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What makes cities livable? Determinants of neighborhood satisfaction and neighborhood happiness in different contexts

Kostas Mouratidis [a,b,*], Athena Yiannakou [b]

[a] Department of Urban and Regional Planning, Norwegian University of Life Sciences, Norway
[b] School of Spatial Planning and Development, Aristotle University of Thessaloniki, Greece

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ABSTRACT

Shaping livable cities is an enduring issue for urban planning, which came dramatically to the forefront of relevant policies with the coronavirus disease (COVID-19) pandemic. This study explores what makes cities livable by using neighborhood satisfaction and neighborhood happiness as measures of urban livability. The determinants of neighborhood satisfaction and neighborhood happiness are examined and compared, using geospatial and survey data from two cities, one from the South and the other from the North European context: Thessaloniki, Greece and Oslo, Norway. A structural equation model is developed and tested. In both cities, common determinants of neighborhood satisfaction are found to be the proximity to city center, neighborhood perceived safety, and place attachment, whereas common determinants of neighborhood happiness are found to be neighborhood perceived safety, neighborhood perceived quietness, neighborhood social cohesion, place attachment, and lower neighborhood density. Important differences between the two cities were also observed. Numerous local amenities seem to positively contribute to urban livability in Thessaloniki, but not in Oslo. Parks and trees are positively linked to neighborhood happiness in Oslo, but not in Thessaloniki. These differences support the view that some of the links between neighborhood characteristics and livability depend on the local context related to local culture, attitudes, and preferences, all of which might also be influenced by the local built environment.

1. Introduction

The number of people living in cities worldwide has been growing dramatically. Offering a high quality of life in cities, an enduring issue for urban planning (Børrud, 2018; Hofstad, 2011; Thin, 2012), is thus becoming increasingly critical. A large number of research studies have been exploring how to make cities more livable (Kent and Thompson, 2014; Mouratidis, 2018b; Pfeiffer and Cloutier, 2016; Shekhar et al., 2019; Tonne et al., 2021; Van Kamp et al., 2003; Wang and Wang, 2016).

Urban livability can be assessed with objective and subjective indicators and at different spatial scales (Marans and Stimson, 2011; Okulicz-Kozaryn, 2013). The neighborhood scale is among the most widely studied in academic research as indeed is the most widely accepted scale for urban planning. Subjective measurement of urban livability at a neighborhood scale is performed with cognitive (neighborhood satisfaction) and affective (neighborhood happiness) evaluations of the neighborhood (Mouratidis, 2020a). Neighborhood satisfaction is a measure of the overall contentment with one's neighborhood, while neighborhood happiness is a measure of the feelings experienced in one's neighborhood. Both neighborhood satisfaction and neighborhood happiness are associated with overall subjective well-being, according to relevant studies (Cao, 2016; Mouratidis, 2020a; Rojas, 2006), thus making them useful indicators of urban livability.

Improving cognitive and affective aspects of urban livability – i.e. people's satisfaction and happiness – are major goals of urban planning and policymaking (Montgomery, 2013; Pfeiffer and Cloutier, 2016; Thin, 2012). Studying and understanding how the urban environment may contribute to satisfaction and happiness can point at attributes that are beneficial or, conversely, harmful for human well-being in cities. Such knowledge thus offers essential information on how to improve life in cities by transforming attributes of the urban environment through urban planning and its tools regarding land use regulation and development control.

In this paper, we attempt to address three issues typical for research on the determinants of urban livability at a neighborhood scale. First,

* Corresponding author at: Department of Urban and Regional Planning, Norwegian University of Life Sciences,Norway.
E-mail addresses: konstantinos.mouratidis@nmbu.no (K. Mouratidis), adgianna@plandevel.auth.gr (A. Yiannakou).

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the local context may influence how the determinants of urban livability are shaped (Yang, 2008) but there is a lack of comparative analyses between different contexts, especially contexts with important cultural and socio-spatial differences. Second, there is a need for theory-driven analyses that examine all possible pathways between environmental characteristics and urban livability and include appropriate control variables (Cao et al., 2018). Third, although neighborhood satisfaction and neighborhood happiness are conceptually distinct and their determinants may differ, studies examining neighborhood happiness are scarce.

To address the above issues, this paper examines the determinants of both neighborhood satisfaction and neighborhood happiness in two cities from distinct cultural and spatial contexts, one located in South Europe and the other in North Europe. This is the first study, to our knowledge, to explore and compare the determinants of urban livability in neighborhoods in South and North European cities. A structural equation model is developed and applied based on theoretical considerations (Campbell et al., 1976; Cao et al., 2018; Marans, 2003; Marans and Rodgers, 1975; Næss, 2019) aiming at addressing methodological problems common in previous studies. Geospatial and survey data from the urban regions of Thessaloniki, Greece and Oslo, Norway are used. Two main research questions are explored: (1) How could the relationship between neighborhood characteristics and urban livability at a neighborhood scale be analyzed based on theoretical considerations? (2) What are the similarities and differences in the determinants of neighborhood satisfaction and neighborhood happiness in Thessaloniki and Oslo?

