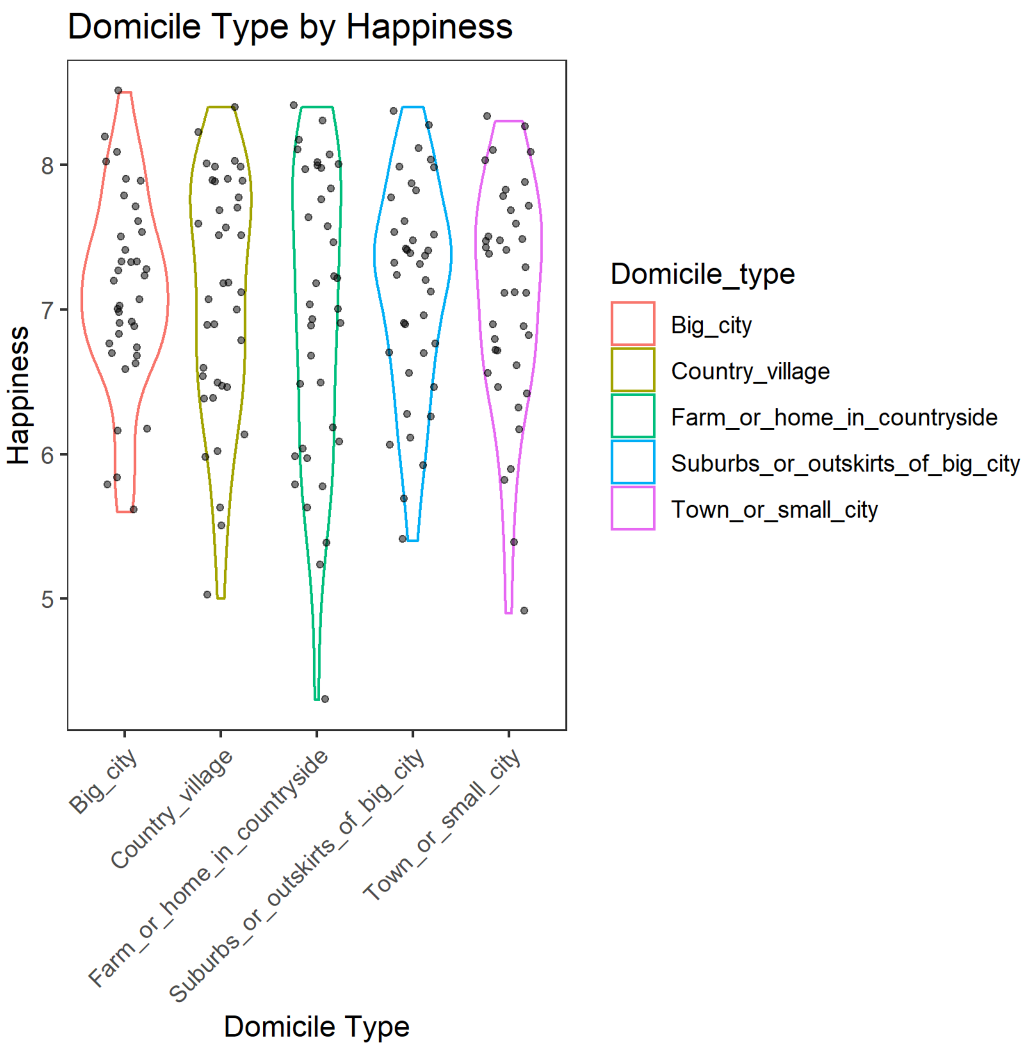

Figure 2: Domicile type by happiness (0-10 scale, unhappy to happy)

