Seminar „Analytische Soziologie: Theorie und empirische Anwendungen“
Venice International University, 20.–23.11.2017

Social Inequalities of Objective and Subjective Environmental Threats: (Replicative) Results of two Surveys with Georeferenced Respondent Data

Lucie Herold, Felix Wolter, Jürgen Schiener
Institute for Sociology, Johannes Gutenberg University Mainz

San Servolo, 22.11.2017

JG|U

Outline

1. Environmental Justice Research and Research Gap
2. Design of the Studies
3. Results
4. Discussion

Outline

1. **Environmental Justice Research and Research Gap**
2. Design of the Studies
3. Results
4. Discussion

Environmental Justice: Theoretical Concept

- General conjecture:
  - the socially disadvantaged additionally have a higher burden in environmental risks.
- Explanatory approach: rational choices in the housing market
  - Preferences in the housing market (location, equipment, environmental quality) determine the rent and buying prize

  ➔ High-status people tend to leave areas with a low environmental quality

  ➔ …and have better opportunities to move into an area with good environmental quality
  = Segregation

This Presentation: Noise Exposure

This Presentation: Noise Exposure

- Noise exposure ≠ noise annoyance
- Only 1/3 of noise annoyance results from acoustic characteristics of noise (Marquis-Favre/Aubrée/Vallett 2005).
- e.g. noise sensibility, attitudes towards the source of noise or the perceived control over the situation are coping resources that determine the degree of noise annoyance.
- Assumptions concerning social status and noise annoyance (Fyhri/Klaeboe 2006):
  - Well educated and high earning people have more coping resources (−)
  - Stating a high noise annoyance can be considered as a coping strategy (+)
- Studies point out a positive effect of social status on noise annoyance (Meyer 2012).

Environmental Justice: State of Research

- Research in the USA:
  - Several studies of the late 20th century show that hazardous waste landfills are significantly more often located in communities with a high proportion of black citizens (e.g. Brown 1995, Mohai/Saha 2015)
- Research in German speaking countries:
  - Mostly epidemiological studies which show that high earners, highly educated people and German (resp. Swiss) citizens are less exposed to environmental risks such as air and noise pollution (Mielck 2004; Stronegger/Freidl 2004; Bolte et al. 2004).
  - These studies are mainly based on subjective statements on exposure to street traffic and air pollution, use bivariate analyses and only refer to a subset of the population (such as children or specific areas).
  - Recent studies with objective environmental data and more advanced analysis methods reveal only a small positive effect for income and (German resp. Swiss) citizenship (Diekmann/Meyer 2010; Meyer 2011, Lakes/Brückner/Krämer 2014).
- Contradictory findings in some recent studies for France and Italy (Padilla et al. 2014; Forastiere et al. 2007).

Conclusion

- While theory and empirical research in the USA indicate a correlation between social status and environmental risk exposure, studies confirming this relationship in Germany are missing.

- Hence in this presentation two questions are addressed:

1. Do citizens with a low social status or a migration background have a higher risk of objective noise exposure?

2. Do citizens with a low social status or a migration background report a lower noise annoyance when controlling for objective noise?

Analysis Approach

- Our perspective is a local context – the City of Mainz.
- Main survey: DFG project “Environmental Justice: Social Distribution, Justice Evaluations and Acceptance Levels of Unfavorable Local Environmental Conditions”
- Replication survey: teaching project.
- In our analyses, we will first focus on the (main) DFG survey and then cursory ask if results are replicable with the second survey.

Outline

1. Environmental Justice Research and Research Gap
2. **Design of the Studies**
3. Results
4. Discussion

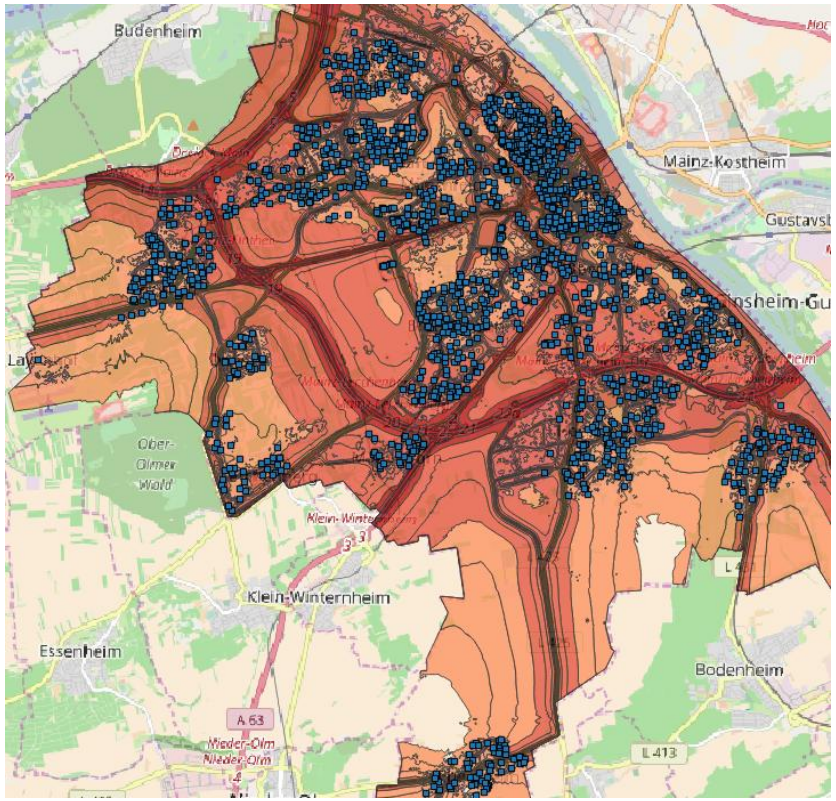
Study Design

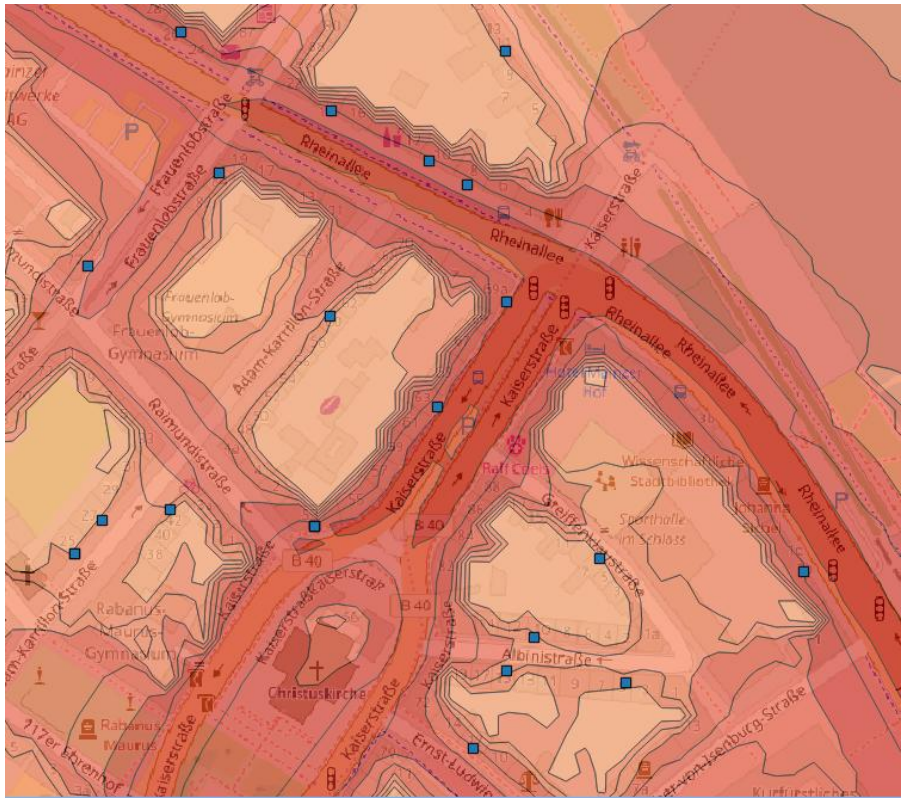
- Two postal surveys in the City of Mainz, autumn 2016.

	Survey 1	Survey 2
Background	DFG project „Environmental Justice“	Teaching project, University of Mainz
Sample	Random sample of the population aged 18 to 70 in Mainz, official population register	Geographic street section sample (Bauer 2014)
Response rate	45 % (COOP 2)	29 % (COOP 2)
N	1802	580
Analysis	CCA	CCA, design weight
n	1455	461

Geo-Referenced Survey Data

- Survey 1 (DFG): Geocoding of the respondents‘ addresses.





Geo-Referenced Survey Data

- Survey 2 (teaching project): Street section sample
- Geo-referencing at street section-level, less exact than in survey 1.

Dependent Variables

- Objective and subjective indicators for aircraft noise and street traffic noise.
- Objective noise exposure:
  - Source: public authorities (street traffic), NGO „Umwelthaus“ (aircraft).
  - Calculated average noise level for each coordinate on the map of Mainz. Models are based on parameters like traffic intensity, velocity, nature of the road, distance to the street, number of flights and aircraft type, and sound reducing obstacles.
  - Mean of 24h.
- Subjective noise annoyance:
  - “How annoyed are you [by day, at night] by the following noise sources?”
  - Mean index of day/night.
- All indicators are standardized with mean 0 and SD 1 for analysis.