The remainder of the paper is organized as follows. Section 2 portrays an overview of existing knowledge on the determinants of neighborhood satisfaction and neighborhood happiness. Section 3 presents the methodological background of the study. Section 4 presents the results of the analysis and a discussion of findings. In the concluding Section 5, we discuss planning and policy implications and propose future research directions.

2. Literature review

Research on urban livability – and on related concepts such as urban happiness, urban quality of life, and urban well-being – has been rapidly growing (Papachristou and Rosas-Casals, 2019; Wang and Wang, 2016). Some studies investigate what makes cities livable by exploring determinants across different cities while others focus on different neighborhoods within a specific city.

To study urban livability or related concepts, some researchers have explored determinants of subjective well-being (i.e. life satisfaction, happiness, or some other self-reported measure of quality of life) in cities and neighborhoods. Leyden et al. (2011) investigated happiness in ten major urban areas worldwide and suggested that perceptions of affordability, of child-friendliness, and of good access to public transport and to cultural and leisure facilities promote happiness in cities. Florida et al. (2013) examined possible determinants of well-being in cities in the United States and identified human capital as an important determinant of urban well-being. Ballas (2013) reviewed trends in studies on quality of life in cities and concluded that the more equitable cities tend to have happier residents. Montgomery (2013) attempted to link urban design to happiness and presented examples from different cities where urban design and planning interventions improved residents' lives. Cloutier et al. (2014) presented the "Sustainable Neighborhoods for Happiness Index (SNHI)", a tool that assesses the sustainability of neighborhoods and their potential contribution to happiness based on nine themes: water management, energy management, urban design, food management, business & economic development, waste management, buildings and infrastructure, transportation, and community governance. Kent and Thompson (2014) presented an overview of literature and concluded that the built environment in cities can influence physical exercise, neighborhood social cohesion, and equitable access to healthy food, thus contributing to well-being. Pfeiffer and Cloutier (2016) reviewed literature on happiness in neighborhoods and suggested that open public spaces, natural and green spaces as well as urban design promoting social interaction and safety contribute to happy neighborhoods. Hogan et al. (2016) examined determinants of happiness in different cities worldwide and found that these may vary for different age groups: perceived access to amenities contributed to happiness of younger residents while perceived quality of governmental services contributed to happiness of older residents. Kyttä et al. (2016) suggested that the determinants of urban livability vary between urban and suburban contexts. Based on data from Helsinki, Finland, they found that easy access to services positively contributed to well-being in urban neighborhoods and negatively to well-being in suburban neighborhoods. Ala-Mantila et al. (2018) investigated well-being in urban areas in Finland and found that the relationship between built environment and well-being is dependent upon the measure used to assess well-being. Specifically, they found that self-reported quality of life was higher in central walkable areas, while, on the contrary, happiness was greater in car-oriented areas. A study from Oslo, Norway by Mouratidis (2019) indicated that perceived neighborhood safety and perceived lack of noise were positively associated with subjective well-being. Shekhar et al. (2019) suggested that the main drivers of urban livability can be classified in four main categories: participation and engagement, access, identity, and safety. Gim (2021) explored determinants of happiness in Seoul, South Korea and argued that strengthening place attachment and improving transportation infrastructure would promote happiness. Park et al. (2021) examined the relationships between neighborhoods characteristics and happiness in Detroit, Michigan in the United States and found that proximity to amenities and safety from crime were associated with greater residents' happiness. Finally, Mouratidis (2021) reviewed pathways between the built environment and subjective well-being and presented an overview of strategies for improving quality of life through urban planning, and specifically through interventions related to urban nature, open spaces, facilities and services, active travel and public transport, technology and emerging mobility, maintenance, noise reduction, aesthetic quality, and socio-spatial equity.

Besides examining the determinants of well-being in cities, urban livability can also be assessed in more direct ways with objective and subjective indicators that aim at directly assessing how the urban environment contributes to residents' quality of life (Fu et al., 2019; Marans and Stimson, 2011; Okulicz-Kozaryn, 2013; Psatha et al., 2011; Zhan et al., 2018). Subjective indicators of urban livability such as residential satisfaction can be assessed at various scales ranging from the dwelling scale to the city/metropolitan scale (Eizenberg et al., 2020; Moeinaddini et al., 2020; Mouratidis, 2018a). Subjective assessment of urban livability is typically performed with cognitive (satisfaction) measures (Marans and Stimson, 2011) evaluating the satisfaction with the dwelling, neighborhood, city, or some intermediate spatial scale. However, some studies have shown that affective measures of urban livability would also be important to assess (Mouratidis, 2020a; Wang and Wang, 2016). Such measures evaluate the emotional experience in urban environments. The present study focuses on urban livability at a neighborhood scale. Here, an overview of cognitive (neighborhood satisfaction) and affective (neighborhood happiness) measures of urban livability at a neighborhood level is presented. Research gaps and problems are also discussed.

