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How a Lack of Green in the Residential Environment Lowers the Life Satisfaction of City Dwellers and Increases Their Willingness to Relocate

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Abstract: This paper investigates whether various forms of green spaces in the residential environment are associated with city dwellers' life satisfaction and their willingness to relocate. Previous research on different forms of green spaces in the residential environment as a direct source of life satisfaction is scarce, and we know little about whether green spaces affect the decision to relocate. We address these topics with a two-equation model that estimates respondents' considerations to relocate while accounting for life satisfaction. With this strategy, we are able to test which aspects of residential greenery (window view, green environment, green yard, own garden, and balcony) are associated with one or both outcomes, controlling for life-course events and demographic characteristics. The data come from a primary survey conducted in two large German cities, Cologne and Hamburg, in 2020/21 ($N = 1886$). The results show that not having green elements in the window view, not having a green yard, and—exclusively for parents—not having a garden increase the likelihood of considering residential relocation. Not having a balcony and not having a garden are directly associated with decreased life satisfaction, and decreased life satisfaction triggers the willingness to relocate.

Keywords: cities; green spaces; health; life satisfaction; life-course; migration; residential environment; residential relocation; well-being; window view



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1. Introduction

Living in green environments can be expected to be positively associated with happiness and life satisfaction, as humans possess an innate need to affiliate with nature [1]. According to the “biophilia hypothesis”, this innate need is embedded in our biology, as humans began to live in cities only recently in their evolutionary history [2]. Although there is considerable variability in the extent to which individuals are drawn to and feel connected to nature [3,4], the positive effects of outdoor activities and natural scenery on health and well-being [5–7] support the biophilia hypothesis [8–10].

Research has focused mostly on the health benefits of nature, rather than on nature as a source of well-being [11]. Natural settings were found to be better able to renew depleted psychological resources compared with urban environments [12–14]. In line with the biophilia hypothesis, the restorative benefits of nature were attributed to the effortless enjoyment of natural settings that allows attentional recovery and reflection [10,15]. Already the view on natural elements out of the window was found to be positively associated with aspects of mental health [14,16], which was first suggested by Ulrich's seminal work on the faster physical recovery from surgery in patients who had a bed with a window view of trees [17]. Comprehensive literature reviews provide evidence for the claim that people living in greener environments have better mental health and report fewer physical symptoms than those deprived of access to nature [7,18,19]. As health-promoting behaviors

and activities are often connected with social engagement and participation, living near green spaces and in walkable environments also increases people's social well-being [7].

When we want to learn more about how people's well-being depends on their exposure to natural elements, it can be useful to analyze their everyday environment, that is to say, the features of their residence and residential area. Because people are exposed to this environment on a day-to-day basis, a (lack of) greenery in the environment might have long-lasting effects on people's quality of life.

Bertram and Rehdanz [20] analyzed the association between the extent of green spaces and their proximity on life satisfaction of Berlin inner-city residents. They found an inverted U-shaped relationship between the amount of green space in a 1 km radius around the dwelling and life satisfaction. The extent of green space varied between under 1% and 31% in the respective buffer areas, while a share of 11% green space increased life satisfaction the most, but the effect fades out beyond this threshold. One strength of this study is that it controlled for demographic and occupational characteristics, health, and house prices of the neighborhood. Therefore, it might be of minor importance that private gardens, cemeteries, and patches of natural vegetation were not considered, as the data on green spaces only included public green areas for predominantly recreational purposes, such as parks and zoos.

Kaplan [14] found that having a view of a garden or trees from the window at home was associated positively with aspects of psychological well-being and with satisfaction with the neighborhood. However, there were also contra-intuitive effects: having a view of a large mowed area, of a stream/river, or of wildlife was neither associated with well-being nor with satisfaction with the neighborhood. It is possible, however, that the coefficients did not reach statistical significance due to low case numbers in these categories of window views. A contra-intuitive finding in this study was that having a view of a park was negatively associated with the respondents' satisfaction with the neighborhood.

Won Sop Shin [16] analyzed associations with a forest view at the workplace and found a negative association with job stress and a positive one with job satisfaction. As these findings were not obtained via multivariate modelling, other influences trumping forest view, for example, having a more spacious office with a nice view due to holding a high position, cannot be ruled out. With this restriction, this study corroborates the above-described findings about the beneficial influence of window views of trees at home.

Krekel et al. [21] found that residential proximity to gardens and parks as well as green space coverage of neighborhoods in major German cities increased life satisfaction, making use of longitudinal data from the Socio-Economic Panel Study (SOEP). Applying fixed-effects estimators, this research restricted the identification of the effects in question to between-city movers, holding individual and city characteristics constant. The positive effects of proximity to green space on life satisfaction were found to be most pronounced in the elderly population. The proximity to water, including lakes, rivers, and canals, was found to be exclusively relevant in the old-age subsample, whereas the proximity to forests was exclusively relevant in the child subsample. This study's major findings corroborate the results of White et al. [22], based on the British Household Panel Study. Applying similar methods, they found that life satisfaction increased significantly with increasing percentages of green space and gardens in the neighborhood of city dwellers, whereas the percentage of fresh water did not have any effect. Another study applying a similar fixed-effects research design on SOEP data found that first-generation immigrant households were not able to improve the air quality of their neighborhood via moving, as opposed to majority and second-generation immigrant households [23].