Independent Variables

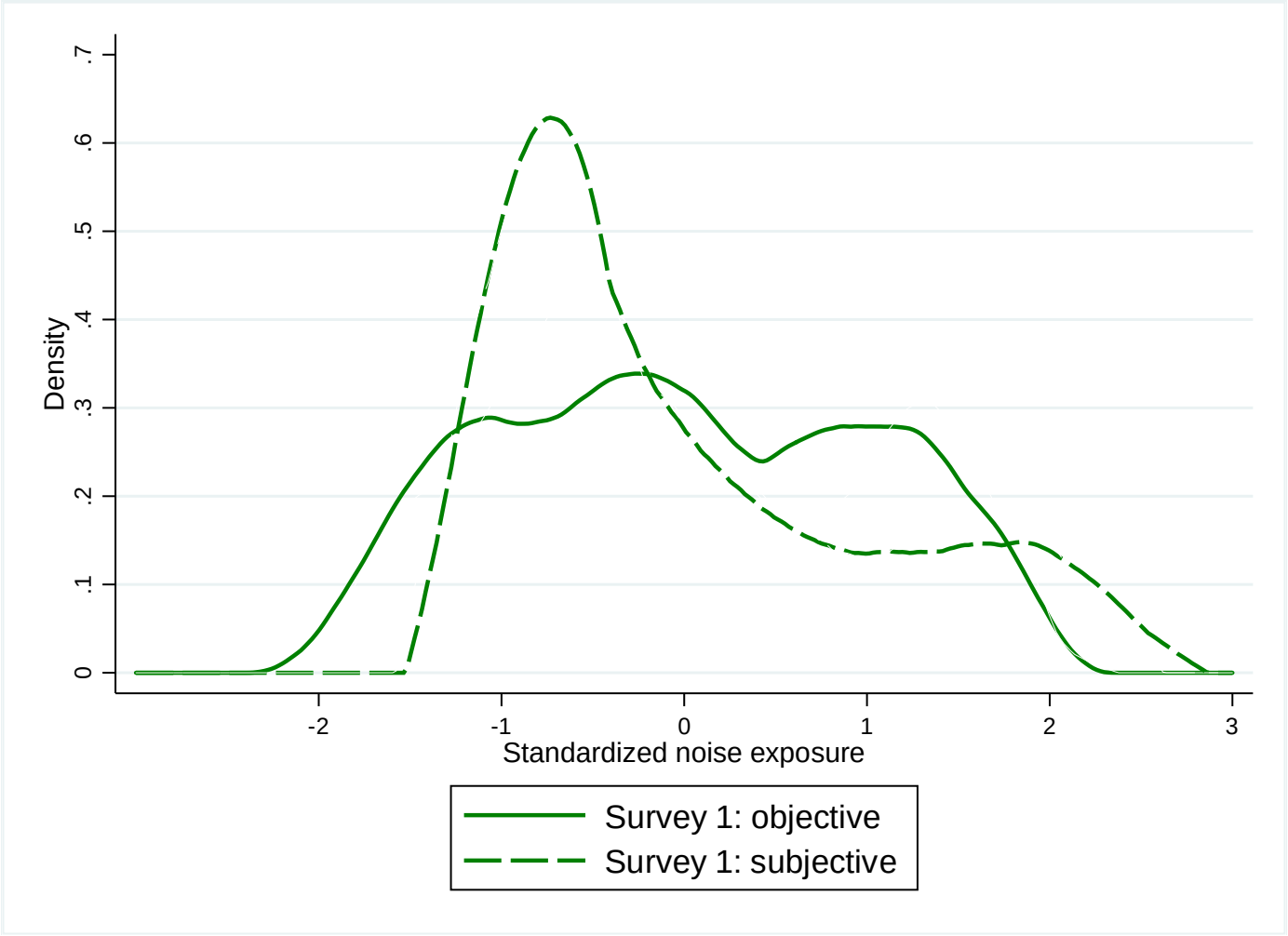
- Social status / migration characteristics:
  - Academic education (1 = yes)
  - Home owner (as a proxy for income)
  - Migration background (1 = no German nationality or not born in Germany)

- Other:
  - Age
  - Gender
  - House type (apartment house, row house, detached house)
  - Daily time spent at home (1 = more than 20h)
  - Car user (1 = yes)
  - Flight user (1 = yes, last 12 months)