Neighborhood satisfaction measures how well the neighborhood covers individual or household needs, or simply the level of content with one's neighborhood. Conceptual frameworks and empirical studies suggest that neighborhood satisfaction represents an important pathway between the urban environment and subjective well-being (Campbell et al., 1976; Marans, 2003; Mouratidis, 2021) and is positively associated with life satisfaction, happiness, and eudaimonia (Cao, 2016; Cummins, 1996; Gür et al., 2020; Mouratidis, 2020a; Rojas, 2006). Neighborhood satisfaction is largely shaped by physical and perceived environmental characteristics (Campbell et al., 1976; Cao, 2016; Lee

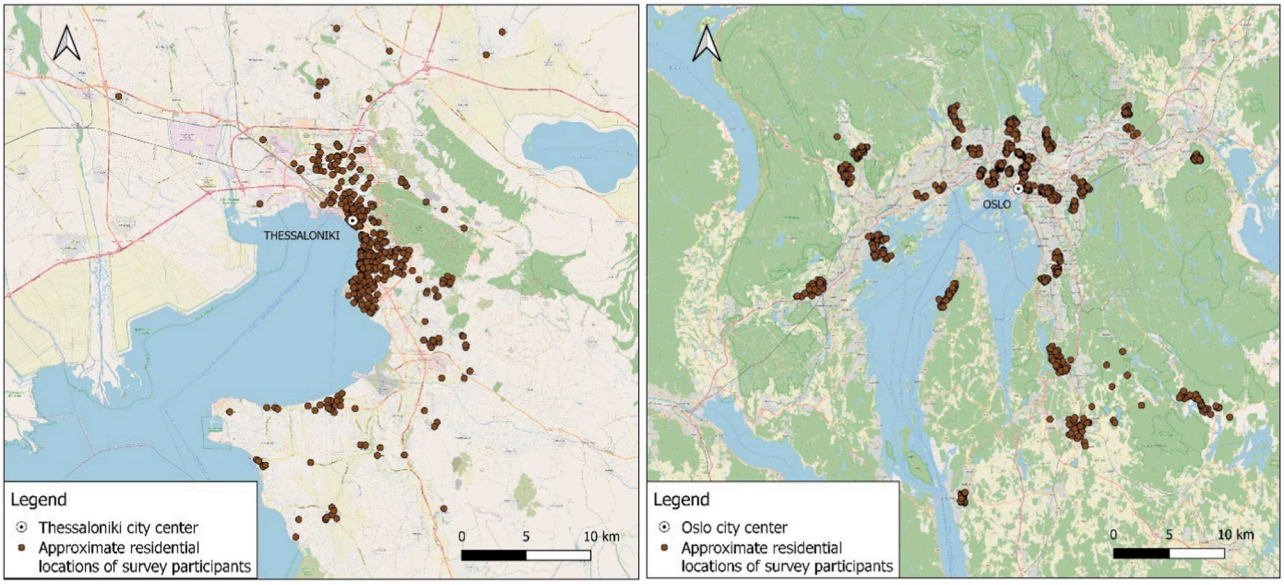

Fig. 1. Maps of the urban regions of Thessaloniki (left) and Oslo (right) showing the approximate distribution of survey participants.

et al., 2017). The contribution of environmental characteristics to neighborhood satisfaction depends on whether neighborhood characteristics match individual and household preferences (Cao and Wang, 2016; McCrea, Shyy, and Stimson, 2014). Physical environmental correlates of neighborhood satisfaction are usually objectively measured with geospatial data. Physical characteristics linked to neighborhood satisfaction include the proximity to the main city center, local amenities, open public spaces, green spaces, and lack of traffic (Howley et al., 2009; Lovejoy et al., 2010; Mouratidis, 2018a; Yang, 2008; Zhang et al., 2017). Perceived environmental correlates of neighborhood satisfaction include perceptions of safety, perceptions of quietness, neighborhood social cohesion, neighborhood attachment, perceptions of accessibility, perceptions of public space quality, and perceptions of aesthetic quality (Buys and Miller, 2012; Cao and Wang, 2016; Davis and Fine-Davis, 1991; Grogan-Kaylor et al., 2006; Howley et al., 2009; Hur and Morrow-Jones, 2008; Hur and Nasar, 2014; Lee et al., 2017; Mouratidis, 2018a; Parkes et al., 2002; Permentier et al., 2011).

Neighborhood happiness can be used as a concept (and variable) describing the affective experience in the neighborhood environment. It is a measure that directly assesses emotions experienced in the neighborhood, thus differing from measuring overall happiness and analyzing its relationship with environmental characteristics. Although there are several studies on environmental correlates of overall happiness (see studies presented above), the possible determinants of neighborhood happiness have been rather underexplored in previous research. Neighborhood density was found to be negatively related to neighborhood happiness, whereas perceived safety, perceived quietness, and perceived cleanliness were linked to higher neighborhood happiness (Mouratidis, 2019). Research at other spatial scales can also shed light on possible determinants of neighborhood happiness. People experience lower momentary happiness when being in urban environments compared to being in nature or in rural areas (MacKerron and Mourato, 2013). Urban nature is linked to positive affective experience (Markevych et al., 2017; White et al., 2013) so it might also contribute to neighborhood happiness.