All in all, there is evidence for direct effects of green spaces on city dweller's well-being, but we know little about how much green is needed for beneficial influences. Studies have analyzed potential influences separately, focusing either on the views out of the window, or on having green spaces in the neighborhood. When green spaces were analyzed in more detail, researchers were interested in its natural quality, differentiating between, for example, landscaped areas including gardens on the one hand, and farmland

and forests on the other. Whether a window view of trees might increase city dwellers' well-being to a similar extent as having a garden or living near a public park is still an open question. Against the background of climate change, this question is relevant with regard to both social issues of environmental justice and environmental issues of city planning. We therefore analyze possible influences of green spaces on life satisfaction more comprehensively, considering both having window view of trees or other greenery, and having access to different categories of green space at home and in the neighborhood (e.g., balcony, garden, green yard, and public park).

Life satisfaction measures are obtained from respondents' cognitive evaluation of all their life circumstances [24], therefore reflecting the respondents' quality of life [25]. Conceptually, life satisfaction is equivalent to subjective well-being [26] or experienced utility [27]. This understanding corresponds well with the life-course approach, which explains residential relocation as instrumental behavior for reaching goals in life-course realms [28,29]. For considering and planning moves across the city boundaries, respondents' evaluations of local opportunities for their occupational career, for their family life, and for pursuing their own interests and hobbies at their current residence compared to opportunities elsewhere have been shown to be strong predictors [28]. These findings underscore the view that people's subjective expected utility of moving compared to their experienced utility at the current place of residence is important for their possible decision to relocate [28,30,31]. Experiencing relevant life-course events, for example, changing jobs or having a child, works as a trigger for deciding in favor of moving [28,32,33].

The life-course approach to residential relocation therefore suggests that experiencing a lack of green space in one's housing environment is associated with both decreased life satisfaction and increased probability of residential relocation. Furthermore, life satisfaction is probably to some extent endogenous in analyses of green space's impact on residential relocation, or, more precisely, on deciding in favor of moving. As (voluntary) residential relocation is a process that normally takes some time, while its motives are subject to change and adaption to perceived opportunities and restrictions, its drivers are best studied prospectively, as predictors of moving intentions [28,34].

Against the background of life-course research, the strand of research reported above has important gaps. The few longitudinal studies estimating the improvement of life satisfaction due to having more green space in one's neighborhood after moving [21,22], or enhancing air quality via moving [23], were not obtained under control of important life-course events. Such life-course events might be confounders that bias the results, as they are important predictors of migration and residential relocation within metropolitan areas, namely, marriage (considered by [22]) or moving together for cohabitation [28,35], second or higher-order childbirth [36,37], and first-time homeownership [38,39]. Especially when they coincide, these events likely draw people to the greener fringes of the cities and to the countryside [40–42]. Moreover, these events themselves also likely increase life satisfaction [43,44].

Thus, we define the following hypotheses:

Hypothesis 1 (H1). *We hypothesize that city dwellers' perception of a lack of green in their residential environment is associated with decreased life satisfaction (H1a) and considering residential relocation (H1b), and we explore whether this possible association holds when controlling for demographic characteristics and life-course events. Furthermore, we analyze for which residential features the supposed association holds: having green in one's window view, having green spaces in one's neighborhood, having a balcony, a green yard, or a garden.*

Hypothesis 2 (H2). *We expect that perceiving a lack of green in the residential environment is associated with both low life satisfaction and considering moving (H2a). Therefore, we test whether life satisfaction is endogenous to considering moving (H2b).*

Hypothesis 3 (H3). *Not having a garden is hypothesized to be a motive for moving, especially for families (H3), as many people want to escape the hustle and bustle of the inner cities when raising a child and want to see their children playing in their own garden [41,42].*

2. Materials and Methods

2.1. Sample

The data used for this analysis come from the first wave of a primary survey carried out in two large German cities, Cologne and Hamburg, each with more than 1 million inhabitants. According to a popular scientific study based on satellite data, Hamburg is the greenest city in Germany with 71% of its surface covered with vegetation, whereas Cologne lies in the mid-field with 58% [45]. The satellite data has the advantage over official statistics of counting public and private vegetation alike, which presumably comes closer to how people perceive their surroundings. Selecting cities with ample vegetation ensures enough variation in social characteristics of respondents exposed to greenery in their living environments.