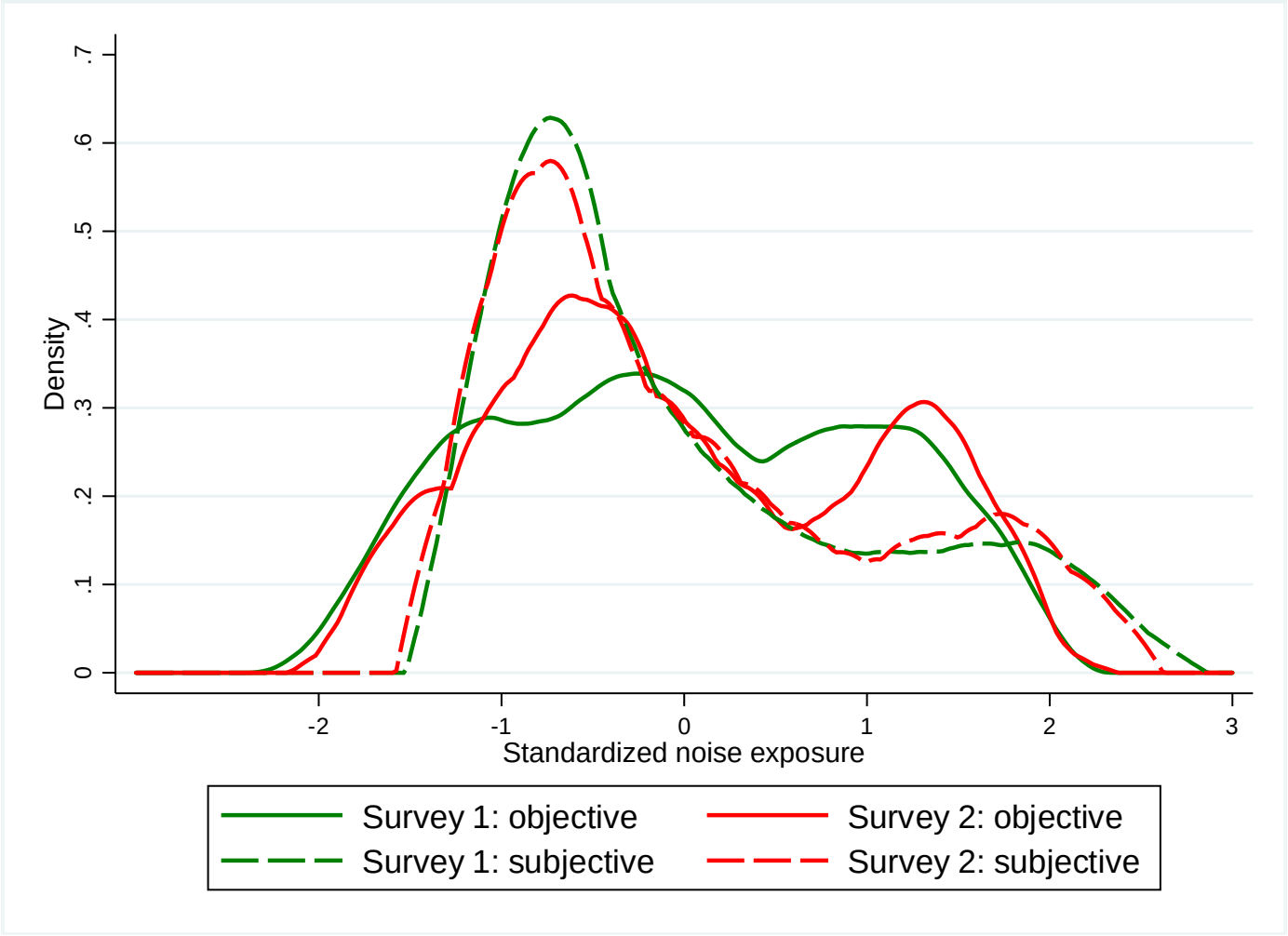
Outline

1. Environmental Justice Research and Research Gap
2. Design of the Studies
3. **Results**
4. Discussion

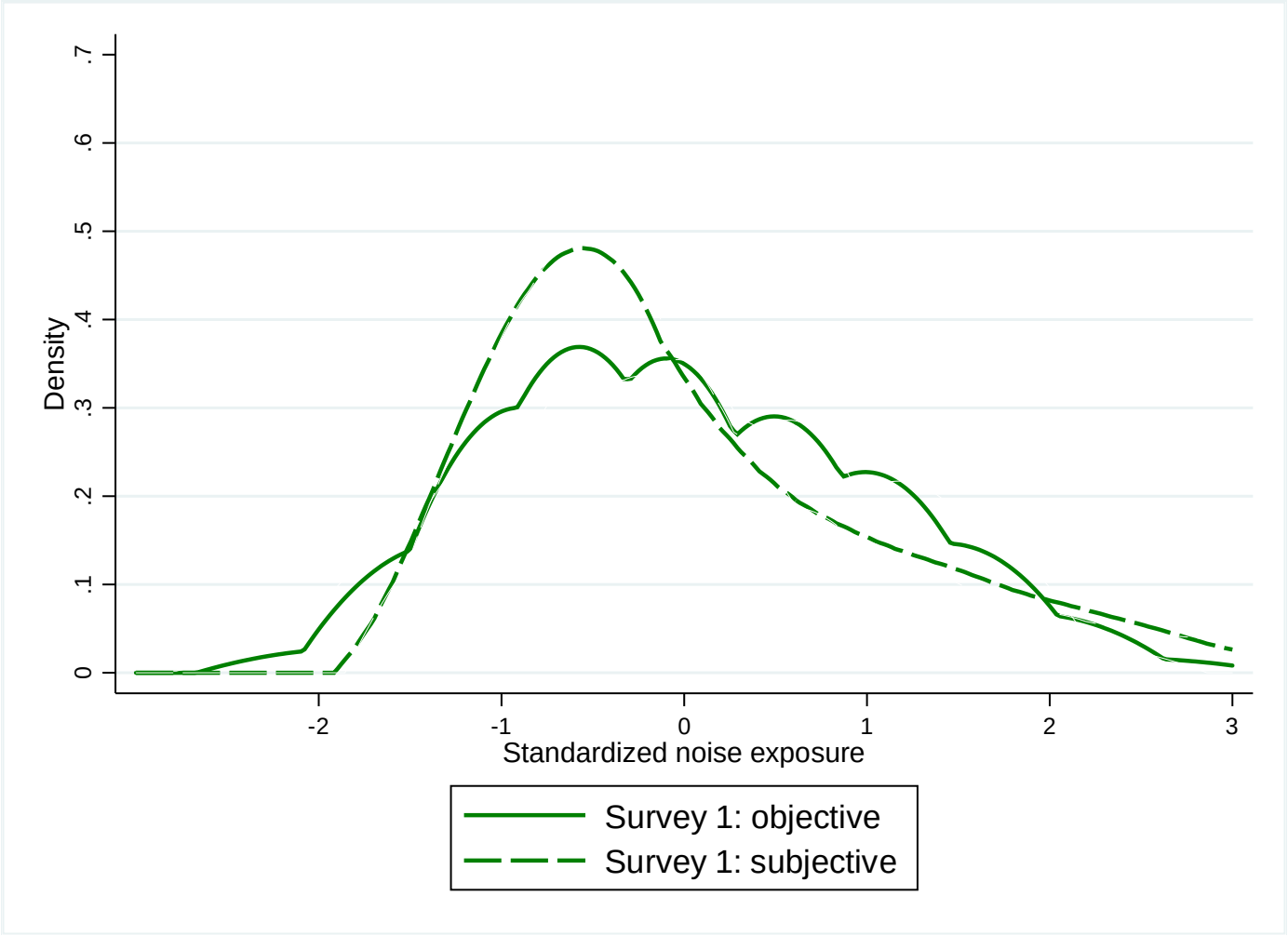
Descriptive Analysis: Aircraft Noise



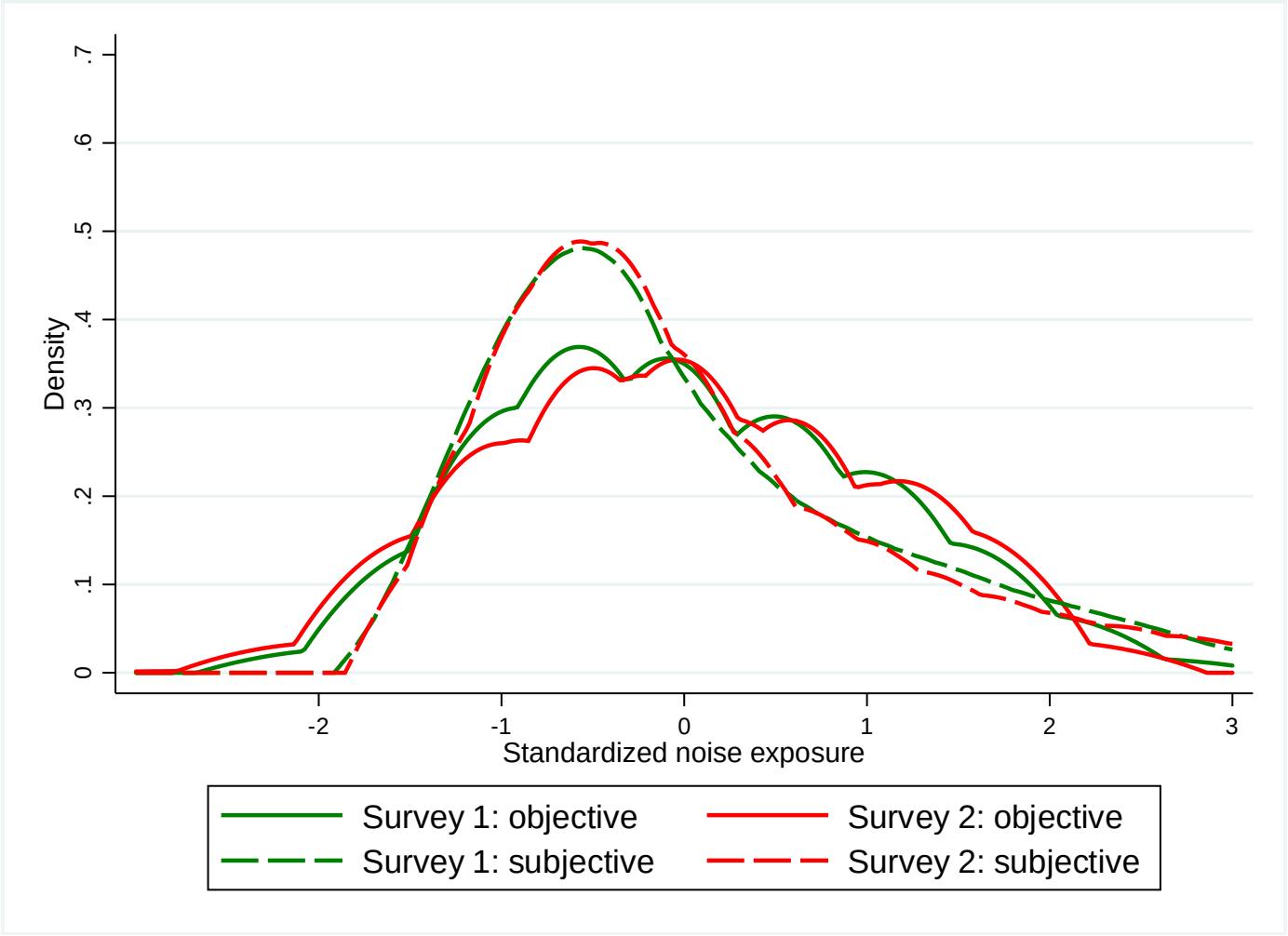
Descriptive Analysis: Aircraft Noise



Descriptive Analysis: Street Traffic Noise



Descriptive Analysis: Street Traffic Noise



Objective and Subjective Noise Exposure: Correlations

- Survey 1 (DFG project, n=1455):

	Aircraft obj.	Aircraft subj.	Street obj.
Aircraft obj.			
Aircraft subj.	0.49		
Street obj.	0.03	−0.09	
Street subj.	0.00	0.12	0.41

Objective and Subjective Noise Exposure: Correlations

- Survey 1 (DFG project, n=1455):

	Aircraft obj.	Aircraft subj.	Street obj.
Aircraft obj.			
Aircraft subj.	**0.49**		
Street obj.	*0.03*	**−0.09**	
Street subj.	0.00	**0.12**	***0.41***