Research on urban livability at a neighborhood scale is often characterized by *three major problems*: (a) the lack of comparative analyses between different contexts, (b) the lack of theory-driven analyses, and (c) the lack of comparisons between determinants of neighborhood satisfaction and neighborhood happiness. Regarding the first problem, the determinants of urban livability may differ between contexts. The particularities of each local context may shape environmental characteristics but also how residents experience and perceive such characteristics. A study from the United States comparing determinants of neighborhood satisfaction in Charlotte and Portland confirms that determinants may largely vary based on the local context (Yang, 2008). That study found that density and mixed land uses positively relate to neighborhood satisfaction in the more compact Portland, but negatively in the more sprawled Charlotte. Such comparative studies are scarce in the existing literature. Comparative studies of cities from different countries with different cultures are even scarcer. The few previous comparative studies examining cities from different countries (see e.g. Hogan et al., 2016; Leyden et al., 2011) assess the built environment only with survey-derived residents' perceptions (which are subject to biases) and not with objectively measured GIS-derived built environment characteristics (e.g. objectively measured density, distances, public transport accessibility, access to facilities, green space). Analyses combining survey with GIS data from different contexts could provide more robust results and shed more light on the role of the local context in urban livability. The second problem in urban livability studies is the lack of theory-driven analyses. This problem has been thoroughly explained by Cao et al. (2018). Empirical research needs to consider the multiple pathways between environmental characteristics and urban livability. Physical neighborhood characteristics may be linked to urban livability both directly but also indirectly via perceived neighborhood characteristics. The arrangement of physical characteristics should also be theory-driven (see e.g. Mouratidis and Poortinga, 2020; Næss, 2019). The time living in a particular neighborhood should be controlled for in relevant analyses (Cao et al., 2018) as it may contribute to place attachment and neighborhood happiness (Mouratidis, 2020b). The third problem relates to the fact that the determinants of neighborhood happiness remain underexplored. Cognitive and affective measures are conceptually distinct and represent different aspects of well-being. At the neighborhood scale, neighborhood satisfaction (cognitive) is a measure of contentment with one's neighborhood, while neighborhood happiness (affective) is a measure of the feelings one experiences in his/her neighborhood. Their predictors might be largely different, so comparisons of independent analyses of neighborhood satisfaction and neighborhood happiness would be particularly useful for better understanding urban livability.

The present study addresses the aforementioned issues by exploring and comparing the determinants of both neighborhood satisfaction and neighborhood happiness in two different cities from distinct contexts and cultures (South and North European). From a methodological point

Table 1
Descriptive statistics and *t*-test comparisons.

Variables	Thessaloniki (N = 523)				Oslo (N = 1339)				*t*-test
	N	Min/Max	Mean	s.d.	N	Min/Max	Mean	s.d.	
Urban livability									
Neighborhood satisfaction	523	0/10	7.45	(2.13)	1334	0/10	8.23	(1.83)	* *
Neighborhood happiness	523	1/5	3.64	(0.91)	1317	1/5	4.11	(0.75)	* *
Perceived neighborhood characteristics									
Safety	523	1/5	3.31	(0.92)	1325	1/5	4.22	(0.83)	* *
Noise	523	1/5	2.63	(1.14)	1336	1/5	2.46	(1.14)	*
Neighborhood social cohesion	523	1/5	3.23	(0.96)	1292	1/5	3.25	(1.09)	
Neighborhood attachment	523	1/5	3.29	(1.15)	1321	1/5	3.91	(1.01)	* *
Physical neighborhood characteristics									
Distance to city center (km)	513	0.2/36.0	8.56	(8.68)	1339	0.7/46.2	10.06	(10.71)	*
Neighborhood density (persons/hectare within 1 km radius)	513	2/210	98.06	(61.93)	1339	1/177	75.27	(54.37)	* *
Amenities (number of amenities within 1 km radius)	513	0/1354	351.70	(388.78)	1339	0/1307	313.32	(322.20)	*
Park area (square meters within 1 km radius)	513	0/492444	115729.42	(89729.50)	1339	0/520002	178714.03	(180685.14)	* *
Tree cover (% within 1 km radius)	513	0/14.5	0.84	(2.25)	1339	7.6/75.2	26.39	(15.92)	* *
Sociodemographic variables									
Age (years)	523	18/79	41.74	(13.85)	1339	19/94	50.14	(15.68)	* *
Female	523	0/1	0.56	(0.50)	1326	0/1	0.54	(0.50)	
Unemployed	523	0/1	0.21	(0.41)	1334	0/1	0.03	(0.16)	* *
Living with partner/spouse	523	0/1	0.62	(0.49)	1324	0/1	0.61	(0.49)	
Immigrant	523	0/1	0.02	(0.12)	1337	0/1	0.09	(0.28)	* *
Income[1,2]	523	0/4250	1062.14	(855.11)	1255	35/4330	642.2	(321.08)	n/a
College degree or higher	523	0/1	0.70	(0.46)	1336	0/1	0.79	(0.41)	* *
Household with children	523	0/1	0.41	(0.49)	1329	0/1	0.32	(0.47)	* *
Time living in dwelling	523	1/5	4.00	(1.29)	1330	1/5	3.75	(1.33)	* *

Notes: Independent sample *t*-tests show significant differences in the means between Thessaloniki and Oslo at *p < 0.05 and **p < 0.001. n/a: not applicable. [1]Income variable for Thessaloniki sample: personal net monthly income in Euros. [2]Income variable for Oslo sample: annual gross household income divided by the square root of household size (in 1000 s Norwegian Kroner).

of view, the statistical modeling in the study is theory-driven aiming at providing well-founded results.