The respondents were selected with a random digit dialing procedure [46] to answer a questionnaire through computer-assisted telephone interviews. At the household level, the target person was selected randomly making use of the “last birthday method”. The field period was from September 2020 to February 2021 and yielded a total sample of 1909 respondents; after data-cleaning, 1886 remained in the analytical dataset. As it was not feasible to sample persons who live in one of these cities and only use mobile phones, the data are restricted to landline users. For Hamburg it was estimated that mobile-only users comprised 12% of the population in 2016 [47]. However, we see no reason for a potential bias in our results due to the selection procedure.

Selection criteria were that respondents were at least 18 years old and had lived for at least 12 months at their current residence, so that everyday routines were well established. In order to ensure an adequate sample size for people considering moving, we oversampled these respondents. A design weight was constructed to correct for the number of landlines and eligible persons in each household, and for the oversampling of those who considered moving.

2.2. Variables

The dependent variables were measured as follows. Whether people were considering moving was measured using the following question (all questions translated from German): “Have you recently thought about moving out of your apartment or house to live somewhere else?”, reflecting the first stage of relocation decision-making [28,48]. Respondents who answered affirmative to this question were asked “Do you plan to move within the next 12 months?”, reflecting the second stage of relocation decision-making [28,48]. As outlined above, we concentrate our analyses mainly on the first stage, considering relocation, as we are interested in whether a lack of green spaces triggers the process of residential relocation. Life satisfaction was assessed with the question “How satisfied are you—all in all—with your life at present?”, measuring people’s overall well-being [25]. The response options ranged from 1 “not at all satisfied” to 7 “completely satisfied”.

The following predictors might not be self-explanatory. The respondents’ health was assessed on a 7-point scale with the question “How would you describe your general health in the past four weeks?”, with response options ranging from “poor” to “excellent”. Studies have shown that self-rating health measurements, including single items with the above-mentioned simple wording, are valuable health status indicators providing comparable results for most population groups [49,50]. Additionally, we account for the feeling of closeness to the residential area, which was measured with the question “Taking everything into account, how closely connected do you feel with your residential area?” Regional attachment is an important predictor of considering moving [28], and it is an appropriate indicator for mental health in this study.

Regarding access to green spaces, the following characteristics of the dwelling and the neighborhood are considered: window view from home, green spaces in the vicinity, having a balcony, a green yard, and a garden or terrace. The terms “balcony” and “terrace” were explained explicitly to avoid confusion in the respondents. In the German context, “balcony” means a platform with railings accessible from flats on the first floor or higher, whereas “terrace” means a platform accessible from flats on the ground floor, often with a smooth transition into a private garden. In our sample, 59% of those who have a garden also have a terrace, and 78% of those with a terrace also have a garden. Therefore, these two categories were combined to “own garden or terrace”. Having a green yard refers to shared front or back yards, which are very common in German cities with multistory buildings. The measurement of the window view from home was based on the question “If you look out of the window of your current dwelling, do you see almost no green, some green or a lot of green, e.g., trees or lawn?”, according to a well-established German survey on environmental awareness [51,52]. Information on whether respondents perceive a lack of greenery in their residential area comes from open questions about disliked features of the neighborhood and reasons for considering moving. Homeownership refers to whether the respondent owns the flat or house he or she currently lives in. Household income is the sum of the respondent’s income plus the income of his or her partner, if applicable. This information was collected in categorized form. As about a quarter of the respondents did not provide information on their income, we imputed the missing values and controlled for imputed answers in the estimations. As preparatory analyses revealed that income was not significant beyond 1000 EUR per month, it was introduced as a binary to reflect this threshold. We did not additionally control for square meters of the dwelling, as this information is correlated with age and income. The number of household members was not controlled for because it was not additionally significant; the same applies to the number of children. Migration background applies if the respondent or at least one of his/her parents was born abroad. Information on life-course events comes from questions asking whether specific events have occurred since the start of the year or are anticipated to occur in the following six months. We combined the events completing school and starting studies; start or end of a job or job change by the respondent himself/herself or his/her partner; marriage or moving together with the partner; birth of a first child or further children.

2.3. Analysis Methods

We first present a descriptive analysis to characterize the total sample and the subsamples of those who were or were not considering moving. To evaluate the relationship between the five variables describing lack of greenery (no green looking out of window, perceived lack of green in residential area, no garden, no balcony, and no green yard), pairwise Pearson’s correlation coefficients are shown.

Regression analysis was used for testing the hypotheses. Associations with life satisfaction were estimated with linear regression, and associations with considering moving were estimated with probit regression, making use of the same predictors. In the next step, considering moving was estimated with a probit model with continuous endogenous covariates predicting life satisfaction. In this model, life satisfaction was treated as endogenous to considering moving and was estimated dependent on employment status, health, and feelings of closeness with the neighborhood. We report average marginal affects in all models to ease the interpretation of the effects. In the last step, the results were validated by repeating the analysis for planning moving.

All analyses were weighted with a combined design weight correcting for the number of landlines and household members, and for the oversampling of respondents who were considering moving. Robust standard errors were calculated in the models.