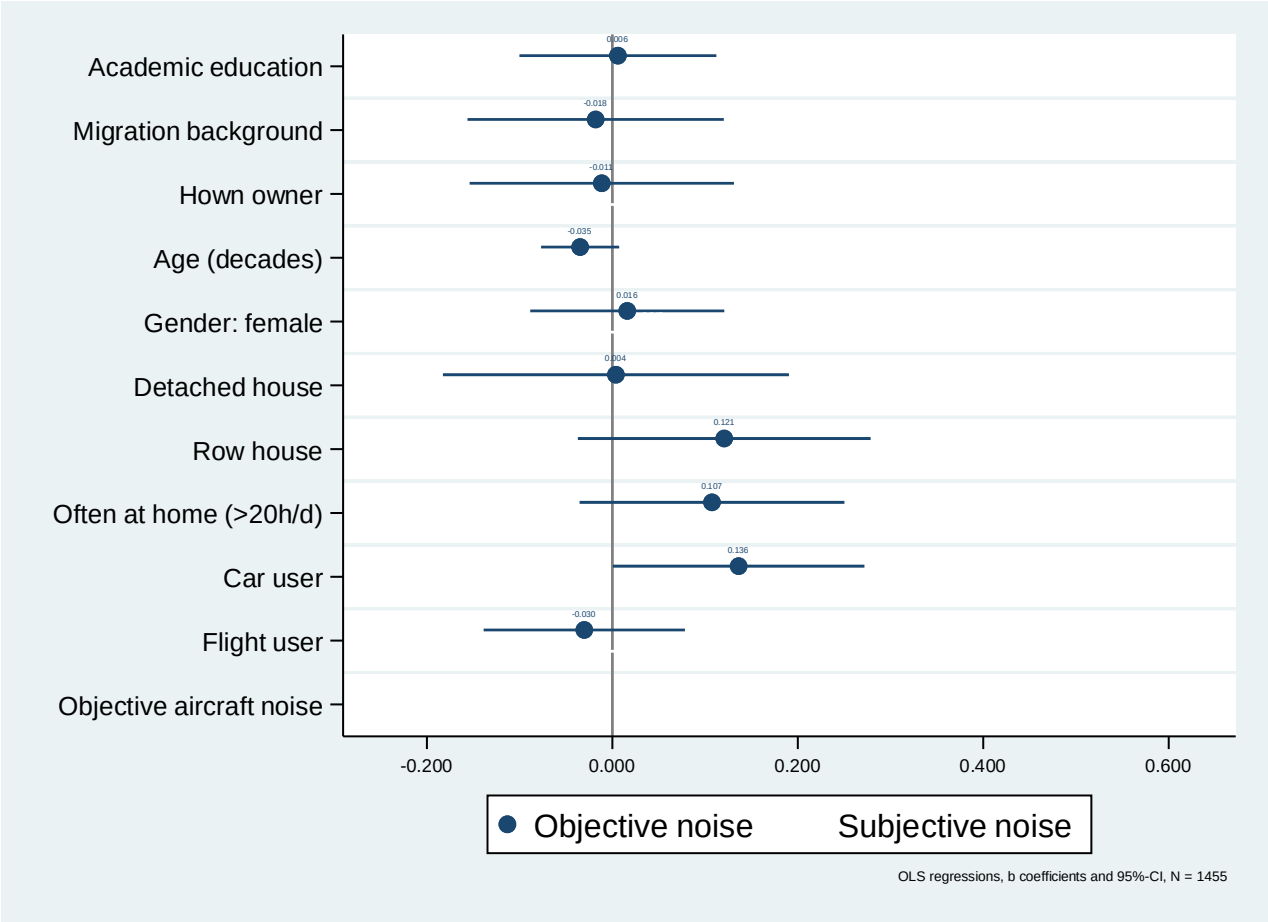
- Survey 2 (teaching project, n=461):

	Aircraft obj.	Aircraft subj.	Street obj.
Aircraft obj.			
Aircraft subj.	**0.54**		
Street obj.	***−0.13***	**−0.11**	
Street subj.	−0.02	**0.22**	***0.30***

Bold: p<0.05 for correlation.
Italic: p<0.05 for difference between study 1 and study 2.

Social Gradient of Aircraft Noise Exposure

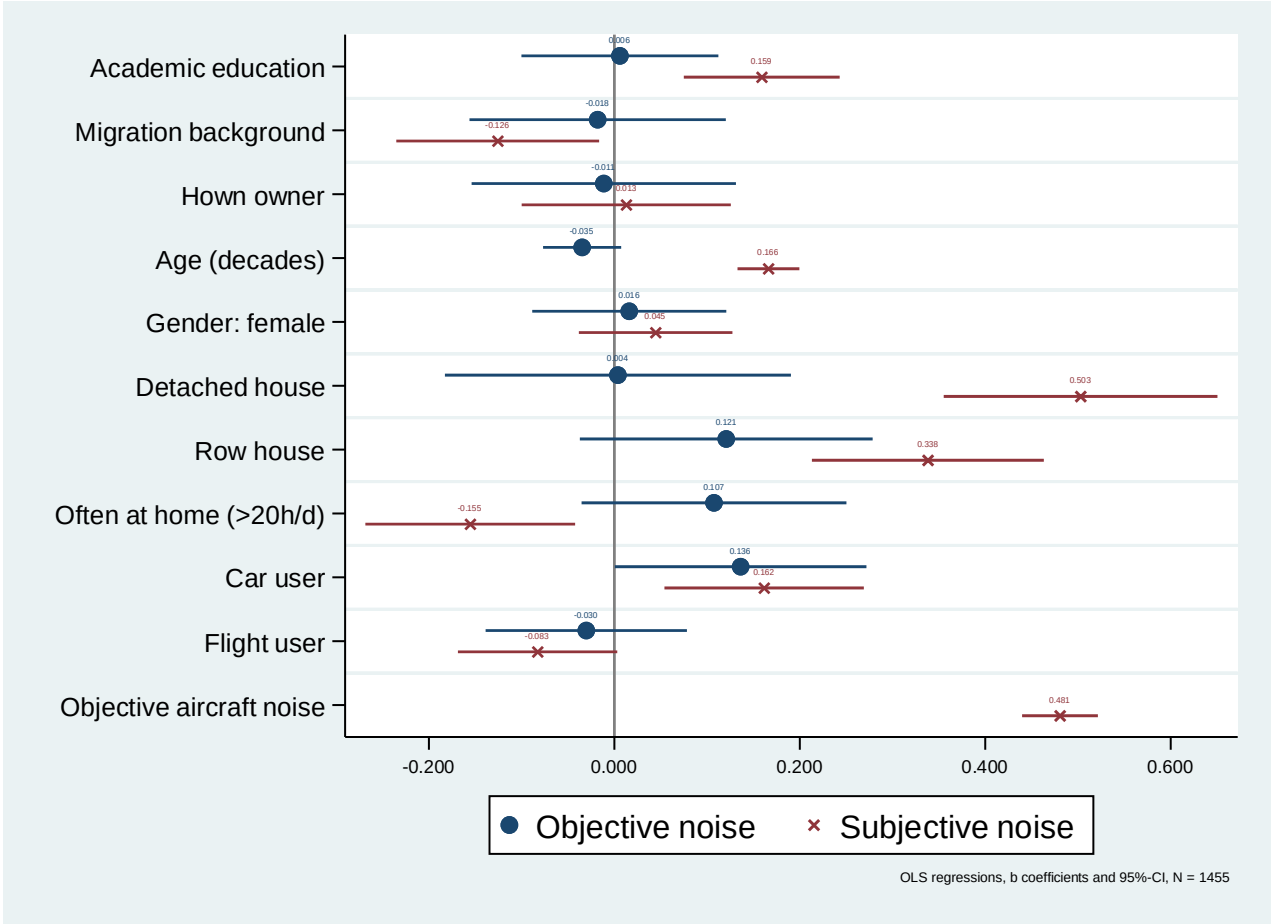
- Study 1 (DFG project):



$R^2 = 0{,}01$

Social Gradient of Aircraft Noise Exposure

- Study 1 (DFG project):