3. Data and methods

3.1. Case areas

The study is based on data from two independent population-based questionnaire surveys carried out in Greece and Norway in 2020 and 2016 respectively. We use data for the urban regions of Thessaloniki, Greece and Oslo, Norway based on these two datasets. Fig. 1 shows maps of the two urban regions and the approximate distribution of survey participants. Thessaloniki urban region has approximately 1.1 million residents and Oslo urban region has approximately 1.5 million residents. Both urban regions have a relatively monocentric structure, are port cities built along a coast, and include diverse types of neighborhoods with a variety of built environment characteristics. In Oslo, compact neighborhoods with relatively high population densities, apartment blocks, and mixed land uses are found mostly around the central business district within the so-called “Ring 3”. Neighborhoods out of Ring 3, but still within the continuous urban area, tend to have a suburban character with lower densities, detached or row housing, and single land uses. Thessaloniki is a much denser city than Oslo and most of its continuous urban area is compactly built-up, characterized by high population densities, apartment blocks, and mixed land uses all over the built-up area along both either main high streets or more local streets. Low-density neighborhoods with detached housing and single land uses are few and mostly located out of the continuous urban area of Thessaloniki. Although Thessaloniki is denser and more compact than Oslo overall, mobility largely depends on the private car even in central areas of Thessaloniki, whereas, in Oslo, cars are heavily restricted within the inner city. Oslo is considered a highly livable city, ranking first in Europe in city satisfaction (European Commission, 2016). However, considerable differences in neighborhood living standards, neighborhood quality, and neighborhood satisfaction have been recorded in Oslo (Andersen et al., 2020; Andersen and Røe, 2017; Brattbakk and Wessel, 2017; Mouratidis, 2020b; Ruud et al., 2018). Neighborhoods of Thessaloniki typically face problems related to public transport services, traffic, maintenance, lack of green space and vegetation, and lack of open public spaces (Papagiannakis et al., 2021; Yiannakou and Salata, 2017). Some of these problems have been exacerbated during recent economic recessions due to the country’s debt crisis that started in late 2009 (see e.g. Papagiannakis et al., 2018; Thoidou, 2013) as well as due to the consequences of the coronavirus disease (COVID-19) pandemic.

3.2. Data sources

The Greek survey was conducted in April-May 2020. This period coincided with the first lockdown measures due to the COVID-19 pandemic. However, questions regarding the neighborhood were presented as general assessments of the neighborhood environment and did not specifically target COVID-19 times. It should be noted that there were other questions in the survey focusing on other themes (e.g. overall subjective well-being, activity participation) that are not part of the present study and which specifically addressed the COVID-19 period; thereby, survey participants could differentiate between COVID-19-related questions and general questions. Thus, we expect that data from the general questions regarding the neighborhood, used in the present study, are not substantially influenced by the early stage of the pandemic. The final sample for Thessaloniki was 523 residents of the urban region, aged 18–79 years. The survey was distributed through a social media campaign combined with snowball sampling using social networks. The survey was distributed in 77 Facebook groups of citizens of Thessaloniki neighborhoods, as well as 27 Facebook groups focusing on a broad range of different topics. Responses from residents of other regions of Greece were excluded from the sample in this study. Snowball sampling was performed by sending out a link to the survey to the authors’ social networks (colleagues were excluded to reduce biases). These acquaintances, in turn, forwarded the survey to their personal social networks. Overall, 299 participants were recruited through the Facebook group campaign, 204 through snowball sampling, and 20 through the webpage of the research and an online article in a magazine that deals with urban matters. The survey was initially pilot-tested and then revised based on the feedback from the pilot. We did not offer

monetary or other incentives to participants of the survey. The sample covers a high diversity of residential locations (inner city, inner suburbs, and outer suburbs), urban forms (low-, medium-, and high-density), and socioeconomic profiles (poorer and richer areas) in Thessaloniki (Fig. 1). The survey was written in the Greek language, thus residents who do not speak the Greek language might have been excluded because of this. Participants were not selected from a sampling frame, so additional sources of biases could be relevant. The sample is subject to biases typical for survey research including a higher representation of highly educated citizens and a lower representation of immigrants (Table A1 in Appendix A).

