KOCHI UNIVERSITY OF TECHNOLOGY

Social Design Engineering Series *SDES-2017-21*

Social value orientation and topography in urbanization: A case of Beijing, China

Zhang Jingchao
School of Economics and Management, Kochi University of Technology
Beijing Association of Sustainable Development

Koji Kotani
School of Economics and Management, Kochi University of Technology
Research Center for Future Design, Kochi University of Technology

Tatsuyoshi Saijo
School of Economics and Management, Kochi University of Technology
Research Center for Future Design, Kochi University of Technology
Research Institute for Humanity and Nature
Urban Institute, Kyusyu University

30th October, 2017

School of Economics and Management
Research Center for Future Design
Kochi University of Technology

Social value orientation and topography in urbanization: A case of Beijing, China

Zhang Jingchao[*,†] Koji Kotani[*,‡,§,¶,‖] Tatsuyoshi Saijo[*,†,‡,**]

November 2, 2017

Abstract

Urbanization leads to cultural changes that shape social values and behavior. Topographical variation in mountainous, hilly and plains areas is considered one of the main indicators of the degree of urbanization, following distance to urban cities. Therefore, it is hypothesized that there may be a topographical difference in distributions of social value orientations (SVOs), which categorize people's social preferences into the prosocial, the proself and unidentified. To examine this hypothesis, we conduct field surveys and experiments in mountainous, hilly and plains areas of Beijing, collecting the sociodemographic information and SVOs of 596 samples. We find that proportions of proself people are higher in plains and hilly areas than in mountainous areas as the distance to the center of Beijing becomes shorter. In addition, the proportion of unidentified people is prominent in hilly areas, as they represent transitional societies. Overall, this result suggests that social preferences transition from the prosocial to the unidentified and then to the proself with topographical changes, implying that new social mechanisms are necessary to shift people's social preferences toward prosocial behavior in the urbanization process. Otherwise, important social problems such as air pollution and sustainability, which require cooperation, will pose more danger in the future.

Key Words: Social value orientation; topography; urbanization

[*]School of Economics and Management, Kochi University of Technology
[†]Beijing Association of Sustainable Development
[‡]Research Institute for Future Design, Kochi University of Technology
[§]Urban Institute, Kyusyu University
[¶]College of Business, Rikkyo University
[‖]Corresponding author, E-mail: kojikotani757@gmail.com
[**]Research Institute for Humanity and Nature

Contents

Nomenclature

SD Standard deviation

SVO Social value orientation

1 Introduction

As the second largest economy in the world, China has been recognized as an important economic contributor to world development in the 21st century (Fang et al., 2015). From 1985 to 2015, China's population ratio in rural areas dramatically declined from $76.29\,\%$ to $43.90\,\%$ in contrast to the high population growth in urban areas (National Bureau of statistics of China, 2016). Along with this urban expansion, China faces a series of challenges such as environmental deterioration and air pollution (Chan and Yao, 2008, Chen et al., 2017). Many scholars suggest that individual voluntary contributions and efforts are essential to address such environmental and sustainability problems together with government interventions (See, e.g., Van Vugt et al., 1995, Van Lange et al., 2007). For instance, Sovacool (2009) reports that an individualistic or selfish orientation in people's personalities becomes an obstacle for public acceptance of renewable energy. Thus, it is claimed that proenvironmental and cooperative behaviors must be promoted at the individual levels for the solutions of various social

problems that arise in the progress of urbanization (Ostrom et al., 2002, Dawkins, 2006, Wilson et al., 2009, Shahrier et al., 2016).

Urbanization together with technological advancement or economic development brings about cultural changes, potentially changing people's values and behaviors (Zeng and Greenfield, 2015). At the same time, it is suggested that the progress or degree of urbanization could be captured by topographical variation, and such topographical environments can explain human psychology, preferences and behaviors (Rentfrow et al., 2013, 2015, Bach et al., 2016, Huggins and Thompson, 2016). For the betterment of environmental and sustainability problems that arise in the process of urbanization, it is valuable to understand how people's preferences and behaviors change with topographical differences. Therefore, this paper addresses individual social preferences in relation to topography.

Geographical differences play a role in the distribution of personality traits. Rentfrow et al. (2013) reveal that people in the United States exhibit three state-level personality traits: "friendly and conventional" in the central US, "relaxed and creative" in the west coast, mountainous and sunbelt regions, and "temperamental and uninhibited" in the Mid-Atlantic and the northeast. Rentfrow et al. (2015) replicates the previous research on geographical psychology and find that personality changes with geographical differences, and people in neighboring regions share a similar personality in Great Britain. These studies focus on personality differences by region that are characterized by north or south, east or west, state or city at national level.