3. Results

3.1. Characteristics of City Dwellers Who Are Considering vs. Not Considering Residential Relocation

Table 1 shows the sample distribution and the distribution of characteristics in the subsamples of those who are considering moving vs. those who are not. Among the population living in the two cities Cologne and Hamburg, 8% see no green or almost no green when looking out of their windows at home, and 5% perceive a lack of green spaces in the vicinity. Among those who are considering moving, responses of no green view from the window are over-represented (10% to 7%), but there is no difference between the groups with regard to perceiving a lack of green in the vicinity. Regarding relevant features of their homes, more than half of the sample population's dwellings do not feature a balcony, about three quarters do not have a green yard, and 54% do not have a garden or a ground-level terrace. There is no difference between those considering vs. not considering moving with regard to not having a balcony, but there are differences with regard to not having a green yard (81% to 77%) and not having a garden or terrace (60% to 53%).

Table 1. Descriptive statistics of the sample and subgroups.

	Mean (Not Considering Moving)	Mean (Considering Moving)	Mean Total	Std. Dev.	Min	Max
Considering moving	-	-	0.226	0.418	0	1
No green in the window view	0.068	0.102	0.076	0.265	0	1
Lack of green in residential area	0.048	0.048	0.048	0.214	0	1
No balcony	0.520	0.519	0.519	0.500	0	1
No green yard	0.765	0.810	0.775	0.417	0	1
No garden or terrace	0.528	0.601	0.544	0.498	0	1
Child(ren) and no garden/terrace	0.126	0.206	0.144	0.351	0	1
Hamburg vs. Cologne	1.490	1.511	1.495	0.500	1	2
Age	54.595	50.181	53.597	15.786	18	96
Female	0.551	0.582	0.558	0.497	0	1
Migration background	0.252	0.258	0.253	0.435	0	1
Health	5.781	5.457	5.708	1.315	1	7
Part-time employed	0.140	0.186	0.150	0.358	0	1
Unemployed	0.023	0.027	0.024	0.152	0	1
Enrolled in education	0.029	0.056	0.035	0.185	0	1
Retired	0.278	0.218	0.265	0.441	0	1
Other occupation	0.061	0.065	0.062	0.242	0	1
Employment status miss.	0.005	0.009	0.006	0.075	0	1
Household income under 1000 EUR	0.042	0.075	0.050	0.217	0	1
Income respondent miss.	0.239	0.311	0.256	0.436	0	1
Feeling of closeness to residential area	5.794	5.218	5.664	1.371	1	7
Homeownership	0.483	0.359	0.455	0.498	0	1
Lives with partner	0.677	0.619	0.664	0.472	0	1
Lives with child(ren)	0.331	0.358	0.337	0.473	0	1
Complete school/start studying	0.039	0.100	0.053	0.224	0	1
Job change self/partner	0.122	0.266	0.155	0.362	0	1
Marriage/cohabitation	0.012	0.037	0.018	0.131	0	1
Childbirth	0.021	0.031	0.024	0.152	0	1
Life satisfaction	6.035	5.555	5.926	0.935	1	7
	N = 989	N = 897	N = 1886			

Mean life satisfaction is 5.9 points on a scale from 1 to 7 (see Table 1). Those who are considering moving are on average less satisfied than those who are not considering moving (5.5 to 6.0), and they have fewer feelings of closeness to the neighborhood (5.2 to 5.8 on a scale from 1 to 7). Life-course events are highly correlated with considering moving, as expected. Among those who are considering moving, the following are more salient than among those who are not considering moving: completing school or starting studying (10% to 4%); starting or ending working or changing job (27% to 12%); getting married or start cohabiting with a partner (4% to 1%); having a child (3% to 2%). Considering moving is distributed similarly between the inhabitants of the two cities, Hamburg and Cologne. Other characteristics are distributed as expected.

Table 2 shows the pairwise Pearson's correlation coefficients of the five items estimating a lack of green spaces in the living environment among city dwellers. Having no or almost no green in the window view at home is moderately correlated with perceiving a lack of green spaces in the living environment ($r = 0.21$ ***) and not having a garden ($r = 0.19$ ***), and somewhat correlated with not having a balcony ($r = 0.07$ **). Perceiving a lack of green spaces in the environment is somewhat correlated with not having a garden ($r = 0.08$ ***). Not having a balcony is somewhat correlated with not having a green yard ($r = 0.13$ ***). The strongest correlations are negative: those who do not have a garden relatively often do have a balcony ($r = -0.39$ ***) or a green yard ($r = -0.24$ ***). These findings reflect the fact that residents living on the ground floor might have a garden or terrace, whereas those living at the higher levels might have a balcony and/or access to a communal inner courtyard.

Table 2. Pairwise Pearson's correlation coefficients of items estimating lack of green spaces.

	1	2	3	4	5
1. No green in the window view	1				
2. Lack of green in residential area	0.212 ***	1			
3. No garden or terrace	0.192 ***	0.078 ***	1		
4. No balcony	0.068 **	-0.015	-0.387 ***	1	
5. No green yard	-0.008	-0.043 +	-0.238 ***	0.128 ***	1

Notes: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, + $p < 0.1$.