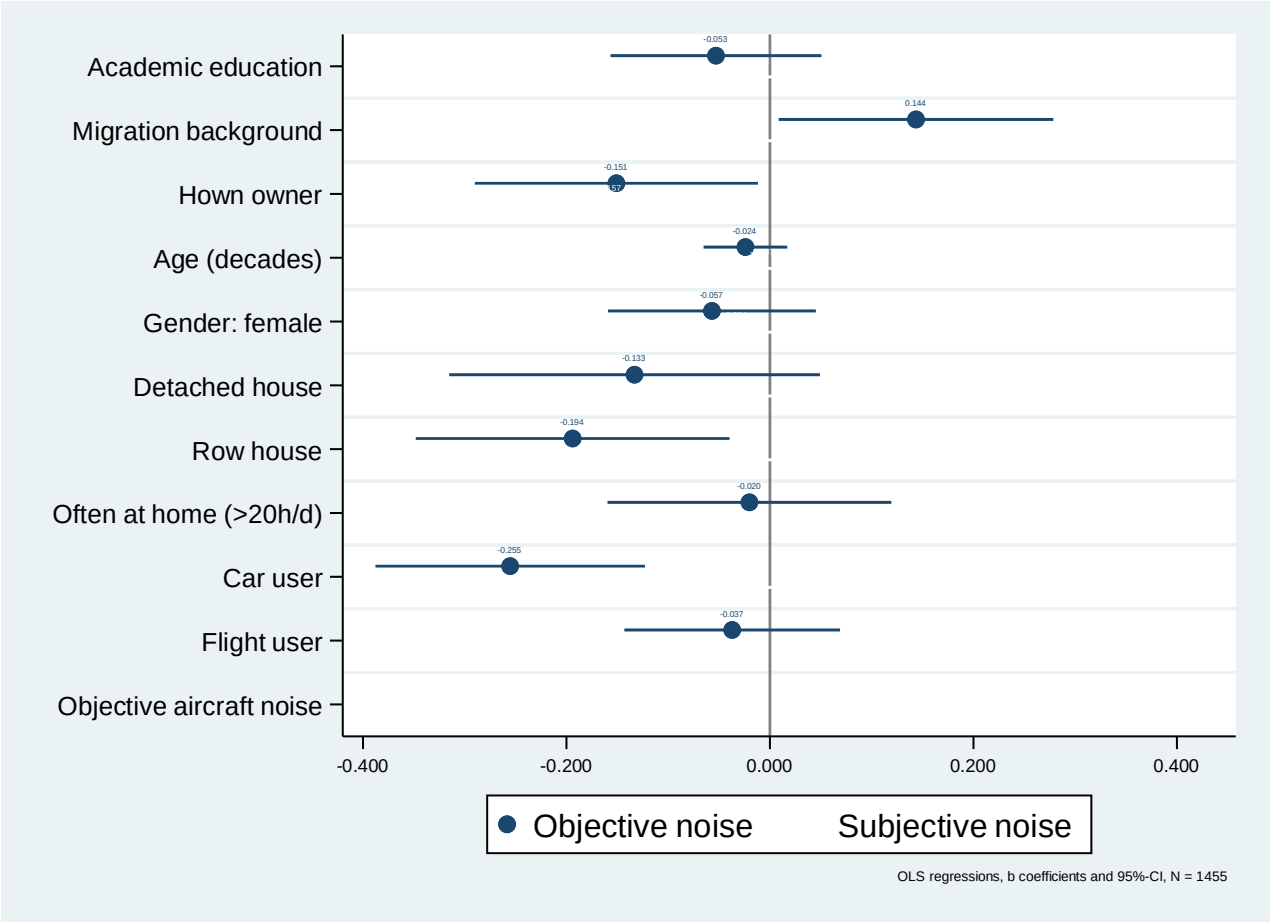


R^2 = 0,01

R^2 = 0,38

Social Gradient of Street Traffic Noise Exposure

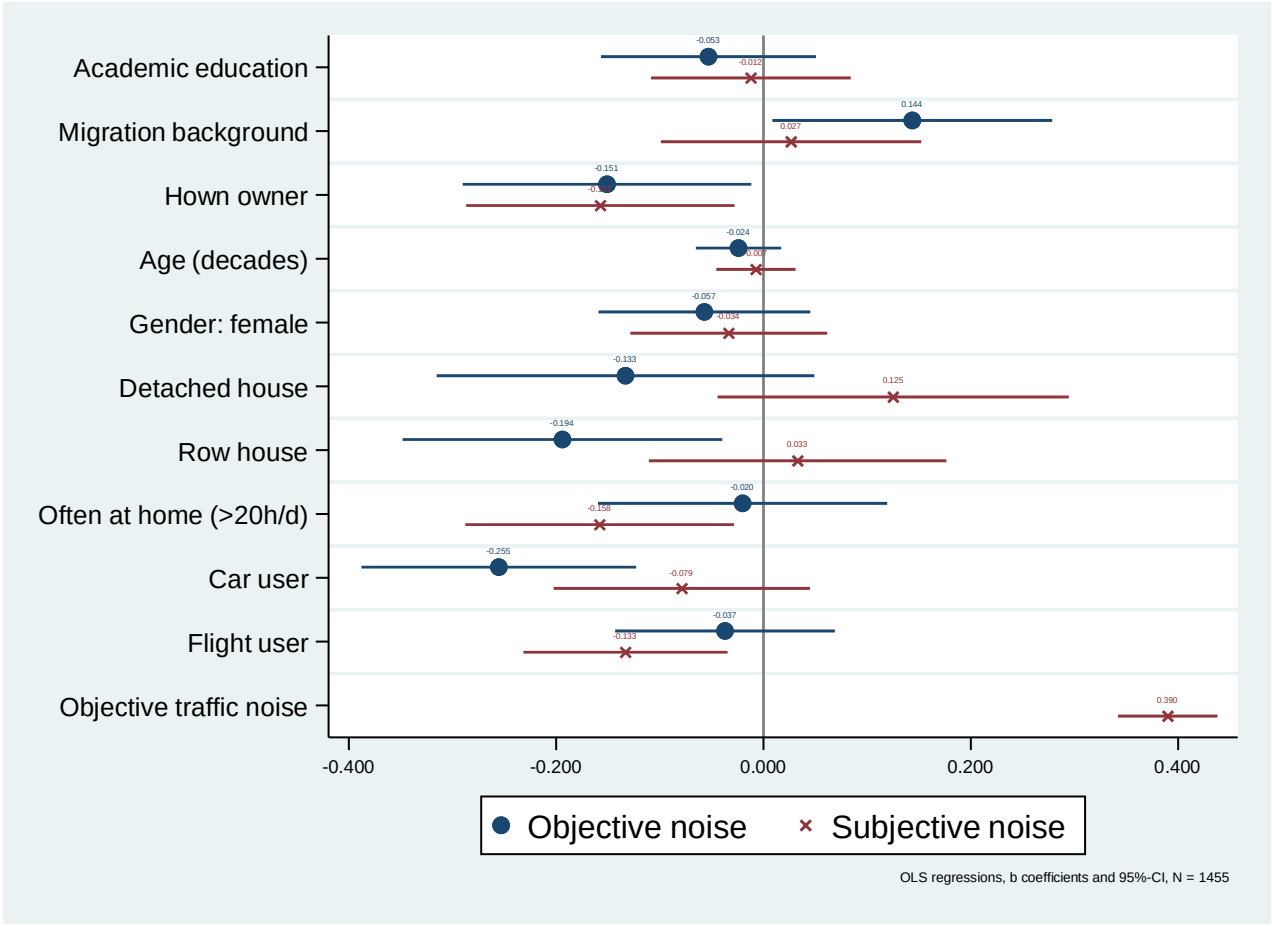
- Study 1 (DFG project):



$R^2 = 0,05$

Social Gradient of Street Traffic Noise Exposure

- Study 1 (DFG project):



R^2 = 0,05

R^2 = 0,18

Results So Far

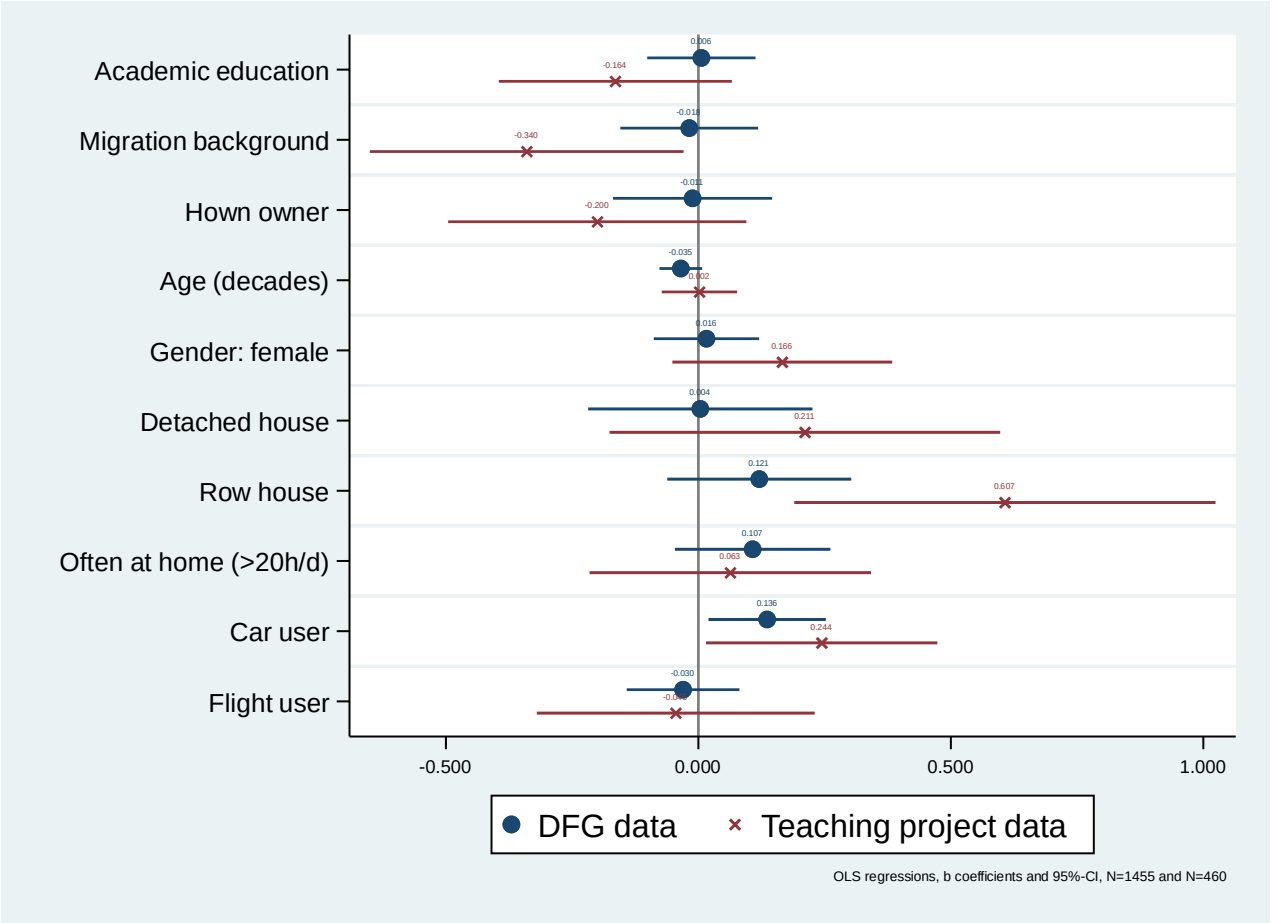
		Social gradient
Aircraft noise	objective	no
	subjective	yes
	difference of effects	yes (partly)
Street traffic noise	objective	yes
	subjective	less pronounced
	difference of effects	no

Replication With Study 2

		Social gradient	Replication?
Aircraft noise	objective	no	partly
	subjective	yes	no
	difference of effects	yes (partly)	
Street traffic noise	objective	yes	Yes, but different variables
	subjective	less pronounced	yes
	difference of effects	no	