Other works focus on value shifts shaped by cultures in combinations of different environments. Zeng and Greenfield (2015) demonstrate that people tended to be more individualistic than collectivistic during ecological changes in China from 1970 to 2008.[1] Talhelm et al. (2014) and Henrich (2014) document that people in wheat-planting regions of China and in Europe exhibit more individualistic traits than those in rice-planting regions of China and Japan owing to different patterns of farming culture. Ockenfels and Weimann (1999) and Brosig-Koch et al. (2011) conduct a solidarity experiment, reporting that people in East Germany are more selfish than West Germany. Shahrier et al. (2016) compare individual social preferences among three regions of Bangladesh, finding that

[1]Ecological change means a change in economic development, urbanization, technology development and education levels.

people tend to be more competitive as societies become capitalistic. Overall, these papers capture the tendency of changes in individual social values under various cultures such as political, economic or technological environments.

None of these previous works have analyzed how social preferences and behaviors are characterized by topographical characteristics together with ongoing urban expansion at the micro level. As noted by Bach et al. (2016), geographical variation in personalities, preferences and behaviors needs to be examined from not only the macro level (i.e., country or state) but also the micro level (i.e., within-state); otherwise, important variations might be neglected. In most cases, topographical variation in mountainous, hilly and plains areas is believed to play a large role in different degrees of urbanization, following distance to urban cities. Therefore, it is hypothesized that there may be a topographical difference in distributions of social value orientations (SVOs) that categorize people's social preferences as prosocial, proself and unidentified. To examine this hypothesis, we conducted field surveys and experiments in the mountainous, hilly and plains areas of Beijing, China, collecting sociodemographic information and SVOs of 596 samples.

2 Data and Methodology

Study area

China has the largest population and highest economic growth in the world. As China's capital city and also the political, economic and cultural center, Beijing embodies China's rapid urbanization and economic development. Beijing's population reached $19.6\,\mathrm{million}$ in 2010, a $44.5\,\%$ rise as reported at the time of 2000 (Beijing Municipal Bureau of Statistics, 2016b). Overall, Beijing has an area of $16\,410.5\,\mathrm{km}^2$, comprising 6 urban and 10 suburban and rural districts. In addition to relatively smaller urban areas ($1368.3\,\mathrm{km}^2$), $92\,\%$ of Beijing belongs to suburban and rural areas (Beijing Municipal Government, 2012). Another important fact is that there is a wide variation among the districts of Beijing with respect to the topography and the degree of urbanization, while they share similar climate and culture (Beijing Municipal Bureau of Statistics, 2016a). Hence, we consider Beijing an

appropriate field for the micro-level analysis in our research.

In March of 2016, we implemented field surveys and experiments to collect people's social value orientations (SVOs) and sociodemographic information in suburban and rural Beijing. As described, Beijing has a topographical difference in mountainous, hilly and plains areas, reflecting different levels of urbanization because of the distance to the center of Beijing (Beijing Municipal Bureau of Statistics, 2016a). Our study areas cover five suburban and rural districts in Beijing (See figure 1 for the distance to the center of Beijing): Yanqing, Miyun, Pinggu, Fangshan and Daxing. Regarding topographical and socioeconomic differences, these districts are categorized into three groups: mountainous areas (Yanqing and Miyun), hilly areas (Pinggu and Fangshan) and a plains area (Daxing). To clarify distance from the survey areas to the center of Beijing, we draw rings from the survey spots in each district around the center of urban Beijing (the center of the ring circle) in figure 1. The bigger the size of the ring, the further the distance is.

As shown in figure 1, these rings divide the five districts into plains, hilly and mountainous areas. The smallest ring represents the plains area (Daxing), which is closest to the center of Beijing. Fangshan and Pinggu are marked by inner and outer rings of hilly areas, respectively, and exhibit the second closest distance to the center of Beijing. The inner and outer rings of mountainous areas represent Yanqing and Miyun, reflecting the most remote distance to urban areas. Although the rings of Pinggu and Yanqing to the center of Beijing appear to be close, the transportation conditions are different. The main roads from urban areas to Yanqing are mountainous, but the roads from the urban areas to Pinggu are flat. Subsequently, it is much more difficult and time-consuming to reach Yanqing than Pinggu from the center of Beijing.

[Figure 1 about here.]