The Norwegian survey was conducted in May-June 2016. The total sample of the survey is 1339 residents of the urban region of Oslo, aged 19–94 years. A random sample selection was performed within selected postal codes. Letters were sent by post to randomly selected residents, inviting them to participate in an online survey. Only adult residents and only one member of each household were invited to participate. The invitation letter as well as the online survey were in both Norwegian and English. Similar to the sample of Thessaloniki, the Oslo sample covers a high diversity of residential locations (inner city, inner suburbs, and outer suburbs), urban forms (low-, medium-, and high-density), and socioeconomic profiles (poorer and richer areas) (Fig. 1). As the majority of the population of Oslo urban region lives in low-density neighborhoods, residents of the inner-city of Oslo were oversampled to achieve a greater balance between denser and less dense neighborhoods in the sample. The survey response rate was 13.8%, so the sample may suffer from non-response bias. Biases typical for survey research are relevant for the Oslo sample, including over-representation of highly educated citizens and under-representation of immigrants (Table A2 in Appendix A). For more details on the survey distribution, the sample characteristics, and the neighborhoods of the survey see Mouratidis (2018a).

3.3. Variable descriptions

Table 1 presents descriptive statistics of all variables used in the study. Descriptive statistical analysis was conducted with IBM SPSS Statistics (version 27). Urban livability was assessed at the neighborhood level and was measured via the surveys with two variables: neighborhood satisfaction and neighborhood happiness. Neighborhood satisfaction is a cognitive assessment of urban livability while neighborhood happiness attempts to capture the emotional/affective component of urban livability. The same questions were used in the two surveys to obtain comparable data on these variables. To assess the neighborhood environment, participants were asked to consider the local area within 15 min walking distance from their dwelling. *Neighborhood satisfaction* was measured with the question "how well do you think your local area meets your current needs?" on a scale from "extremely poorly" (0) to "extremely well" (10). An additional explanation was provided: "consider your local area's internal (physical and social) and external (accessibility to other areas) characteristics". *Neighborhood happiness* assesses the affective experience in the neighborhood and was measured with the question "how would you describe your feelings experienced when walking (or biking) in your local area?" on a scale from "very negative" (1) to "very positive" (5). This question aimed at assessing the feelings that residents experience when they are outdoors in their neighborhood as opposed to being at home. Specifying "feelings experienced when walking or (biking) in your local area" ensures that residents consider feelings while being outdoors and not indoors. Walking (and to a lesser extent biking) is a slow travel mode allowing to both visit different parts of the neighborhood and have time to experience feelings generated by the neighborhood environment. Thus, walking around in the neighborhood is a suitable way to assess neighborhood's impact on the emotional state (i.e. neighborhood happiness). It should be noted, however, that additional questions on feelings experienced in the neighborhood (e.g. while sitting outdoors or questions on specific places) might have provided even more balanced and reliable measurements of neighborhood happiness.

Perceived neighborhood characteristics (Table 1) were assessed via the surveys by asking residents to evaluate the qualities of their neighborhood (area within 15 min walking distance from their dwelling). Respondents were asked to evaluate *safety* and *noise* in their neighborhood on a scale from "very low" (1) to "very high" (5). *Neighborhood social cohesion* was measured based on the definition by Kawachi and Berkman (2000, p. 175): the "extent of connectedness and solidarity among groups in society". Survey respondents from Thessaloniki were asked to evaluate "neighborliness (good relationships between neighbors)" in their neighborhood on a scale from "very low" (1) to "very high" (5). Survey respondents from Oslo were asked to evaluate "to what extent they feel that their neighbors help one another" on a scale from "not at all" (1) to "a great deal" (5). *Neighborhood attachment* was measured by asking participants (in both surveys) how attached they feel to their neighborhood on a scale from "not at all" (1) to "a great deal" (5).

Individual sociodemographic variables (Table 1) were also obtained via the surveys: age, gender, employment status, education, citizenship, cohabitation status (living with partner or spouse), income, presence of children in the household, and time living in the present dwelling. Time living in the present dwelling was evaluated in both surveys on a scale from "less than a year" (1) to "more than ten years" (5). The sample for Thessaloniki is younger on average than the one for Oslo. This is possibly due to the distribution method of the Greek survey that included a social media campaign. Another important difference between the two samples is the unemployment rate. The unemployment rate for the Thessaloniki sample is substantially higher than for the Oslo sample. This reflects the rise in unemployment in Greece due to the country's debt crisis in 2010 s and the impact of COVID-19 in the more recent period. In Tables A1 and A2 in Appendix A, we observe similarities in how the samples from the two cities compare to their respective populations (i.e. gender, education, income, unemployment rate). It is worth pointing out that the main aim of the paper is not to offer a perfectly representative univariate analysis of neighborhood satisfaction or neighborhood happiness, but to study how neighborhood characteristics relate to neighborhood satisfaction and neighborhood happiness with structural equation models that account for a wide range of sociodemographic variables. Thus, the differences in the survey recruitment method (social media versus post) and the samples' deviations from their respective populations are not expected to meaningfully influence the outcomes of the study (Hough et al., 2008).