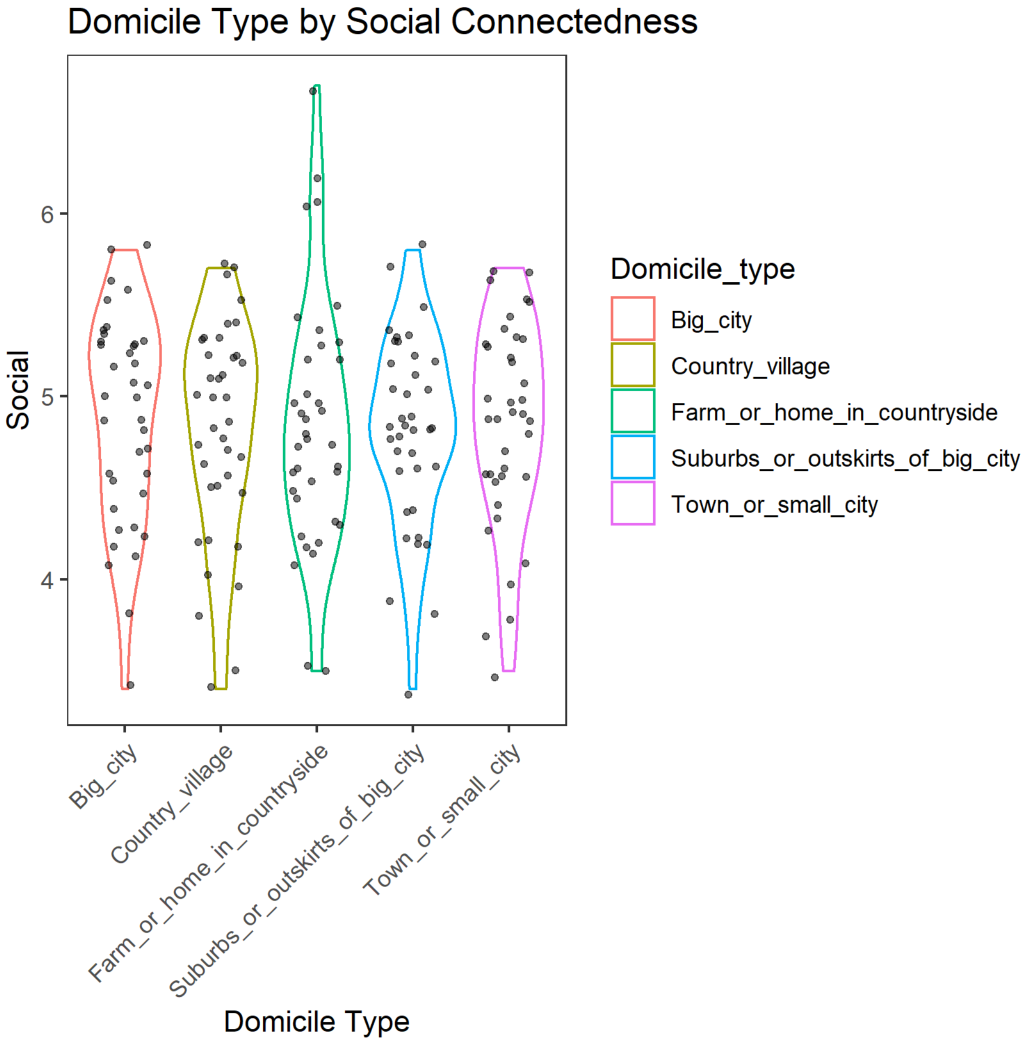

Figure 3: Domicile type by social (0-7 scale, never to daily)