In 2015, Daxing had the highest population density of $1507\,\text{people}\,\text{km}^{-2}$, while Yanqing and Miyun had the lowest population density of $157\,\text{people}\,\text{km}^{-2}$ and $215\,\text{people}\,\text{km}^{-2}$, respectively (Beijing Municipal Bureau of Statistics, 2016a). As a transitional group, Fangshan and Pinggu have a population density of $526\,\text{people}\,\text{km}^{-2}$ and $445\,\text{people}\,\text{km}^{-2}$, respectively. If we further compare the change of population density from 2011 to 2015, the same tendency is observed (Beijing Municipal

Bureau of Statistics, 2012, 2016a). In this five-year period, Daxing led in growth of population density by 128 people km^{-2}, which is in sharp contrast to the decline in population density by 3 people km^{-2} in Yanqing. Taking Fangshan as a case of hilly areas, population density grows by 40 people km^{-2} in-between. In summary, a distinct variation among plains, hilly and mountainous areas can be detected by the above statements. This distinction is in accordance with our expectation that due to the proximity to urban areas and convenient transportation, the plains areas are influenced by the economic development and urbanization in Beijing. Next, hilly areas could be considered a transitional society in the process of urbanization and economic development. Remote mountainous areas fall into the least-urbanized group due to their distance from urban areas and inconvenient transportation.

Field surveys and experiments

We conducted field surveys and experiments based on 605 respondents; sociodemographic information and SVOs, respectively, were collected through face-to-face interviews in Beijing. The head of household or the decision maker in the household was asked to be responsible for the interview. In the end, 596 samples were used in the data set because of the missing observations in 8 questionnaires. The respondents' sociodemographic information contains age, gender, education, occupation, annual household income and the number of children in a household. Table 1 lists the detailed definitions for all the sociodemographic variables collected in surveys. Education is an ordered categorical variable from 1 to 4 representing the orders of education levels from low to high. Age and household income are numerical variables to capture their influence on SVOs. The occupation and the number of children in the household are hypothesized as important determinants of people's social preferences, following Shahrier et al. (2016). In regard to occupation, we take it as a dummy variable by asking whether they engage in farming as a main occupation. If "No," it means that they do not engage in farming, taking jobs in the business and service sectors.

[Table 1 about here.]

A decomposed social value orientation (SVO) game is employed to measure people's social preferences, categorizing the social preferences into four types of SVOs: prosocial, competitive, individ-

ualistic or unidentified (Van Lange et al., 1997, 2007). This SVO game consists of 9 questions, each of which asks subjects to choose one option among three. Each option comes with two numbers as in the enumeration of options A, B and C shown below, representing the payoffs for "oneself" (You) and "the other," respectively. The oneself (You) and the other are considered a pair of two persons where "the other" is unknown to the other. A specific example for one question in the SVO game is as follows:

Option A: You receive 500; the other receives 100.

Option B: You receive 500; the other receives 500.

Option C: You receive 550; the other receives 330.

Suppose that one subject chooses one option among three options A, B or C. Subjects who choose option A are considered to be competitive since this option reflects the motivation to maximize the gap between oneself and the other ($500 - 100 = 400$). Subjects who choose option B are considered to be prosocial because they tend to maximize the joint outcome ($500 + 500 = 1000$). Option C represents an individualistic orientation because of the highest personal outcome among the three options (550), regardless of the outcome of the other.

When a subject makes at least 6 consistent choices of options with one orientation among the prosocial, the competitive and the individualistic over 9 questions, she is judged to have a specific orientation and is otherwise "unidentified" (Van Lange et al., 2007). For the explanation of the SVO game, we distributed a written instruction and made the presentation to the respondents. They were informed that all the numbers in the options of questions represent the payoffs for oneself and the other in a pair. The respondents are informed when they are randomly paired with another person in this game, but the identity of the partner is never revealed. We explain that the payment to each subject is calculated by summing the payoffs earned from 9 options selected by oneself for "oneself" and 9 options selected by the partner for "the other." The maximal individual gain is $10\,$RMB ($\approx 1.54\,$USD) and the mean of the individual's gain is $8\,$RMB ($\approx 1.24\,$USD).[2]

[2]In the March of 2016, the exchange rate is $1\,$USD $\approx 6.48\,$RMB.

Empirical method

To characterize people's social value orientation, the multinomial logit model is employed taking the SVO as a dependent variable and other sociodemographic variables as independent variables. As mentioned, the SVOs consist of the prosocial, the individualistic, the competitive and the unidentified, and only 20 samples ($3.36\,\%$) in our data are identified as competitive. Therefore, we decided to merge the individualistic and competitive orientations into the "proself" for simplicity of analysis.[3] Subsequently, a dependent variable in the multinomial logit model becomes an unordered categorical variable to consider the three categories of prosocial, proself and unidentified, assuming that the base group is prosocial. The model is utilized to estimate the marginal probability of being in one of the social value orientations when one independent variable increases by one unit. The multinomial logit model can be described as:

$$\mathrm{Prob}_i(j) = \mathrm{Prob}(S_{ji} \geq S_{Ji}), \quad \forall J \neq j \tag{1}$$

where i is the ID number of the respondents ($i = 1, \ldots, 596$), j represents one orientation among three social value orientations J where $J = \{\text{prosocial, proself, unidentified}\}$. $\mathrm{Prob}_i(j)$ represents the probability that respondent i falls into orientation j, and this predicted orientation j represents the outcome with the highest tendency for individual i among three orientations. S_{ji} is assumed to be a linear function of independent variables:

$$S_{ji} = \boldsymbol{\beta}_j \mathbf{X}_i + \epsilon_{ji}, \tag{2}$$

where $\mathbf{X}_i$ represents the vector of independent variables for respondent i, $\boldsymbol{\beta}_j$ refers to the vector of regression coefficients depending on orientation j, and ϵ_{ji} is an error term. From equations (1) and (2),