3.2. Green Spaces in the Living Environment, Life Satisfaction and Considering Moving

In a first step, we estimate life satisfaction (Model 1) and considering moving (Model 2) separately with the same predictors. In a second step, we estimate considering moving (Model 3) with instrumental variable probit regression, treating life satisfaction as endogenous and dependent on employment status, health, and feelings of closeness with the neighborhood. We report average marginal effects for the probit regressions, which makes them easier to compare with the coefficients obtained by OLS (ordinary least squares) regression and eases interpretation regarding their strength. We interpret the strength of the associations dependent on the predicted mean with regard to life satisfaction and the predicted probability with regard to considering and planning relocation.

Model 1 in Table 3 shows that perceiving a lack of greenery in the window view at home or in the vicinity, and not having a green yard are not important, but having no balcony and having no garden or terrace are associated with decreased life satisfaction (Figure 1b). Having no balcony is estimated to decrease life satisfaction by 2% ($-0.101/5.926$), as does having no garden or terrace ($-0.132/5.926 = -0.022$). Although these figures are rather low, these findings are remarkable, as they were obtained under control of well-known determinants of life satisfaction, like employment status and health, and under control of life-course circumstances. Compared with full-time employed respondents, those in all other categories of employment status reported lower life satisfaction, except for retired persons, who reported about the same degree of life satisfaction as those in full-time employment. Additionally, both good health and feelings of closeness to one's neighborhood are positively associated with life satisfaction. Among household character-

istics, only living with a partner is significantly associated with increased life satisfaction. Moreover, two life-course events, completing school or starting studies, and childbirth, are associated with increased life satisfaction, whereas childbirth exerts the strongest relative effect among all predictors in the model ($0.423/5.926 = 0.071$).

Table 3. Influences of a green environment on life satisfaction and considering moving.

	Model 1 ¹ Life Satisfaction		Model 2 ² Considering Moving		Model 3 ³ Considering Moving		
	Marg. Effects	Robust Std. Err.	Marg. Effects	Robust Std. Err.	Marg. Effects	Robust Std. Err.	
No green in the window view	0.095	0.074	0.043	0.031	0.222	0.113	*
Lack of green in residential area	−0.048	0.089	−0.025	0.039	−0.138	0.149	
No balcony	−0.101	0.048	* 0.011	0.019	−0.013	0.070	
No green yard	−0.053	0.051	0.060	0.021	** 0.170	0.078	*
No garden or terrace	−0.132	0.068	+ −0.029	0.027	−0.187	0.096	+
Child(ren) and no garden/terrace	−0.063	0.091	0.153	0.037	*** 0.518	0.135	***
Hamburg vs. Cologne	0.010	0.043	−0.016	0.017	−0.056	0.064	
Age	0.002	0.002	−0.002	0.001	+ −0.003	0.002	
Gender	0.016	0.046	0.019	0.018	0.073	0.065	
Migration background	0.015	0.048	−0.011	0.020	−0.045	0.074	
Household income under 1000 EUR	0.007	0.130	0.047	0.050	0.153	0.179	
Income respondent miss.	−0.070	0.050	0.079	0.020	*** 0.235	0.076	**
Homeownership	0.056	0.051	−0.054	0.020	** −0.169	0.076	*
Lives with partner	0.279	0.054	*** −0.008	0.020	0.128	0.076	+
Lives with child(ren)	−0.008	0.069	0.101	0.028	*** 0.354	0.100	***
Complete school/start studying	0.181	0.093	+ 0.075	0.047	0.359	0.166	*
Job change self/partner	−0.076	0.061	0.131	0.024	*** 0.422	0.096	***
Marriage/cohabitation	0.146	0.114	0.157	0.066	* 0.674	0.246	**
Childbirth	0.423	0.118	*** −0.055	0.060	0.033	0.212	
Health	0.211	0.022	*** −0.026	0.007	***		
Feeling of closeness to residential area	0.181	0.018	*** −0.039	0.007	***		
Part-time employed	−0.250	0.069	*** 0.050	0.027	+ 0.027		
Unemployed	−0.221	0.134	+ −0.056	0.059			
Enrolled in education	−0.271	0.143	+ 0.007	0.067			
Retired	0.058	0.075	0.029	0.029			
Other occupation	−0.275	0.093	** 0.026	0.038			
Employment status miss.	0.782	0.318	* −0.043	0.136			
Life satisfaction					−0.576	0.070	***
Number of cases		1886		1886		1886	
Degrees of freedom		27		27		20	
McFadden's pseudo R ²				0.093			
Adjusted R ²		0.248					
Overall model significance		***		***		***	

Notes: ¹ Linear regression on life satisfaction, design weighted. ² Probit regression on considering moving, design weighted. ³ Probit model of considering moving with endogenous covariates predicting life satisfaction (health, feelings of closeness to the residential area, and employment status), design weighted. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, + $p < 0.1$.