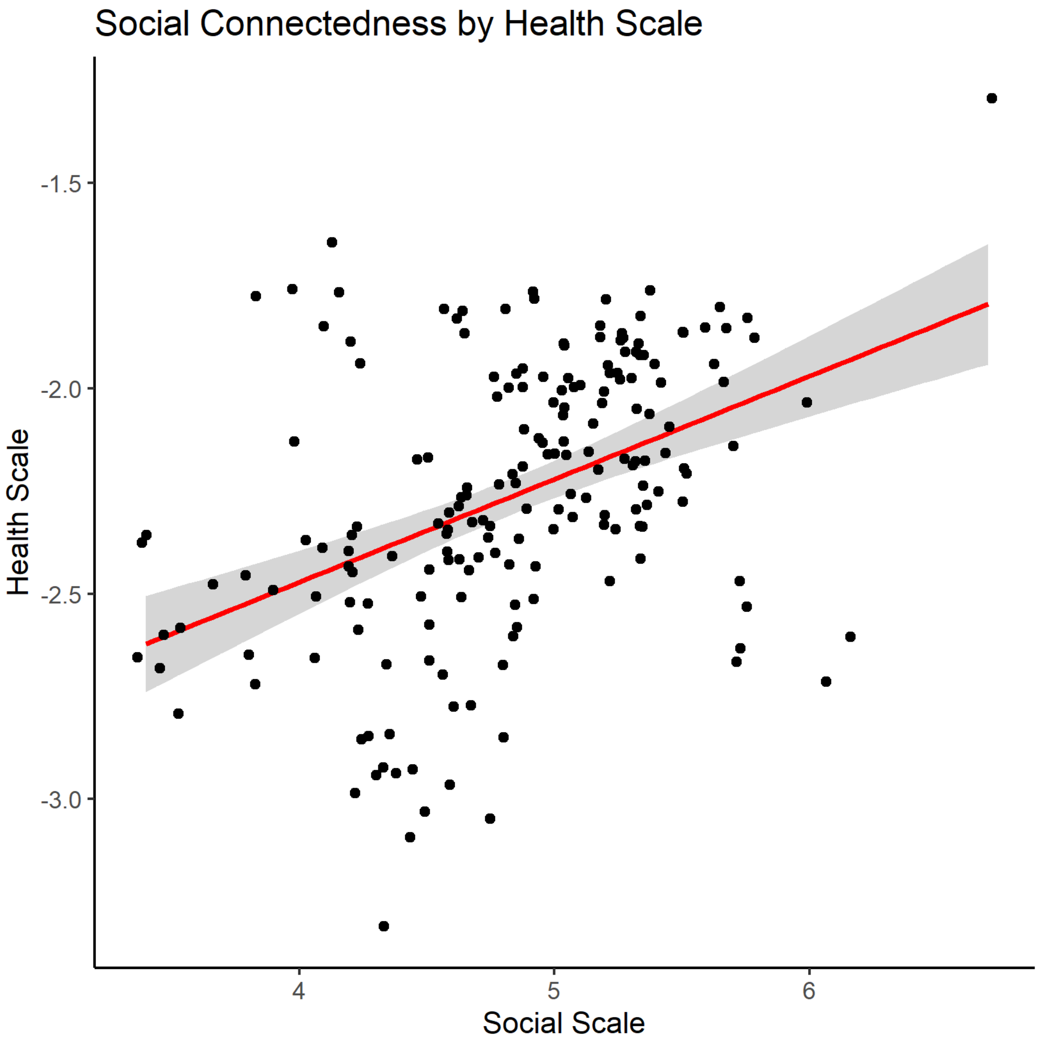

Figure 4: Social connectedness by health linear model

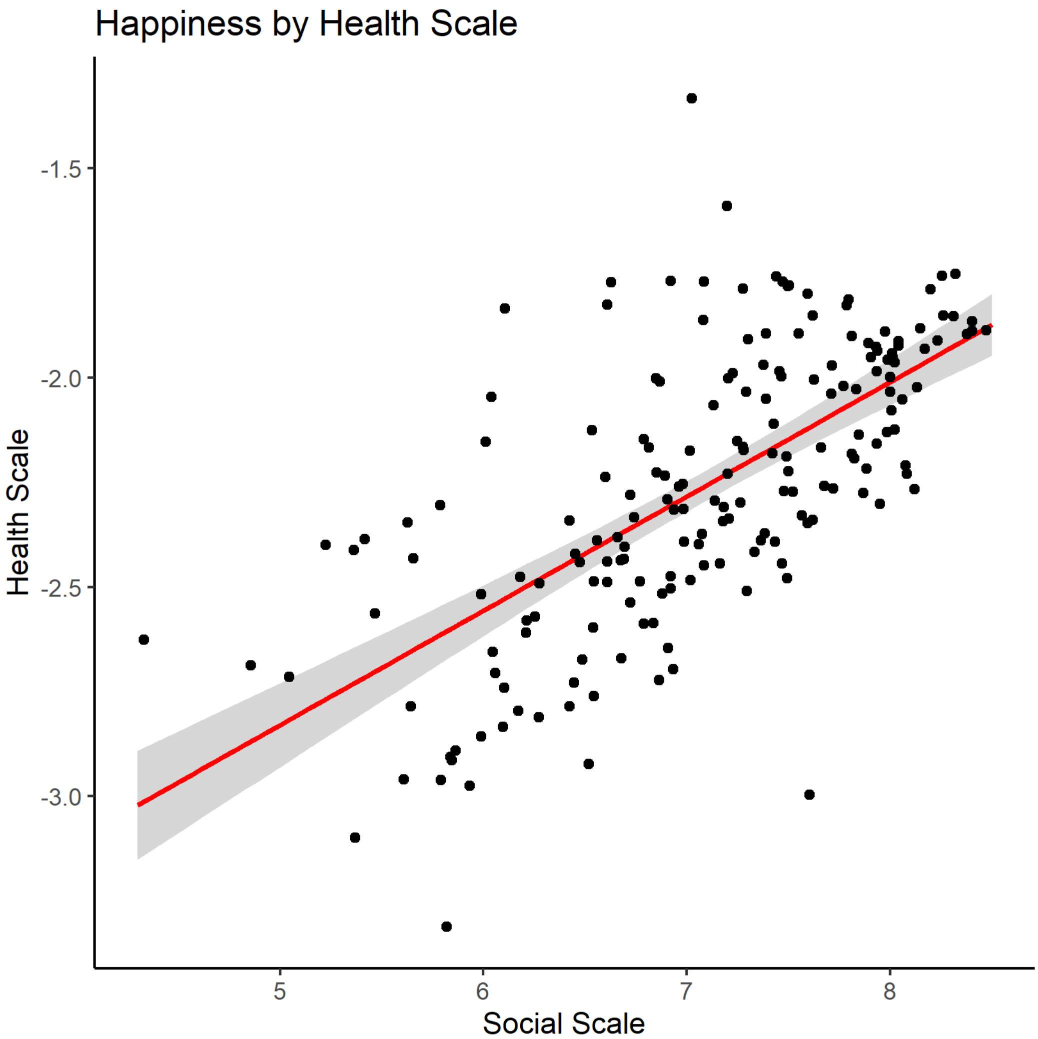

Figure 5: Happiness by health linear model

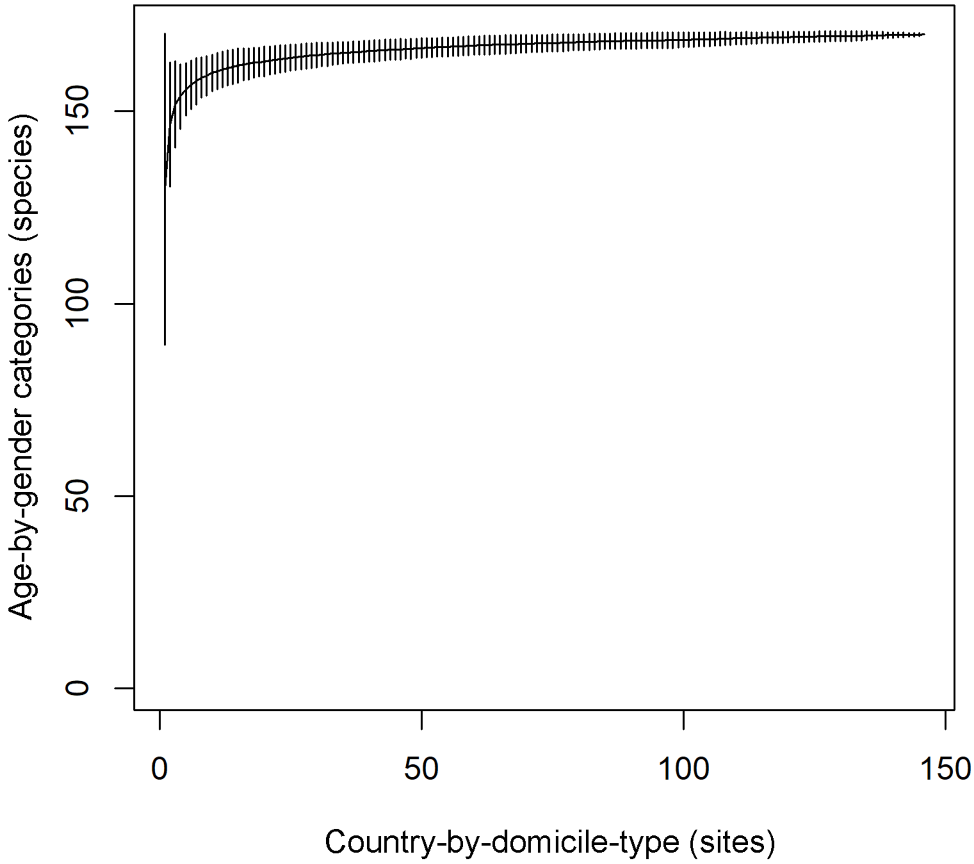

Figure 6: Species-Individual Curve Plot

Diversity After removing sites with less than 100 observations, there were still 146 out of 190 sites with more than 100 observations per site (Fig. 6).

Alpha diversity was measured by species number, Shannon diversity, effective number of species, and effective number of species, rounded to the nearest integer. Here, the species are represented as age-by-gender and alpha diversity simply means abundance or species richness in an ecosystem or site. Ireland_farm_or_home_in_countryside has the highest number of species