Replication With Study 2

- Objective aircraft noise:

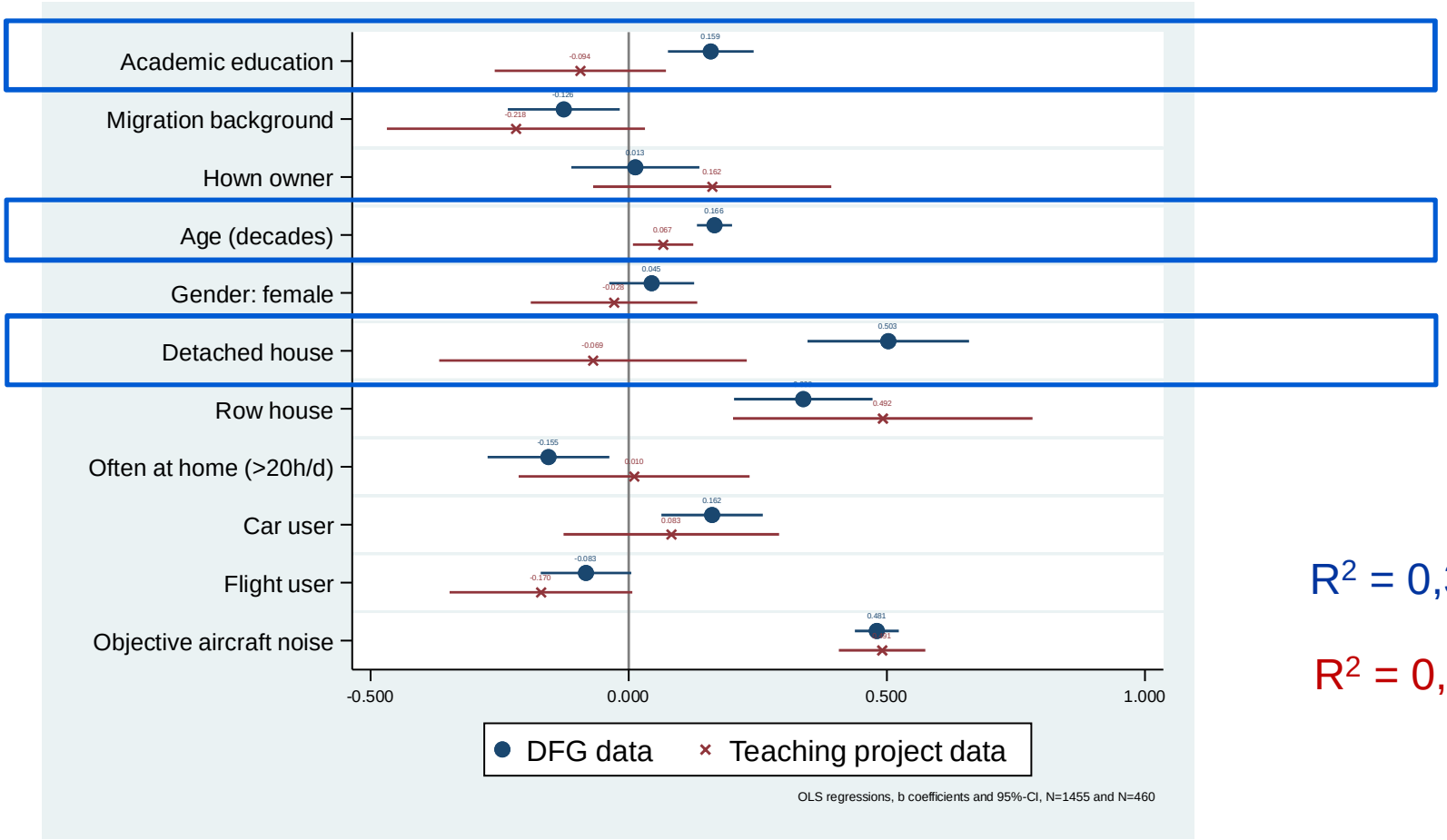


R^2 = 0,01

R^2 = 0,06

Replication With Study 2

- Subjective aircraft noise:

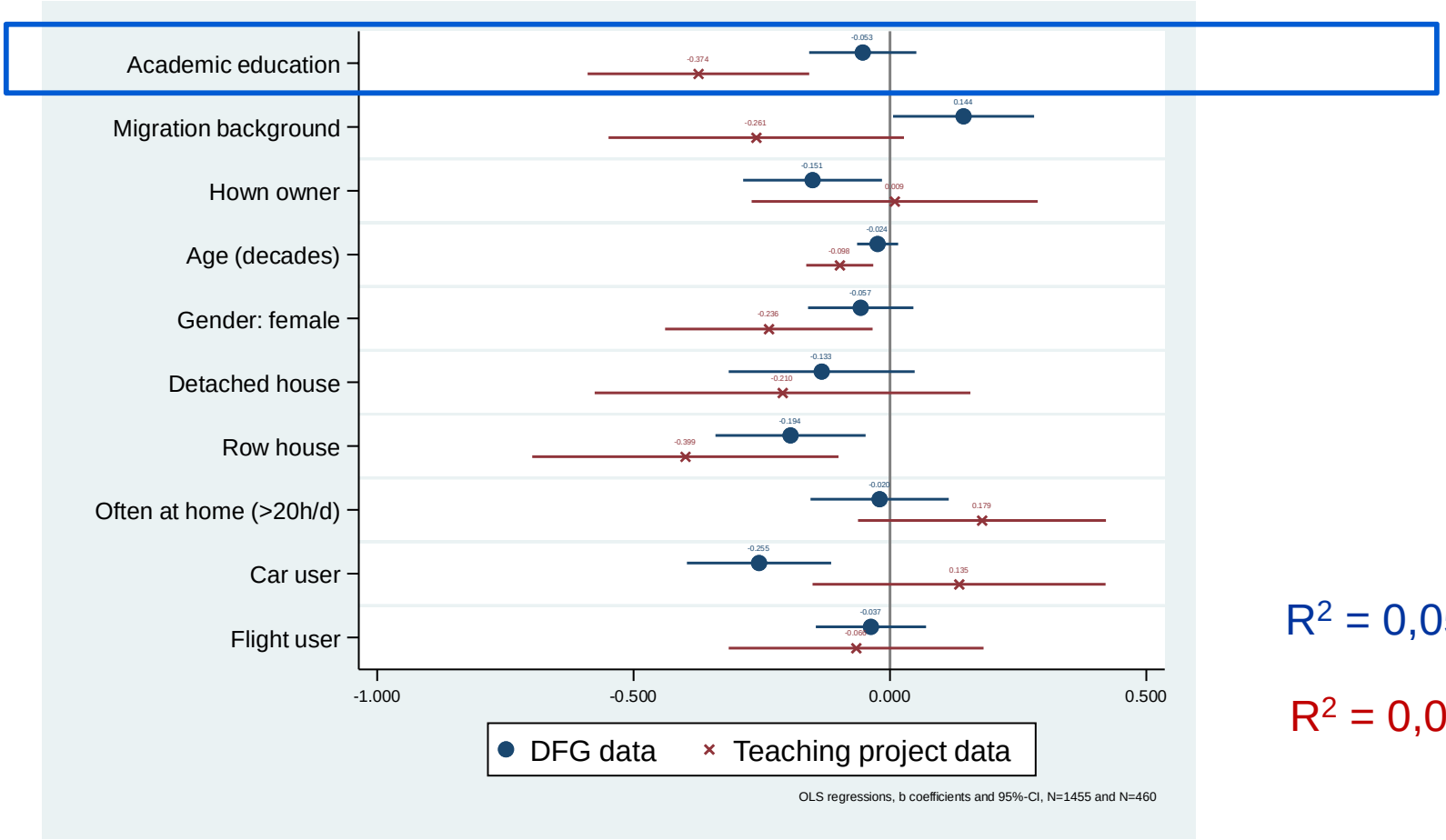


R^2 = 0,38

R^2 = 0,38

Replication With Study 2

- Objective street traffic noise:

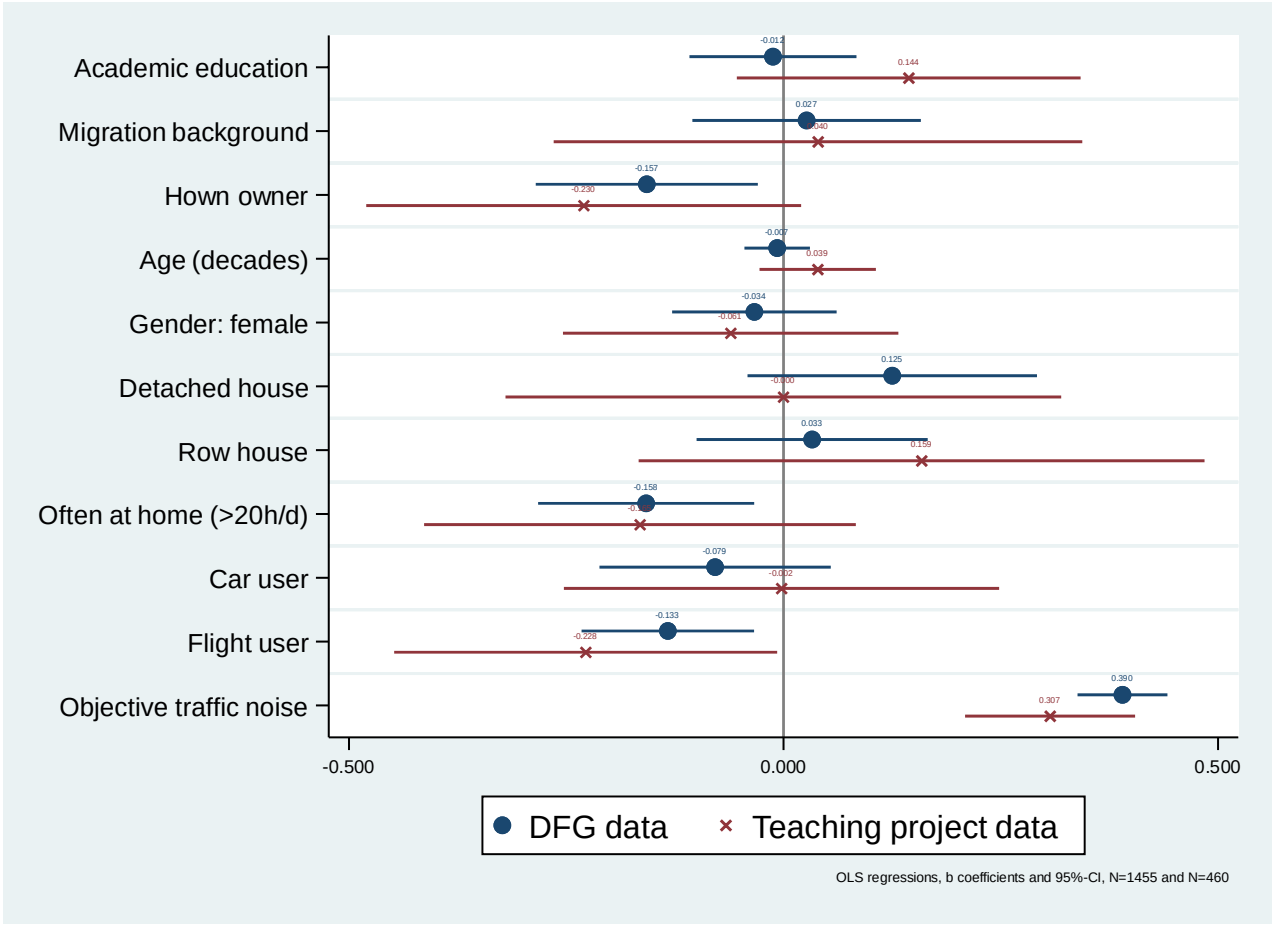


$R^2 = 0,05$

$R^2 = 0,09$

Replication With Study 2

- Subjective street traffic noise:



R^2 = 0,18

R^2 = 0,12

Replication With Study 2

- Problem with multiple testing?
  - Here: 2*10+2*11=42 tests for different coefficients
  - 2,1 randomly significant with p=.05
- We found 4 significant differences.

Outline

1. Environmental Justice Research and Research Gap
2. Design of the Studies
3. Results
4. **Discussion**

Discussion

- How to deal with replication?
  - Adjusting the sample?
  - Choice of alpha level / power issues?
- How can (social) differences in the subjective annoyance be explained?
- Next step: Improvement of Geodata (regarding housing data)

Thank you very much!

herold@uni-mainz.de
felix.wolter@uni-mainz.de
juergen.schiener@uni-mainz.de

Literature

- Bauer, Johannes 2014: New Sample Designs. An Improvement and Alternative to Random Route Samples, Working Paper: LMU München.
- Bolte, Gabriele; Elvers, Horst-Dietrich; Schaaf, Beate; Berg, Andrea von; Borte, Michael; Heinrich, Joachim 2004: Soziale Ungleichheit bei der Belastung mit verkehrsabhängigen Luftschadstoffen: Ergebnisse der Kinderkohortenstudie LISA , in: Umweltgerechtigkeit. Die soziale Verteilung von Umweltbelastungen. Weinheim: Juventa, S. 175–198.
- Brown, Phil 1995: Race, class, and environmental health: a review and systematization of the literature, Environmental research 69 (1), S. 15–30.
- Diekmann, Andreas; Meyer, Reto 2010: Demokratischer Smog? Eine empirische Untersuchung zum Zusammenhang zwischen Sozialschicht und Umweltbelastungen, KZfSS Kölner Zeitschrift für Soziologie und Sozialpsychologie 62 (3), S. 437–457.
- Forastiere, Francesco; Stafoggia, Massimo; Tasco, Carola; Picciotto, Sally; Agabiti, Nerina; Cesaroni, Giulia; Perucci, Carlo A. 2007: Socioeconomic status, particulate air pollution, and daily mortality. Differential exposure or differential susceptibility, American journal of industrial medicine 50 (3), S. 208–216.
- Fyhri, Aslak; Klæboe, Ronny 2006: Direct, indirect influences of income on road traffic noise annoyance, Journal of environmental psychology 26 (1), S. 27–37.
- Lakes, Tobia; Brückner, Maria 2011: Sozialräumliche Verteilung der Lärmbelastung in Berlin, UMID-II. Themenheft Umweltgerechtigkeit, S. 26–28.
- Marquis-Favre, Catherine; Premat, Eric; Aubrée, D. 2005: Noise and its effects–a review on qualitative aspects of sound. Part II: Noise and annoyance, Acta Acustica united with Acustica 91 (4), S. 626–642.
- Meyer, Reto 2011: Eine empirische Untersuchung zur sozialen Verteilung von Verkehrslärm in den Städten Basel und Bern, Schweizerische Zeitschrift für Soziologie 37 (1), S.. 99-126
- Meyer, Reto 2012: Eine methodische Studie zur Verwendung subjektiver Beurteilungen in der Environmental Justice-Forschung, Umweltpsychologie (16 (2)), S. 65-85.
- Mielck, Andreas 2004: Unterschiede bei Lärmbelastung und Luftverschmutzung nach dem Haushaltseinkommen, in: Umweltgerechtigkeit. Die soziale Verteilung von Umweltbelastungen. Weinheim: Juventa, S. 139–153.
- Mohai, Paul; Saha, Robin 2015: Which came first, people or pollution? A review of theory and evidence from longitudinal environmental justice studies, Environmental Research Letters 10 (12), S. 1–9.
- Padilla, Cindy M.; Kihal-Talantikite, Wahida; Vieira, Verónica M.; Rossello, Philippe; Le Nir, Geraldine; Zmirou-Navier, Denis; Deguen, Severine 2014: Air quality and social deprivation in four French metropolitan areas—a localized spatio-temporal environmental inequality analysis, Environmental research 134, S. 315–324.
- Stronegger, Willibald-Julius; Freidl, Wolfgang (2004): Infrastrukturgerechtigkeit am Beispiel Wohnumwelt und Gesundheit in einer urbanen Population, in: Umweltgerechtigkeit. Die soziale Verteilung von Umweltbelastungen. Weinheim: Juventa, S. 93–115.

Descriptive Analysis: Independent Variables

	Survey 1	Survey 2	Diff.
Academic education (1=yes)	50,5	51,6	
Home owner (1=yes)	38,5	38,0	
Migration background (1=yes)	17,3	12,4	*
Age (decades)	4,2	4,7	***
Gender (1=female)	54,2	55,3	
Apartment house (1=yes)	70,6	77,9	**
Row house (1=yes)	18,1	11,1	***
Detached house (1=yes)	11,3	11,1	
Daily time spent at home (1= >20h)	19,5	26,7	**
Car user (1=yes)	79,0	83,7	*
Flight user (1=yes)	59,9	61,0	

Indicated are percentages and the mean (SD) for age.

Subjective Noise Annoyance: Study 1

14.a Jetzt folgen Fragen zum Thema Lärm in Ihrer Wohnung:
Wie sehr fühlen Sie sich in Ihrer Wohnung tagsüber durch die folgenden Lärmarten gestört, wenn die Fenster offen sind?

	Überhaupt nicht gestört										Sehr stark gestört
	0	1	2	3	4	5	6	7	8	9	10
Straßenverkehrslärm	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Eisenbahnlärm	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Fluglärm	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Lärm durch Nachbarn	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Lärm durch Lokale, Geschäfte, Leute auf der Straße	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Andere Lärmquelle, nämlich:	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

- + day, windows closed; + night, windows open; + night, windows closed.

Subjective Noise Annoyance: Study 2

F14 **Wie stark fühlen Sie sich in Ihrer Wohnung <u>tagsüber</u> durch die folgenden Lärmarten gestört?**

Bitte antworten Sie auf der Skala von 1 = „überhaupt nicht gestört“ bis 7 = „sehr stark gestört“. Mit den Werten dazwischen können Sie Ihre Antwort abstufen.