Physical neighborhood characteristics (Table 1) were obtained with geospatial analysis in geographic information systems (GIS). The geospatial analysis was conducted based on the residential location that participants filled in when completing the surveys. The analysis was conducted individually for each participant's residential location. The following characteristics were measured in GIS: distance to city center, neighborhood density, amenities, park area, and tree cover. QGIS software was used for GIS analysis. *Distance to city center* assessed the location of each participant's dwelling in relation to the city center of Thessaloniki or Oslo. It was calculated in GIS as the distance, in kilometers, from each dwelling to the city center based on the pedestrian network. *Neighborhood density* was calculated in GIS as the population density within a 1000 m radius from each participant's dwelling. Population data for Thessaloniki were obtained from high-resolution population density maps (FCL and CIESIN, 2020). For Oslo, the population dataset for statistical grids (250 m x 250 m) from Statistics Norway was used. *Amenities* were calculated in GIS as the number of amenities within a 1000 m radius from each participant's dwelling. This analysis used data from OpenStreetMap on the "amenity" category. All different types of amenities in this category were included in the analysis, for example: restaurant, cinema, school, post office, library, theater, bank, and hospital. *Park area* was calculated in GIS as the total area of parks within a 1000 m radius from each participant's dwelling. This analysis used data from OpenStreetMap on the "park" category. *Tree cover* was calculated

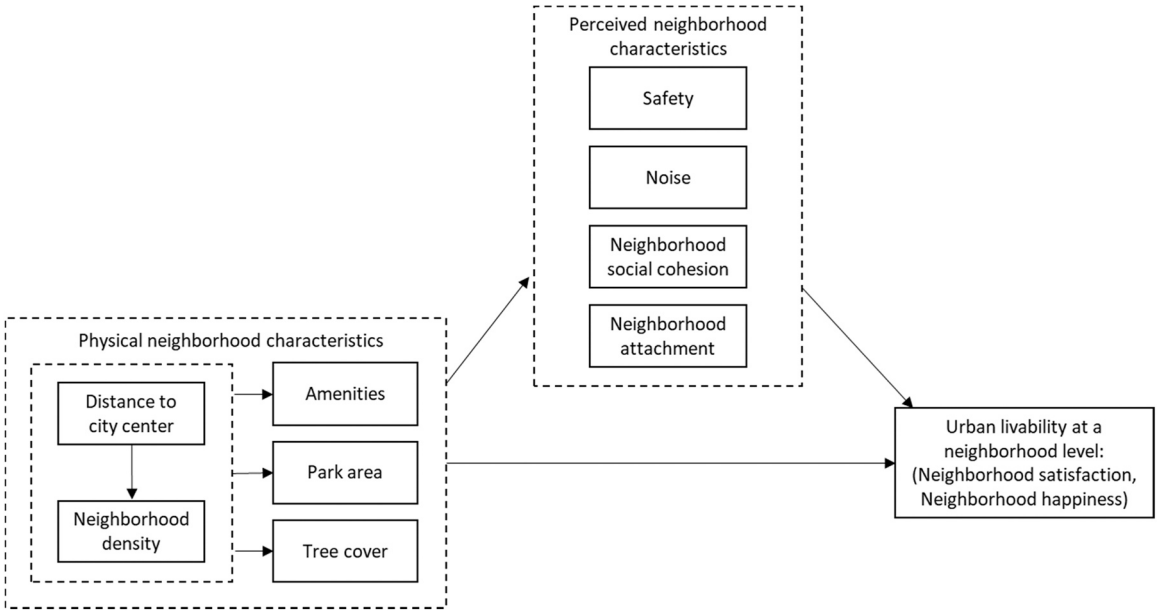

Fig. 2. Model showing potential links between neighborhood characteristics and urban livability. *Note*: The model also includes sociodemographic variables as exogenous variables, as explained in Section 3.5.

in GIS as the mean percentage of tree canopy cover within 1000 m radius from each participant's dwelling. This analysis used global tree cover data updated in 2019 by Hansen et al. (2013).

We checked the quality and coverage/completeness of the OpenStreetMap "amenities" category in three ways: comparisons with observations during in-person inspection of the areas, comparisons with data from Google Maps, and comparisons with actual land use data previously collected by the authors. We observed that the types of amenities included in the OpenStreetMap data are similar for both cities. We also observed that OpenStreetMap data do not include all the existing amenities in each city but include a large proportion of them that is similar for the two cities, making the two datasets comparable. Finally, we performed robustness tests for the analysis in Sections 4.2 and 4.3 by removing some types of amenities from both datasets and performing again the statistical analysis to check whether the results would be affected. Results remained similar, adding greater robustness to the analysis.

3.4. Analytical method

In this study, we used structural equation modeling (Byrne, 2016) to explore the determinants of urban livability at a neighborhood level. We used IBM SPSS Amos (version 27) software package. Structural equation modeling consists of path analysis (structural model) and/or latent constructs (measurement model). Here, we used only path analysis since the variables are based on single-item measures. Structural equation modeling can handle continuous and dichotomous variables. Neighborhood satisfaction and neighborhood happiness were measured on 0–10 and 1–5 scales respectively. These variables are ordinal in nature but can be treated as continuous (Ferrer-i-Carbonell and Frijters, 2004). To estimate the statistical effects of the structural equation model, we used maximum likelihood estimation. We also performed bootstrapping of 1000 replications to obtain reliable significance levels for the statistical effects and counter normality issues in the data (Pek et al., 2018; Preacher and Hayes, 2008).