at 157 and 5,057 observations. Turkey_country_village has the lowest number of species at 56 and 110 observations. United_Kingdom_suburbs_or_outskirts_of_big_city has the highest Shannon diversity at 4.911929 and the highest effective number of species at 135.90134 (rounded to 136) with 155 species and 2,026 observations. Turkey_country_village has the lowest Shannon diversity at 3.848964 and the lowest effective number of species at 46.94439 (rounded to 47) with 56 species and 110 observations.

What is the relationship between environmental factors and the effective number of species? A big city has the highest effective number of species, followed by a town or small city, country or village, suburbs, and farm or home in countryside respectively (Fig. 7a). The effective number of species is positively related to happiness and is negatively related to health (1-5 scale, good to poor) and social connectedness (Fig. 7b-d).

Beta diversity was measured by comparing diversity of species (age-by-gender) across different ecosystems or sites. Here, sites are represented as country-by-domicile type. Diversity across sites were measured using Bray-Curtis (Fig. 8) and the binary version of Jaccard (Fig. 9) Non-metric Multi-dimensional Scaling (NMDS) ordinal plots. Both methods yielded no convergence, even when increasing from k = 2 to 3 dimensions. Turkey and Romania country villages appear to be most distant from the others in terms of their diversity (age-by-gender).

Is beta diversity significantly correlated to country or domicile type? Using a PERMANOVA test