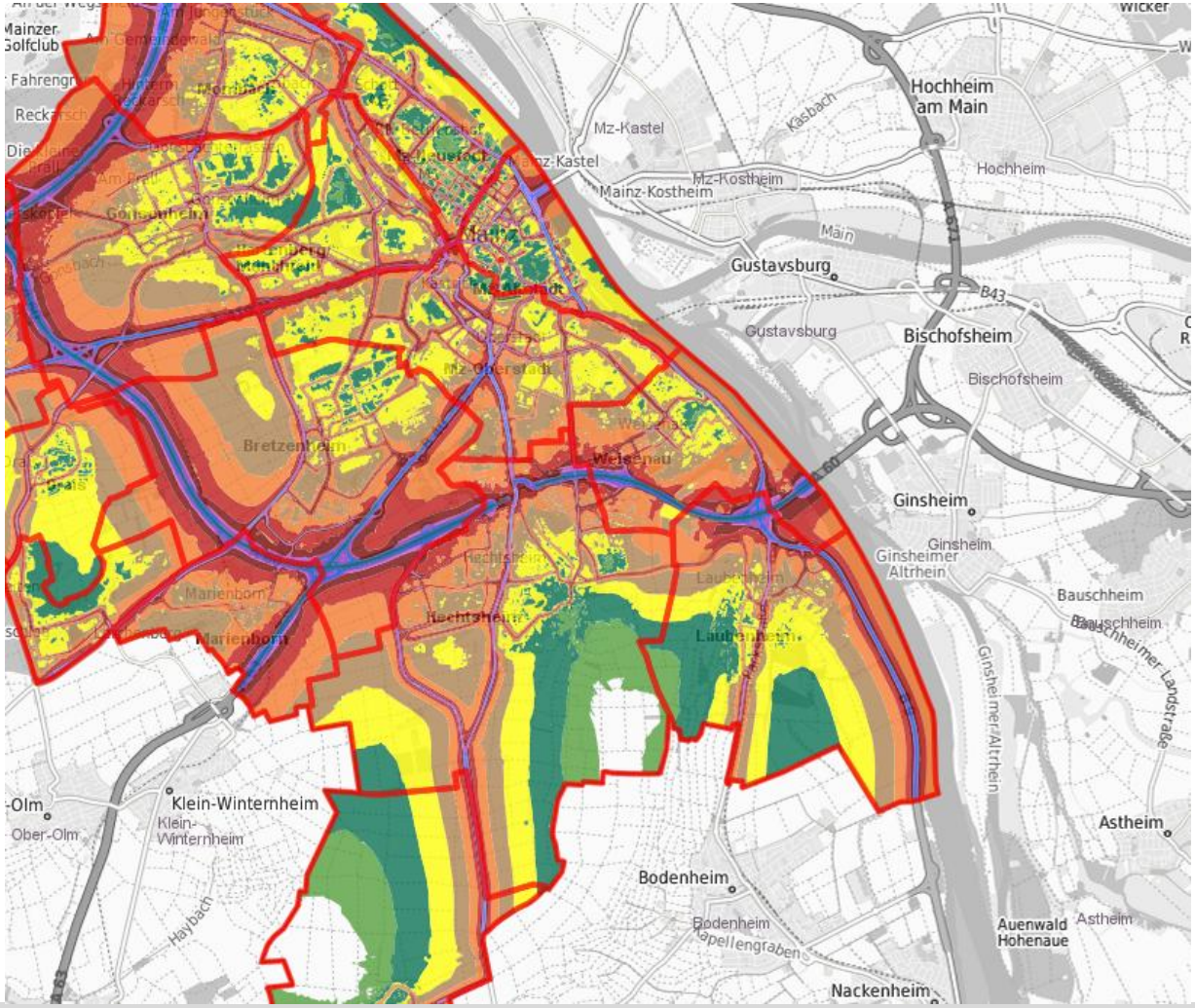
	<u>Tagsüber:</u>	überhaupt nicht gestört ←						→ sehr stark gestört
a)	Straßenlärm	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6	☐ 7
b)	Eisenbahnlärm	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6	☐ 7
c)	Fluglärm	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6	☐ 7
d)	Lärm von Nachbarn	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6	☐ 7
e)	andere Lärmquellen	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6	☐ 7

F15 **Und wie stark fühlen Sie sich in Ihrer Wohnung <u>nachts</u> durch die folgenden Lärmarten gestört?**

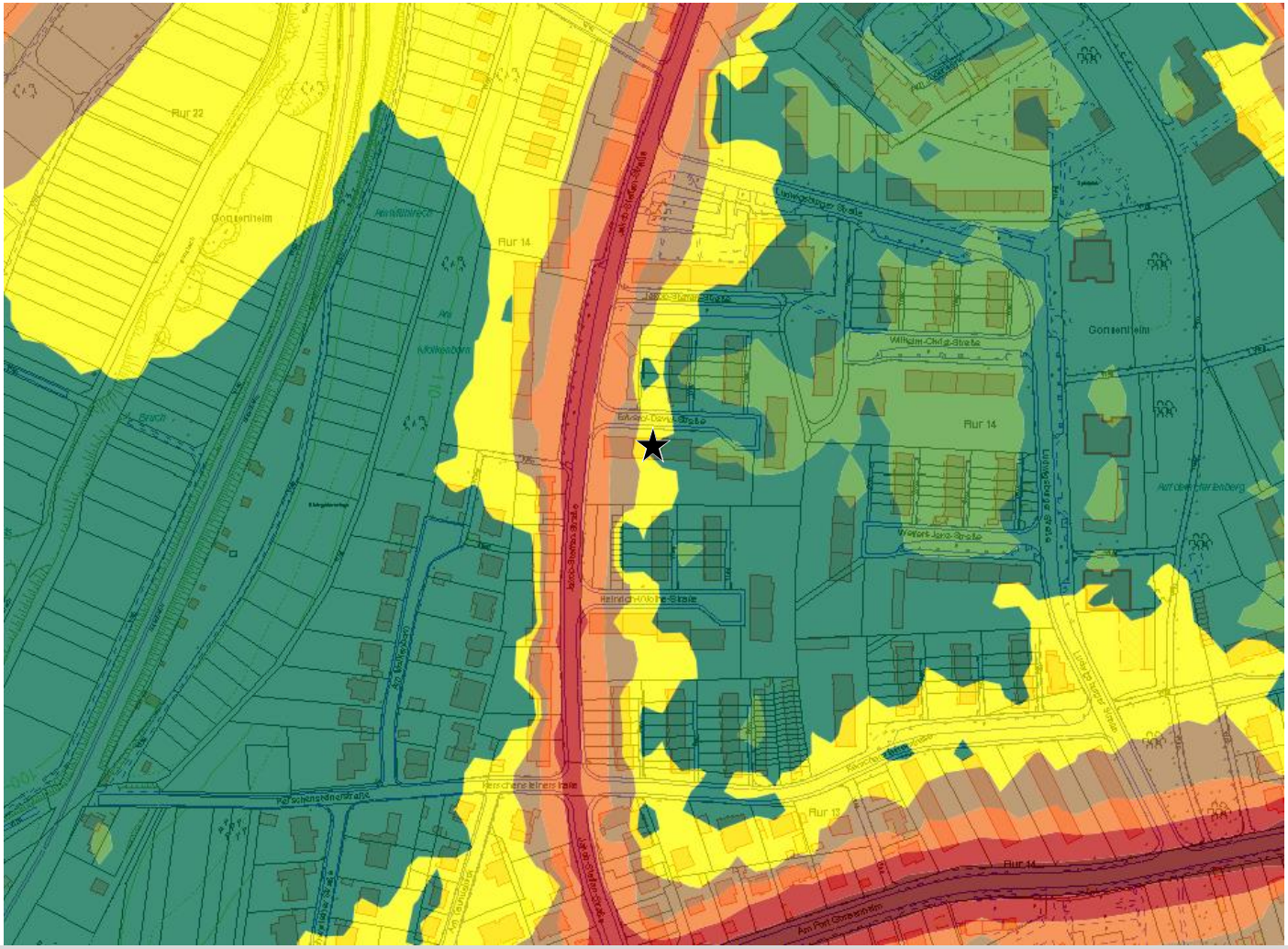
Bitte antworten Sie auf der Skala von 1 = „überhaupt nicht gestört“ bis 7 = „sehr stark gestört“. Mit den Werten dazwischen können Sie Ihre Antwort abstufen.

	<u>Nachts:</u>	überhaupt nicht gestört ←						→ sehr stark gestört
a)	Straßenlärm	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6	☐ 7
b)	Eisenbahnlärm	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6	☐ 7
c)	Fluglärm	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6	☐ 7
d)	Lärm von Nachbarn	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6	☐ 7
e)	andere Lärmquellen	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6	☐ 7

Street Traffic Noise in Mainz



Street Traffic Noise in Mainz



Street Section Sample

- Grundprinzip (GIS-Programm QGIS):
  - Abgrenzung aller Wohn- und gemischten Bauflächen in Mainz.
  - Zufällige Verteilung von 200 Punkten in den Flächen („Gießkannenprinzip“).
  - Auswahl der 200 den Punkten am nächsten gelegenen Straßenstücke (Straßenstück: Straßenabschnitt zwischen zwei Einmündungen).
- Sodann:
  - Begehung vor Ort mit Zählung der Haushalte in den Straßenstücken. Ergebnis = 11208 Haushalte.
  - Zufällige Auswahl von 68 Straßenstücken mit 3971 Haushalten, von denen in jedem Straßenstück jeder zweite Haushalt mit einem Fragebogen bestückt wurde.
  - Resultierende Bruttostichprobe = 2000 verteilte Fragebögen.
- Auswahlebene Person: Next-Birthday-Methode.
- Designgewichtung für empirische Analysen.