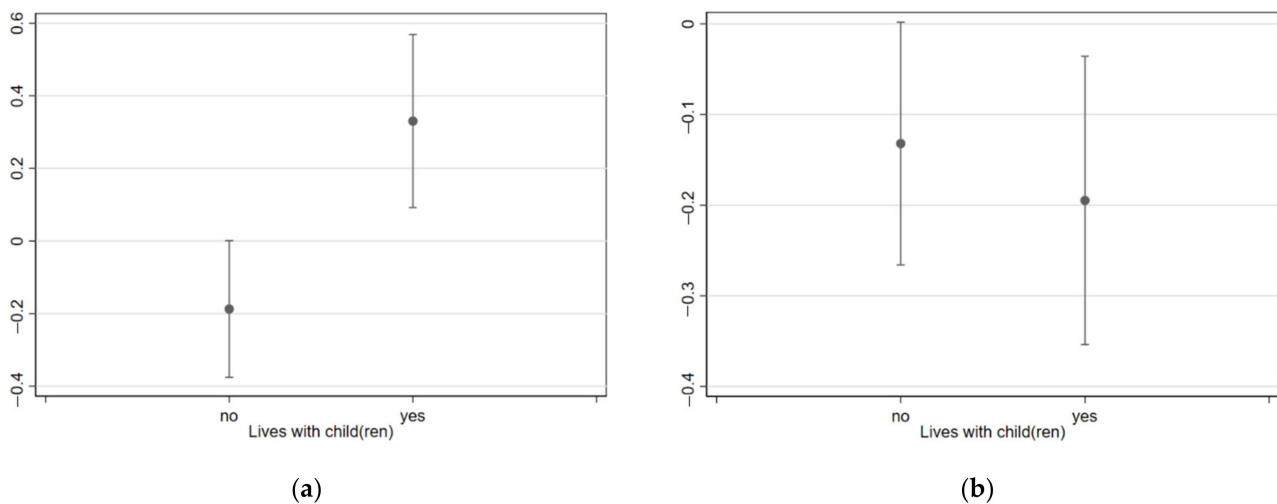


Figure 1. Average marginal effects of having no garden while living with children or not on considering moving (a) and life satisfaction (b).

Model 2 in Table 3 suggests that not having a green yard and—exclusively for parents—not having a garden are positively associated with considering moving, whereas the other aspects of a green living environment do not play any role in this regard. As life satisfaction is not considered in this model, the estimates are not interpreted in detail. However, we want to highlight the finding that both physical and mental health, estimated as feelings of closeness to the neighborhood, are significant for considering relocation as well as for life satisfaction, whereas employment status is exclusively associated with life satisfaction.

Model 3 in Table 3 shows that not having green in the window views at home doubles the probability of considering moving ($0.222/0.226 = 0.982$), whereas perceiving a lack of green spaces in the vicinity is not additionally significant. Not having a balcony does not play a role in considering moving, but not having a green yard and garden or terrace does. Not having a green courtyard increases the probability of considering moving by 75% ($0.170/0.226$). Contrary to our expectation, having no garden or terrace decreases the probability of considering moving, but exclusively for childless persons. Further analyses revealed that this contra-intuitive association of increased moving considerations among people with a garden is due to young adults who want to move out of the parental home, but the case numbers are too low for additionally controlling for this group. In line with our expectations, having no garden or terrace is associated with an increased probability of considering moving in adults with children of whatever age (Figure 1a). It is estimated that having no garden or terrace increases the probability of considering moving in parents by 150% ($(-0.187 + 0.518)/0.226$).

Demographic characteristics are not relevant with regard to considering moving, but some household characteristics are. Homeownership is associated with a decreased probability of considering moving, as expected. Those who live with children and have a garden are less likely to consider moving. All life-course events are strongly and positively associated with considering moving, except for childbirth. Marriage or starting cohabitation triples the likelihood of considering moving ($0.674/0.226 = 2.982$), which is the strongest association in this model.

Reduced life satisfaction is an additional important trigger for considering moving. Each point more on the life satisfaction scale is estimated to almost outweigh the effect of marriage. The error terms of both equations, life satisfaction and considering moving, are significantly correlated, indicating that both outcomes are partly influenced by the same issues. The Wald test of exogeneity indicates that treating life satisfaction as endogenous significantly improves the estimation of considering moving.

3.3. Validation of the Results with Regard to Planning Moving

Model 4 in Table 4 repeats the estimation obtained for considering moving, but this time for planning moving. Although the three-stage model of residential relocation suggests that life satisfaction does not directly influence migration intentions or plans to move, but does so indirectly via considering moving, it is interesting to see whether the associations found with greenery in the living environment are still important at the planning stage. The three-stage model of relocation decision-making postulates that at the planning stage, people have decided in favor of moving [28,48]. Accordingly, it was found that many of them have concrete ideas about where to move, including what kind of new domicile is feasible and affordable [53]. If wishes concerning more green spaces in the living environment were abandoned during the process of decision-making, the respective associations would decrease and lose significance. According to the estimates in Model 4, this is not the case. Associations between not having green in the window view of the current home or not having a green yard are even stronger with planning moving compared with only considering it; the same is true for not having a garden among parents.