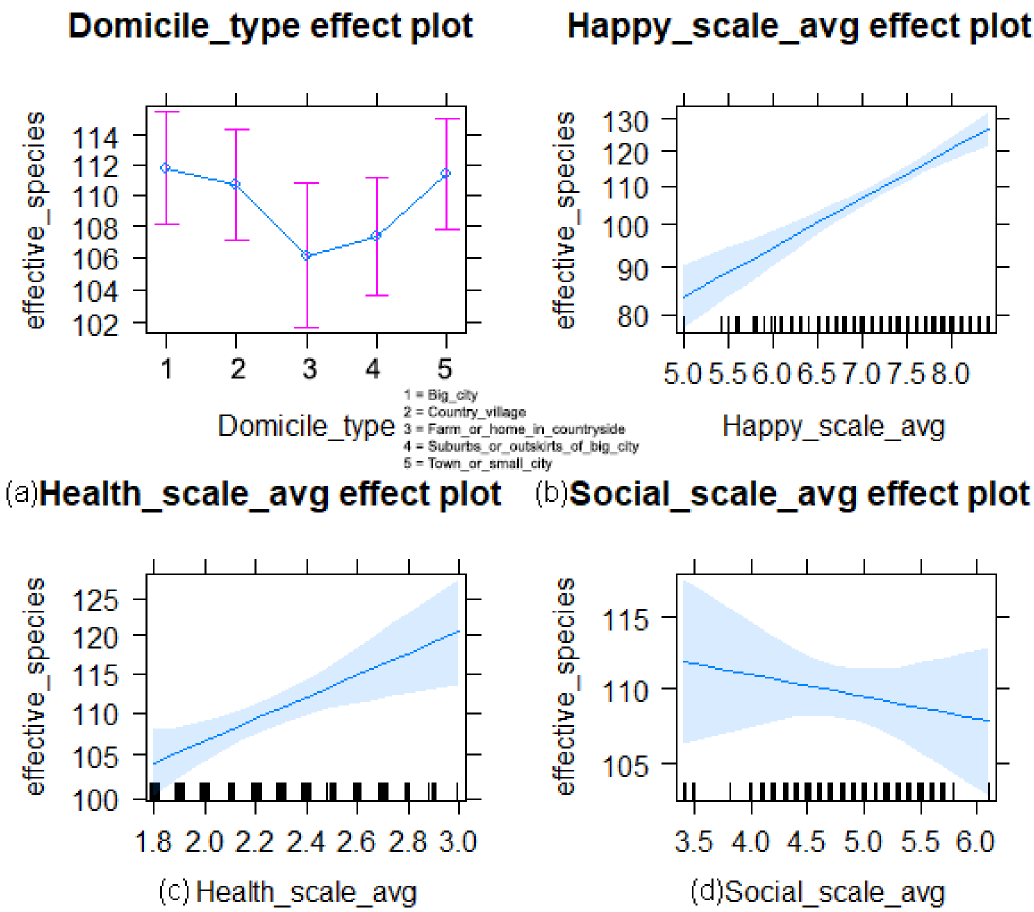

Figure 7: (a) Effective number of species by domicile type, (b) Effective number of species by happiness (0-10 scale, unhappy to happy), (c) Effective number of species by health (1-5 scale, good to poor), and (d) Effective number of species by social connectedness (0-7 scale, never to daily)