[3] In the literature, prosocial and proself behaviors are widely used as two essential aspects of human behavior (Van Lange et al., 1998, Bogaert et al., 2008, Wilson et al., 2009, Timilsina et al., 2016, Wei et al., 2016).

the multinomial logit models can be specified as:

$$\begin{aligned} \mathrm{Prob}_i(j) &= \mathrm{Prob}(\boldsymbol{\beta}_j \mathbf{X}_i + \epsilon_{ji} \geq \boldsymbol{\beta}_J \mathbf{X}_i + \epsilon_{Ji}), \quad \forall J \neq j \\ &= \mathrm{Prob}(\boldsymbol{\beta}_j \mathbf{X}_i - \boldsymbol{\beta}_J \mathbf{X}_i \geq \epsilon_{Ji} - \epsilon_{ji}). \end{aligned} \tag{3}$$

The reduced form of equation (3) is:

$$\mathrm{Prob}_i(j) = \frac{\exp \boldsymbol{\beta}_j \mathbf{X}_i}{\sum_J \exp \boldsymbol{\beta}_J \mathbf{X}_i}. \tag{4}$$

where the vector of regression coefficients $\boldsymbol{\beta}_j$ are estimated from a standard maximum likelihood method. The set of independent variables $\mathbf{X}_i$ contains age, gender, education, number of children in a household, occupation, annual household income and area dummies.[4]

Ethics statement

This study was approved by the research ethics committee of Kochi University of Technology. Subjects provided their written consent to participate in this study.

3 Result and discussion

Table 2 describes the distributions of social value orientations (SVOs) in three areas of Beijing. In general, $59.90\,\%$ of the respondents are identified as prosocial, and only $30.54\,\%$ and $9.56\,\%$ are proself and unidentified, respectively. This result indicates that a majority of people in Beijing's suburban and rural areas are prosocial. In particular, a proportion of prosocial people is high in mountainous areas ($75.56\,\%$), and consequently a proportion of proself people is the lowest ($19.26\,\%$). The proportion of proself people reaches the highest in plains areas ($35.33\,\%$), followed by hilly

[4]Some researchers may claim that there might be reverse causality in our regression; i.e., competitive people move to and live in urban cities. However, regarding rural-urban migration, many studies establish that poor economic conditions mainly push people to migrate from rural to urban areas (Dudwick et al., 2011, Young, 2013, Brueckner and Lall, 2015), or a wide variety of opportunities including health and employment in urban areas are found to be the main motivations (Todaro, 1996, Zhang and Song, 2003). In other words, none of these studies suggest that more competitive or individualistic people tend to migrate to more urbanized or competitive societies. Shahrier et al. (2016) further illustrate that there is no reverse causality between area dummies and SVOs in Bangladesh.

areas ($33.12\,\%$). A proportion of unidentified people is found to be high in hilly areas ($12.86\,\%$). In summary, table 2 reveals that distributions of SVOs correlate with the topography or the degree of urbanization.

[Table 2 about here.]

Table 3 provides summary statistics for the independent variables. On average, annual household income is the highest in plains areas, and the lowest is in mountainous areas, and the income gap between these two areas is considerably large. Average household income in hilly areas is lower but closer to that in plains areas. However, the highest household income is found in hilly areas followed by plains and mountainous areas. This result exhibits evidence of economic development across the suburban and rural areas of Beijing. Plains and hilly areas take the lead in economic development due to shorter distance from urban areas in Beijing, while mountainous areas are the least developed due to distance and transportation limitations.

On average, the age of the subjects across the three areas are close each other. The youngest group is represented by people in plains areas, followed by those in hilly and mountainous areas. Subjects have reached the primary school level on average. Among the three areas, people in mountainous areas have the lowest education level. The number of household children below 15 years old is the highest in plains areas and the lowest in mountainous areas. With respect to the occupation dummy, the proportion of farmers ($95\,\%$) is highest in mountainous areas, with a significant decline ($71\,\%$) in hilly areas, and it turns out to be the lowest ($69\,\%$) in plains areas. This result verifies that with locations closer and more convenient to city areas in Beijing, societies are influenced by urbanization with more business or job engagement other than farming activities.

[Table 3 about here.]