Table 4. Influences of a green environment on considering and planning moving.

	Model 3 ¹ Considering Moving			Model 4 ² Planning Moving		
	Marg. Effects	Robust Std. Err.		Marg. Effects	Robust Std. Err.	
No green in the window view	0.222	0.113	*	0.420	0.139	**
Lack of green in residential area	−0.138	0.149		−0.234	0.206	
No balcony	−0.013	0.070		−0.110	0.094	
No green yard	0.170	0.078	*	0.234	0.111	*
No garden or terrace	−0.187	0.096	+	−0.344	0.127	**
Child(ren) and no garden/terrace	0.518	0.135	***	0.408	0.185	*
Hamburg vs. Cologne	−0.056	0.064		−0.203	0.088	*
Age	−0.003	0.002		−0.017	0.003	***
Gender	0.073	0.065		0.007	0.090	
Migration background	−0.045	0.074		0.132	0.096	
Household income under 1000 EUR	0.153	0.179		0.271	0.202	
Income respondent miss.	0.235	0.076	**	0.137	0.101	
Homeownership	−0.169	0.076	*	−0.268	0.112	*
Lives with partner	0.128	0.076	+	0.000	0.101	
Lives with child(ren)	0.354	0.100	***	0.056	0.125	
Complete school/start studying	0.359	0.166	*	0.376	0.171	*
Job change self/partner	0.422	0.096	***	0.335	0.107	**
Marriage/cohabitation	0.674	0.246	**	0.806	0.224	***
Childbirth	0.033	0.212		0.346	0.227	
Life satisfaction	−0.576	0.070	***	−0.491	0.087	***
Number of cases		1886			1886	
Degrees of freedom		20			20	
Wald χ^2		201.2			211.0	
Wald χ^2 of exogeneity		17.9	***		10.6	**

Notes: ¹ Probit model of considering moving with endogenous covariates predicting life satisfaction (health, feelings of closeness to the residential area, and employment status), design weighted. ² Probit model of planning moving with endogenous covariates predicting life satisfaction (health, feelings of closeness to the residential area, and employment status), design weighted. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, + $p < 0.1$.

Other associations with planning residential relocation are as expected and well in line with other research findings. The older people are, the less likely they are to decide and plan for moving. Although families with children often consider moving, they are not more likely than childless households to decide in favor of moving. These findings suggest

that older persons and families face more difficulties fulfilling their wishes on the housing market. Homeownership is a deterrent for moving intentions, whereas life-course events are triggers.

The marginal effect of life satisfaction on planning moving is somewhat smaller than on considering it, underscoring the notion that life satisfaction triggers starting the process of decision-making on whether or not to move. Nevertheless, the Wald chi-squared statistic indicates that the estimate of planning migration is significantly improved when life satisfaction is treated as endogenous.

4. Discussion

Living in a green, landscaped environment is highly valued by most people, which is reflected in the willingness to pay high prices for residences located in scenic environments [6], for example, at a shoreline, in a hilly landscape, or under large trees [5]. However, the population living in cities now exceeds that living in the countryside worldwide, and many large cities have been growing rapidly in the past decades [54]. Additionally, in cities of moderate size and under moderate immigration pressure, the necessity of building new dwellings often conflicts with maintaining green spaces, trees, or other vegetation. Therefore, housing construction might counteract the efforts of city planners at maintaining and increasing green infrastructure in order to mitigate high temperatures in urban landscapes, which becomes increasingly important in view of climate change [55]. When it comes to deciding what is more important, building a particular housing block or maintaining green spaces or some trees, practitioners face the following question: how much green do humans need?

This article contributes to answering this question from two sides. It analyzes whether city dwellers' perceptions of a lack of green spaces in their living environment are associated with decreased life satisfaction, and whether such a lack triggers residential relocation. Although it is well documented that people living in greener environments have better mental health and report fewer physical symptoms [7,18,19], studies on well-being are scarce. Among them are studies that concentrated on window views and analyzed specific domains of satisfaction [14,16]. They found that having a garden or trees in the home or work window view was associated with increased residential or job satisfaction; however, there were few controls in these studies. Other studies found that closer proximity to or higher coverage with green spaces and gardens after moving from one city to another had a positive effect on life satisfaction [21,22]. These studies made use of longitudinal data applying fixed-effects approaches, but they did not control for important life-course events like marriage or getting a new job, which are important triggers for migration [28,33] and which also affect life satisfaction [43,44].