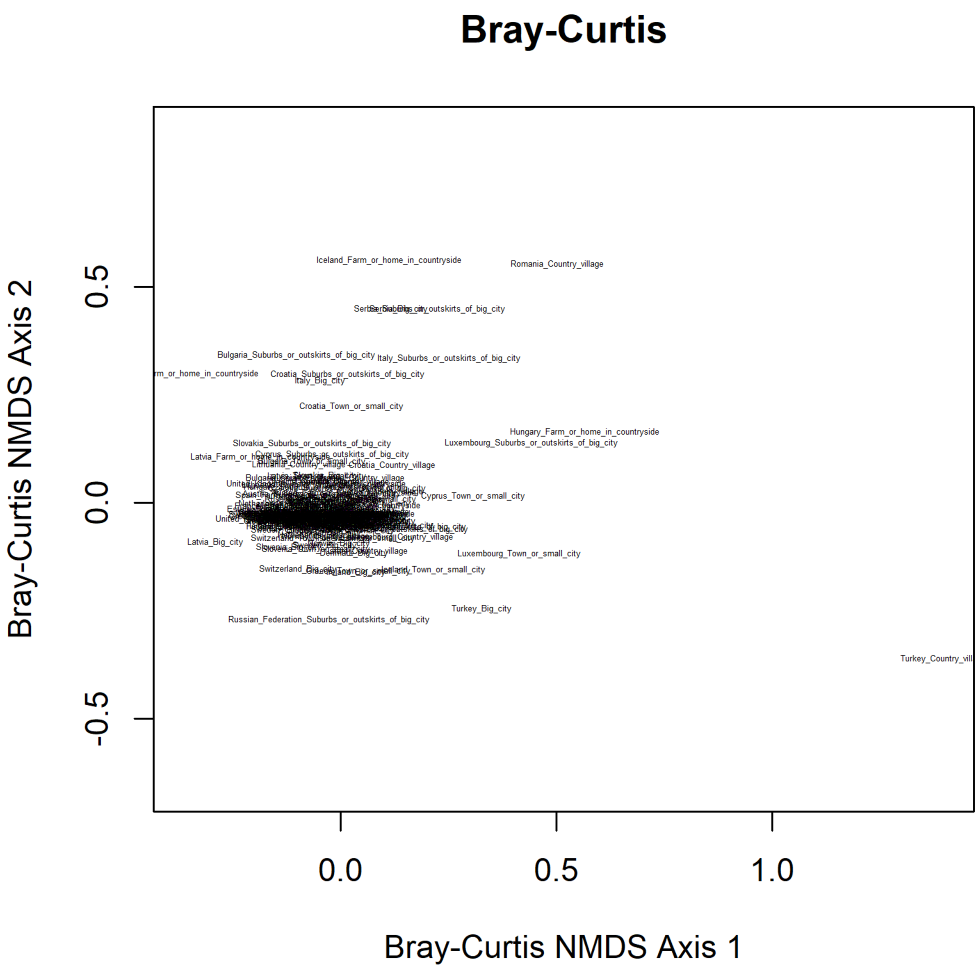

Figure 8: Bray-Curtis NMDS

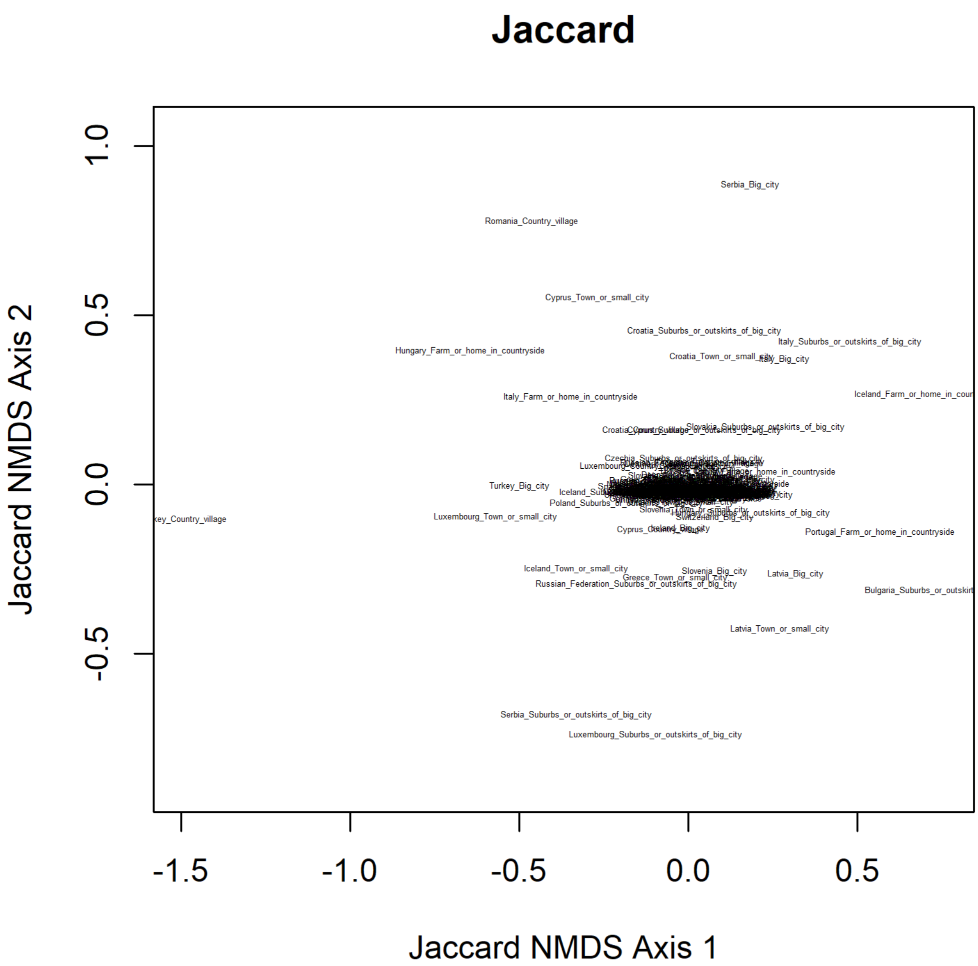

Figure 9: Jaccard NMDS

shows that, both country and domicile type are significantly correlated to beta diversity, $p < 0.001$ and with country having a larger R-squared value of 0.33957 compared to a R-squared value of 0.05230 for domicile type.

Is there a correlation between "species" and happiness across sites? There is a significant correlation between "species" and happiness across sites, mantel statistic $r = 0.2346$, $p = 0.001$.

Is there a correlation between "species" and health across sites? There is a significant correlation between "species" and health across sites, mantel statistic $r = 0.09944$, $p = 0.021$.

Is there a correlation between "species" and social connectedness across sites? There is not a significant correlation between "species" and social connectedness across sites, mantel statistic $r = 0.08752$, $p = 0.06$.

Discussion

This study indicates that using a human community framework to determine if domicile type is correlated to health, happiness or social connectedness shows that they are not significantly correlated while happiness and social connectedness are significantly correlated to health. Previous analysis utilizing SPSS indicated a significant correlation between each variable at an individual level. When reproduced in R at the individual level, this holds true. The only discrepancy between the two scales were with domicile type. Perhaps the distribution of "species" across domicile types accounts for the discrepancies. A cross comparison of the same number of "species" in each category might have a different outcome. Further analysis needs to be done to understand the discrepancies between the community and individual scale.

When looking at the relationships among environmental variables, social connectedness and happiness are significantly correlated to health, $p < 0.01$ with a positive relationships. In other words, health increases as happiness and social connectedness increase. These findings match research and my hypothesis. A community scale analysis may be an effective tool when linking social connectedness and happiness to health.