Table 4 reports the marginal effects of each independent variable on the probability that a subject is proself or unidentified, taking the prosocial as the reference group in the multinomial logit regression. In general, age and education do not have a significant effect on people's SVOs. Household income and occupation dummy (farmer or not) are significant factors that affect the likelihood that a subject

is unidentified in SVOs. There is a negative relationship between number of children in a household and the proself orientation. Gender positively influences proself orientation. With respect to area dummies, people in plains and hilly areas are more likely to have a proself orientation compared to those in mountainous areas. More interestingly, people in hilly areas tend to be more unidentified in SVOs.

[Table 4 about here.]

More specifically, an increase in household income by $10\,000$ RMB significantly leads to a higher probability that a subject will be unidentified by $1.3\,\%$, taking the prosocial orientation as a reference group (table 4). In Beijing's rural area, $10\,000$ RMB (≈ 1543.2 USD) is a large amount of money that accounts for $39\,\%$ of the average household income in our survey. As a consequence, it is less likely that such an increase in household income would materialize within a short period for a household. Thus, the magnitude of the income effect can be considered practically insignificant because the marginal probability that a subject will be unidentified changes very slowly.

As described in Table 4, males appear to have a higher tendency to be proself than females by $7.1\,\%$, which is consistent with the previous findings in Van Lange et al. (1997) and Eckel and Grossman (1998). They report that females exhibit higher prosocial preferences than males. Our result reflects a gender difference in the proself orientations in China. In reality, as in most other countries, males are for the most part the head of household and bread earner in China. They need to work very hard for family survival or better living conditions. Given these conditions in China, it is expected that males would have the higher probability of being proself than females.

Regarding the number of children under 15 years old, our results reveal that one more child in a household brings about a $5.9\,\%$ decline in the likelihood that a subject is proself, taking the prosocial as a reference group. On the contrary, Shahrier et al. (2016) report that people become more individualistic or unidentified with the increased number of children per household. Unlike other countries such as Bangladesh, China has implemented the one-child and two-child policies since 1979 and 2015, respectively. Hence, unlike in Bangladesh, it is neither substantially difficult nor affordable to raise one or two children in Beijing; having children is welcomed. In addition, Chinese parents place

particularly high expectations and importance on the next generation because of the one-child policy of the past three decades. Thus, people can be cooperative in sharing information or experience for the development of children in the future.

As shown in Table 4, farmers tend to have a higher probability than nonfarmers of being unidentified by $10.9\,\%$, relative to the probability of a subject being prosocial. This result indicates that farmers' social preferences are more unpredictable than those of nonfarmers. In one sense, agriculture in China has gradually shifted from traditional to modern approaches due to the progress of agricultural technologies. Beijing has taken the lead in this transition, and the modernization of agriculture enables people to easily and independently engage in farming and the sale of products using new technologies and online networks. On the other hand, traditional agriculture requires a larger labor force or more engagement by local people, which might stimulate collaboration among farming households. Based on these two aspects, farmers might have unstable or unidentified values owing to this transition in agriculture.

With respect to area dummies, the results reveal that in comparison with people in mountainous areas, those in plains and hilly areas exhibit a greater tendency to be proself than prosocial by $14.3\,\%$ and $14.4\,\%$, respectively. More interestingly, people in hilly areas are more likely to be unidentified by $6.4\,\%$ compared with mountainous areas. These results illustrate our expectation that topographical variation in mountainous, hilly and plains areas is an important determinant of people's social preferences regarding the distance to urban areas. As mentioned, plains areas (Daxing) are located the shortest distance from the center of Beijing, followed by hilly areas (Fangshan and Pinggu) and mountainous areas (Yanqing and Miyun), which are the furthest from the center of Beijing. Due to the advantages or disadvantages of each district in topography, urbanization in Beijing has been developed at different speeds, and thus, this result appears to suggest that topographical variation shapes lives and people's social preferences.

The plains area of Daxing experiences the first round of urbanization among these districts and is influenced by Beijing in the form of sharp increase in population, which is in sharp contrast to mountainous areas. Under these conditions, industries are rapidly expanding in the plains area, attracting people to this area for job opportunities and a new life. Thus, villages in the plains area have

developed along the lines of "urban villages," with sound infrastructure, services and housing conditions. As a consequence, these rural residents can easily get access to goods, services or resources by themselves. Once people adapt themselves to such an independent life, they are more likely to become individualistic (Henrich, 2014). Based on the above set of life changes in the plains area, it is plausible that these people tend to fall within the proself orientation.

Mountainous areas are now viewed mainly as important ecological assets or barriers to protect nature and the Beijing environment. Due to the beauty of the wilderness and environment, eco-based services and tourism have grown, and to prevent natural disasters such as floods and mudflows, local people voluntarily cooperate and help each other on a daily basis in both their jobs and private life. Therefore, people in mountainous areas are usually friendly with not only neighbors but also other people, implying that cooperation in the culture remains, as shown by certain Chinese traditions such as *Luoye Guigen*, mutual cooperation among households is sustained to maintain each other's houses.[5] Hilly areas (Fangshan and Yanqing) could be viewed as having just begun the process of urbanization, and they are now going through a transition from the mountainous and plains areas. Therefore, people's values and behavior may also be transitioning, resulting in individual social preferences to be the unidentified, which is consistent with Shahrier et al. (2016).