We contribute to closing this research gap with tailor-made primary data, gathered in the two German cities Cologne and Hamburg, in 2020/21. The sample of 1886 respondents was selected randomly [56]. It represents the German-speaking population aged 18 and older with telephone landlines, living at their current address for at least one year. Persons who were considering residential relocation were oversampled to ensure sufficient cases for in-depth analysis of what triggers the process of relocation decision-making. Characteristics of the living environment were gathered with regard to the view from the window at home, green spaces in the neighborhood, and three features of the dwelling: a balcony, a communal green courtyard, and a garden or terrace.

The results show that not having a balcony and not having a garden or terrace were associated with decreased life satisfaction, taking various other factors into account, among them physical and mental health, family and employment characteristics, and life-course events. Having no green in the window view and few or no green spaces in the neighborhood were not associated with life satisfaction, but additional analyses showed a negative association with residential satisfaction (results available on request). Although these findings lend only partial support to Hypothesis 1a, saying that green spaces in

the living environment are important for city dwellers' quality of life, we consider these findings substantial, as they were obtained under consideration of important controls.

Having no or almost no green in the window view at home, and not having a green courtyard were associated with a higher likelihood of considering residential relocation. These findings lend support to Hypothesis 1b, saying that perceiving a lack of green spaces triggers relocation decision-making in city dwellers. Again, these associations were found under control of life-course events, that is, completing school or starting studying, starting or changing jobs, marriage or starting cohabiting with a partner, and childbirth, and under control of homeownership, demographic characteristics, and life satisfaction.

Perceiving a lack of green spaces in one form or another was found to influence both life satisfaction and considering relocation, corroborating Hypothesis 2a. Considering life satisfaction as endogenous to considering moving improved the model significantly, which supports Hypothesis 2b. Moreover, it strengthened the associations between single categories of a green environment and considering moving. This finding supports the view that a lack of green spaces in the close vicinity of the dwelling triggers relocation decision-making at least partly through its negative influence on life satisfaction.

Not having a garden was associated with an increased probability of considering relocation exclusively among households with children. This is in line with Hypotheses 3, saying that particularly for families living in large cities, not having a garden is a reason for moving.

Limitations of this study might be seen foremost in its cross-sectional character that does not allow causal interpretations. On the one hand, we cannot conclude that a lack in the categories of green space in the living environment studied here causes life (dis-)satisfaction and considering moving. On the other hand, we think that reverse causality largely can be ruled out. It might be the case that respondents reporting a higher quality of life are more often aware of having a pleasant window view and attractive green spaces in the neighborhood. However, at least the survey questions about having a balcony, a terrace or garden, and a green yard should yield measures that are objective.

Regarding the field period, it is possible that the Corona pandemic led to more awareness and usage of green spaces in the vicinity. It might also be possible that features of the dwelling, that is, having a balcony, a green yard, and a garden or terrace, and green spaces in the neighborhood were more strongly connected with well-being and considering moving during this period than before. However, other influences on the outcomes in question might have been even stronger, for example, financial insecurity and perceived health risks.

Relying on subjective assessments of green spaces in the residential environment can be seen as another limitation. Theoretically, it would have been possible to make use of geocoded data to estimate whether a park is in close proximity, or whether there are trees in the street, if a sufficient number of respondents gave their postal address. But we doubt that making use of such objective data would enhance the measurement of the relationships in question. After all, there is much evidence for the Thomas Theorem [57] (p. 572) in various fields of social research, saying that when people define situations as real, they are real in their consequences.

5. Conclusions

Our findings suggest that residential buildings that allow direct access to green spaces and the open air are relevant for city dwellers' life satisfaction, and that experiencing a lack in this regard triggers people's willingness to relocate. Having no green in the window view, no balcony, no green yard, and no garden when having children were associated with decreased life satisfaction and/or trigger considering moving. Moreover, the effects in question were even stronger on making concrete plans to relocate in the next 12 months. Therefore, the results suggest that a significant share of city dwellers are not willing to put up with experiencing being deprived of "nature" at their domicile. Instead, decreased life satisfaction has behavioral consequences. In light of these findings, it seems likely

that experiencing a lack of greenery in large cities increases the demand for dwellings at the fringes of the cities and in the countryside, fueling urban sprawl. However, the findings suggest that consistently considering direct access to urban nature when planning new residences and maintaining existing neighborhoods is a helpful tool to counteract city flight.

With regard to experiencing a lack of greenery in the residential environment, the study failed to find significant effects on both life satisfaction and considering moving. We think that further studies are necessary to analyze whether this finding is substantial. First, we found that experiencing a lack of greenery in the neighborhood was moderately correlated with both having no green in the window view and having no garden. Further studies should analyze whether green in the neighborhood is more relevant for those who neither have a garden nor green in the window view. Secondly, our strategy of measuring a lack of green in the residential environment with a single item might have resulted in an underestimation of the true effect size. Further studies might want to treat this perception as a latent construct composed of more concrete perceptions, such as whether there is a park, a shoreline, or a wood in close proximity. Although more complex, such a strategy of measuring a perceived lack of greenery in the residential environment would be better able to separate the true effect from random error in the answers on a single-item question.

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