Analysis of alpha and beta diversity followed my expectations in that Shannon diversity and effective number of species were highest in cities. Not surprisingly, the effective number of species is positively related to happiness; meaning that the more diverse a human society—here analyzed as an ecosystem, the greater the happiness. Contrary to my hypothesis, effective number of species is negatively related to social connectedness and health. In other words, social connections and health go down as diversity, measured in age-by-gender categories, increases. Both country and domicile type are significantly correlated to beta diversity, with country having a larger impact. There is a significant correlation between community composition and happiness as well as community composition and health across sites. Similar to findings of effective number of species and social connectedness, community composition and social connectedness are not a significantly correlated across sites. Perhaps this has more to do with how cooperation within and between groups are linked by similarities in age and gender, rather than differences, and that social connections are not important drivers when analyzing human societies in a community ecology framework.

Citation of Data

ESS Round 9: European Social Survey Round 9 Data (2018). Data file edition 2.0. NSD - Norwegian Centre for Research Data, Norway – Data Archive and distributor of ESS data for ESS ERIC. doi: 10.21338/NSD-ESS9-2018.

ESS Round 8: European Social Survey Round 8 Data (2016). Data file edition 2.1. NSD - Norwegian Centre for Research Data, Norway – Data Archive and distributor of ESS data for ESS ERIC. doi: 10.21338/NSD-ESS8-2016.

ESS Round 7: European Social Survey Round 7 Data (2014). Data file edition 2.2. NSD - Norwegian Centre for Research Data, Norway – Data Archive and distributor of ESS data for ESS ERIC. doi: 10.21338/NSD-ESS7-2014.

ESS Round 6: European Social Survey Round 6 Data (2012). Data file edition 2.4. NSD - Norwegian Centre for Research Data, Norway – Data Archive and distributor of ESS data for ESS ERIC. doi: 10.21338/NSD-ESS6-2012.

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