4 Conclusion

Urbanization can lead to cultural changes that influence human values and behavior. Topographical differences in plains, hilly and mountainous areas can reflect different degrees of urbanization based on distances to city areas. Hence, it is likely that there are topographical differences in social value orientation (SVOs). To examine this relationship, we conducted field surveys and experiments in Beijing, finding that the proportions of proself people are higher in plains and hilly areas than in mountainous areas, where the distance to the center of Beijing is shorter. As a transitional society, people in hilly areas tend to be more unidentified in SVOs. Overall, we demonstrate that social preferences transition from the prosocial to the unidentified and then to the proself with topographical changes.

[5] *Luoye Guigen* refers to the traditional belief that human spirits and souls go back to their birth places for peaceful rest.

This result implies that new social mechanisms are necessary to influence social preferences, inducing prosocial behavior in the process of urbanization. Otherwise, important social problems such as air pollution or sustainability, which require further cooperation for solutions, will pose more danger in the future.

We note some limitations of our study and directions for future research. This study does not take into account samples of people who live in the center of Beijing. In reality, it was extremely difficult for us to find and contact such people for data collection under time and budget constraints, and thus, we have mainly collected samples in suburban and rural areas. However, we conjecture that the qualitative results will not change even if we add the sample of residents in the center of Beijing. As for future research, similar types of research could be explored in other countries that experience rapid urbanization and serious social problems. In that case, it is meaningful to confirm the robustness of this analysis by comparing our results with those in different countries. Although we admit that our research has certain limitations and possibilities, it is our belief that this paper represents an important first step in addressing how social preferences are shaped by topographical differences in the urbanization process. Based on these findings, we suggest new social mechanisms are needed to induce prosocial behavior in urban societies and to secure human sustainability; we also hope that the robustness of our results will be established in the near future.

5 Bibliography

Bach, R., Defever, A. M., Chopik, W. J., and Konrath, S. (2016). Geographic variation in empathy: A state-level analysis. *Journal of research in personality*, 68:124–130.

Beijing Municipal Bureau of Statistics (2012). Beijing regional statistical yearbook 2012. Technical report, China statistics press.

Beijing Municipal Bureau of Statistics (2016a). Beijing regional statistical yearbook 2016. Technical report, China statistics press.

Beijing Municipal Bureau of Statistics (2016b). Beijing statistical yearbook 2016. Technical report, China statistics press.

Beijing Municipal Government (2012). Plans for the main functional area in Beijing (in Chinese).

Bogaert, S., Boone, C., and Declerck, C. (2008). Social value orientation and cooperation in social dilemmas: A review and conceptual model. *British journal of social psychology*, 47:453–480.

Brosig-Koch, J., Helbach, C., Ockenfels, A., and Weimann, J. (2011). Still different after all these years: Solidarity behavior in East and West Germany. *Journal of public economics*, 95:1373–1376.

Brueckner, J. and Lall, S. (2015). Cities in developing countries: Fueled by rural-urban migration, lacking in tenure security, and short of affordable housing. In Duranton, G., Henderson, V., and Strange, W., editors, *Handbook of regional and urban economics*. North Holland.

Chan, C. K. and Yao, X. (2008). Air pollution in mega cities in China. *Atmospheric environment*, 42:1–42.

Chen, W., Zhang, Y., Pengwang, C., and Gao, W. (2017). Evaluation of urbanization dynamics and its impacts on surface heat islands: A case study of Beijing, China. *Remote sensing*, 9:453.

Dawkins, R. (2006). *The selfish gene*. Oxford university press.

Dudwick, N., Hull, K., Katayama, R., Shilpi, F., and Simler, K. (2011). *From farm to firm: Rural-urban transition in developing countries*. World Bank publications.

Eckel, C. C. and Grossman, P. J. (1998). Are women less selfish than men? Evidence from dictator experiments. *Economic journal*, 108:726–735.

Fang, C., Ma, H., and Wang, J. (2015). A regional categorization for "new-type urbanization" in China. *PLoS ONE*, 10:e0134253.

Henrich, J. (2014). Rice, psychology, and innovation. *Science*, 344:593–594.

Huggins, R. and Thompson, P. (2016). Socio-spatial culture and entrepreneurship: Some theoretical and empirical observations. *Economic geography*, 92:269–300.

National Bureau of statistics of China (2016). China statistical yearbook 2016. Technical report, China statistics press.

Ockenfels, A. and Weimann, J. (1999). Types and patterns: An experimental East-West-German comparison of cooperation and solidarity. *Journal of public economics*, 71:275–287.

Ostrom, E., Dietz, T., Dolsak, N., Stern, P. C., Stonich, S., and Weber, E., editors (2002). *The drama of the commons*. Washington, DC: National academy press.

Rentfrow, P. J., Gosling, S. D., Jokela, M., Stillwell, D. J., and Kosinski, M. (2013). Divided we stand: Three psychological regions of the United States and their political, economic, social, and health correlates. *Journal of personality and social psychology*, 105:996–1012.

Rentfrow, P. J., Jokela, M., and Lamb, M. E. (2015). Regional personality differences in Great Britain. *PLoS ONE*, 10:e0122245.

Shahrier, S., Kotani, K., and Kakinaka, M. (2016). Social value orientation and capitalism in societies. *PloS ONE*, 11:e0165067.

Sovacool, B. K. (2009). Rejecting renewables: The socio-technical impediments to renewable electricity in the United States. *Energy policy*, 37:4500–4513.

Talhelm, T., Zhang, X., Oishi, S., Shimin, C., Duan, D., Lan, X., and Kitayama, S. (2014). Large-scale psychological differences within China explained by rice versus wheat agriculture. *Science*, 344:603–608.

Timilsina, R. R., Kotani, K., and Kamijo, Y. (2016). Sustainability of common pool resources. *PLoS ONE*, 12:e0170981.

Todaro, M. (1996). Income expectations, rural-urban migration and employment in Africa. *International labour review*, 135:421–444.

Van Lange, P. A., Bekkers, R., Shuyt, T. N., and Vugt, M. V. (2007). From games to giving: Social value orientation predicts donation to noble causes. *Basic and applied social psychology*, 29:375–384.

Van Lange, P. A., De Bruin, E. M., Otten, W., and Joireman, J. A. (1997). Development of prosocial, individualistic, and competitive orientations: Theory and preliminary evidence. *Journal of personality and social psychology*, 73:733–746.

Van Lange, P. A., Vugt, M. V., Meertens, R. M., and Ruiter, R. A. (1998). A social dilemma analysis of commuting preferences: The roles of social value orientation and trust. *Journal of applied social psychology*, 28:796–820.

Van Vugt, M., Meertens, R. M., and Van Lange, P. A. (1995). Car versus public transportation? The role of social value orientations in a real-life social dilemma. *Journal of applied social psychology*, 25:258–278.

Wei, Z., Zhao, Z., and Zheng, Y. (2016). Moderating effects of social value orientation on the effect of social influence in prosocial decisions. *Frontiers in psychology*, 7:952.

Wilson, D. S., O'Brien, D. T., and Sesma, A. (2009). Human prosociality from an evolutionary perspective: Variation and correlations at a city-wide scale. *Evolution and human behavior*, 30:190–200.

Young, A. (2013). Inequality, the urban-rural gap and migration. *Quarterly journal of economics*, 128:1727–1785.

Zeng, R. and Greenfield, P. M. (2015). Cultural evolution over the last 40 years in China: Using the Google Ngram Viewer to study implications of social and political change for cultural values. *International journal of psychology*, 50:47–55.

Zhang, K. H. and Song, S. (2003). Rural-urban migration and urbanization in China: Evidence from time-series and cross-section analyses. *China economic review*, 14:386–400.

List of Figures

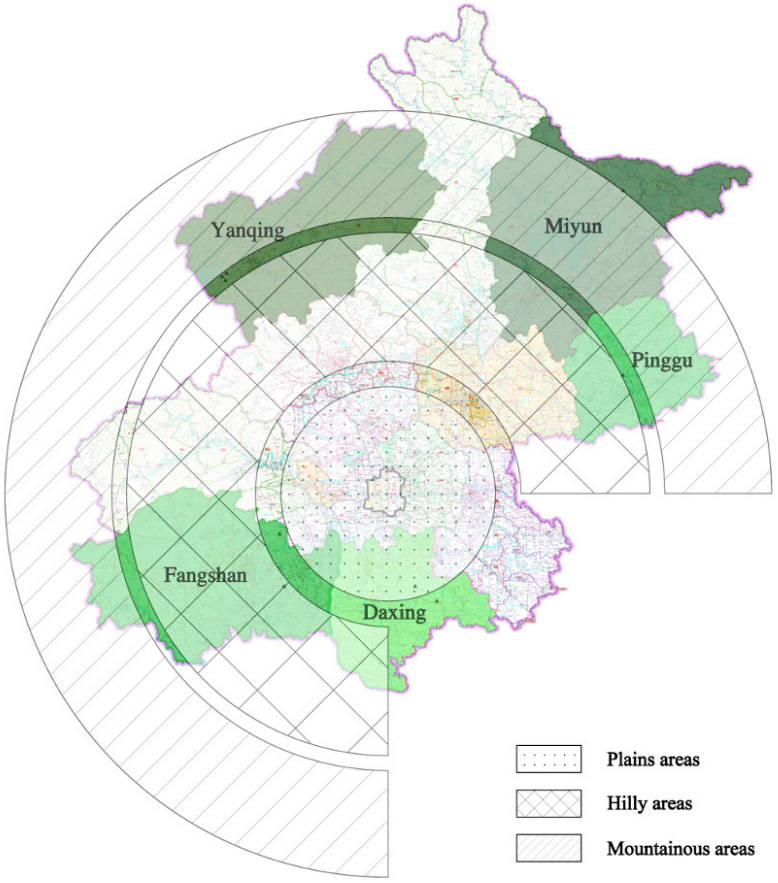

Figure 1: The survey areas in Beijing

List of Tables

Table 1: Descriptions of the independent variables

Variable	Description
Education	An ordered categorical variable that takes 1 when a respondent is educated at primary school level, 2 is middle high school level, 3 is high school level and 4 is university level.
Household income	Annual household income for the year of 2015 in $10\,000$ RMB.
Age	Age of the respondent
Gender	A dummy variable that takes 1 when the respondent is male, otherwise 0.
Children	The number of the children in a household who are below 15 years old.
Farmer	A dummy variable that takes 1 when a respondent engages in farming as a main occupation, otherwise 0.
Area dummy	A dummy variable that takes 1 when a respondent resides in plains (hilly) areas, taking mountainous areas as a base group.

Table 2: Distribution of social value orientation (SVO) in three areas

	Prosocial	Proself	Unidentified
Mountain	102 (75.56 %)	26 (19.26 %)	7 (5.19 %)
Hilly	168 (54.02 %)	103 (33.12 %)	40 (12.86 %)
Plains	87 (58.00 %)	53 (35.33 %)	10 (6.67 %)
Overall	357 (59.90 %)	182 (30.54 %)	57 (9.56 %)

Table 3: Summary statistics for all the independent variables

	Areas			Overall
	Mountain	Hilly	Plains	
Household income in 10 000 RMB				
Average (Median)[1]	1.47 (1.00)	2.84 (3.00)	2.97 (3.00)	2.56 (2.00)
SD[2]	1.02	1.98	1.78	1.85
Min	0.2	0.2	0.2	0.2
Max	5	12	8	12
Age				
Average (Median)	56.45 (56.00)	54.19 (56.00)	53.86 (54.00)	54.62 (55.00)
SD	11.30	14.08	10.71	12.72
Min	20	20	21	20
Max	91	88	86	91
Education (categorical variables)				
Average (Median)	1.65 (2.00)	1.97 (2.00)	1.79 (2.00)	1.85 (2.00)
SD	0.64	0.84	0.74	0.78
Min	1	1	1	1
Max	3	4	4	4
Children (< 15 year-old)				
Average (Median)	0.34 (0.00)	0.49 (0.00)	0.59 (1.00)	0.48 (0.00)
SD	0.51	0.60	0.64	0.59
Min	0	0	0	0
Max	2	2	2	2
Gender (Male $= 1$)				
Average (Median)	0.65 (1.00)	0.55 (1.00)	0.80 (1.00)	0.64 (1.00)
SD	0.48	0.50	0.40	0.48
Min	0	0	0	0
Max	1	1	1	1
Farmer (YES $= 1$)				
Average (Median)	0.95 (1.00)	0.71 (1.00)	0.69 (1.00)	0.76 (1.00)
SD	0.22	0.45	0.46	0.43
Min	0	0	0	0
Max	1	1	1	1
Sample size	135	311	150	596

[1] Median in parentheses.
[2] SD stands for standard deviation.

Table 4: Marginal effects of the multinomial logit regression

	Multinomial logit regression	
	Proself	Unidentified
Household income (in 10 000 RMB)	0.015	0.013**
	(0.012)	(0.006)
Education	−0.046	0.010
	(0.030)	(0.016)
Children	−0.059*	0.003
	(0.035)	(0.016)
Gender (base group = female)	0.071*	0.002
	(0.041)	(0.020)
Age	−0.003	0.000
	(0.002)	(0.001)
Farmer	−0.069	0.109***
	(0.057)	(0.019)
Area dummy (base group = mountainous areas)		
Plains areas	0.143**	0.016
	(0.068)	(0.038)
Hilly areas	0.144***	0.064**
	(0.054)	(0.030)

The regression takes the prosocial as the reference group.
Children refer to the number of children in a household whose age is below 15 years old.
***significant at the 1 percent level, **significant at the 5 percent level and *significant at the 10 percent level.
The LR χ^2 value in the multinomial logit regression is 63.10 and significant at the 1 percent level.