3.5. Model

Fig. 2 shows the structural equation model tested in the study. The model examines relationships between physical neighborhood characteristics, perceived neighborhood characteristics, and urban livability at a neighborhood level (measured with neighborhood satisfaction and neighborhood happiness). The model is partially based on previous conceptualizations on determinants of neighborhood satisfaction (Campbell et al., 1976; Marans, 2003; Marans and Rodgers, 1975). These conceptualizations suggest that physical environmental characteristics are linked to environmental satisfaction via the mediating role of perceived environmental characteristics. In addition to this mediating pathway, we also chose to test the potential direct links from physical neighborhood characteristics to neighborhood satisfaction and neighborhood happiness, as also suggested by Cao et al. (2018). The arrangement of physical neighborhood characteristics in our model is based on previous relevant conceptualizations (Mouratidis and Poortinga, 2020; Næss, 2019). The model also includes individual sociodemographic characteristics (presented in Table 1) as exogenous variables, not shown in Fig. 2 to reduce visual complexity. Individual sociodemographic characteristics were linked to correlate with distance to city center and neighborhood density (error terms for the latter) and were also unidirectionally linked to perceived neighborhood characteristics, neighborhood satisfaction, and neighborhood happiness. Four analyses were performed based on the model in Fig. 2. We performed two analyses with neighborhood satisfaction as a final outcome variable: one for Thessaloniki and one for Oslo. We then performed two analyses with neighborhood happiness as a final outcome variable: one for Thessaloniki and one for Oslo.

4. Results

4.1. Descriptive comparisons

Table 1 presents comparisons between Thessaloniki and Oslo in terms of neighborhood characteristics and urban livability. Independent sample *t*-tests were performed to identify statistically significant differences. Mean neighborhood density is considerably higher for residents of Thessaloniki. Median neighborhood density, not shown in Table 1, is even higher in Thessaloniki (113 persons per hectare in Thessaloniki and 50 persons per hectare in Oslo). Largely due to the higher density and mixed land-use policies, the number of amenities is also considerably larger in Thessaloniki (median 229 amenities within 1 km radius in Thessaloniki compared to median 134 amenities within

Table 2
Structural equation modeling results on neighborhood satisfaction in Thessaloniki.

	Endogenous variables							
	Amenities	Park area	Tree cover	Safety	Noise	Neighborhood social cohesion	Neighborhood attachment	Neighborhood satisfaction
Direct effects								
Distance to city center	-0.380**	-0.414***	-0.415**	-0.161[a]	-0.068	-0.104	-0.105	-0.119
Neighborhood density	0.277**	0.285**	-0.623**	-0.179*	0.186**	-0.244**	-0.234*	-0.011
Amenities				0.035	0.215**	0.010	0.268**	0.088[a]
Park area				-0.034	0.086	-0.055	0.016	0.045
Tree cover				0.010	-0.040	-0.024	-0.017	-0.100*
Safety								0.127*
Noise								0.015
Neighborhood social cohesion								0.032
Neighborhood attachment								0.199**
Indirect effects								
Distance to city center	-0.214**	-0.220**	0.481**	0.139[a]	-0.329**	0.216**	0.010	-0.103
Neighborhood density				-0.006	0.109**	0.002	0.090**	0.044
Amenities								0.061**
Park area								-0.002
Tree cover								-0.004
Total effects								
Distance to city center	-0.594**	-0.634**	0.066*	-0.021	-0.397**	0.112*	-0.094*	-0.222**
Neighborhood density	0.277**	0.285**	-0.623**	-0.185**	0.295**	-0.242**	-0.144[a]	0.033
Amenities				0.035	0.215**	0.010	0.268**	0.149**
Park area				-0.034	0.086	-0.055	0.016	0.043
Tree cover				0.010	-0.040	-0.024	-0.017	-0.104*
Safety								0.127*
Noise								0.015
Neighborhood social cohesion								0.032
Neighborhood attachment								0.199**
Summary statistics								
Squared Multiple Correlation (SMC)	0.384	0.434	0.160	0.070	0.229	0.069	0.142	0.185

Notes: [a]$p < 0.10$, * $p < 0.05$, * * $p < 0.01$, * ** $p < 0.001$. All effects are standardized. Number of observations N = 513.
Significance levels are calculated with bootstrapping. Bootstrap replications = 1000.
Goodness-of-fit measures: X2/df = 2.404 (p = 0.000). CFI = 0.984. GFI = 0.988. RMSEA = 0.052.
Standardized effect of distance to city center on neighborhood density = −0.773 (p = 0.002)
The model also includes individual sociodemographic characteristics as exogenous variables.

1 km in Oslo). Average park area and tree cover are substantially larger in Oslo. Thessaloniki is a denser, more vibrant city with more local amenities, while Oslo is a less dense and much greener city than Thessaloniki. Comparisons of perceived neighborhood characteristics suggest that Oslo neighborhoods are considered safer and quieter, on average, than those of Thessaloniki. Residents of Oslo tend to be more attached to their neighborhood than residents of Thessaloniki. Overall, urban livability at a neighborhood level is found to be higher on average in Oslo than in Thessaloniki, as neighborhood satisfaction (8.23 versus 7.45) and neighborhood happiness (4.11 versus 3.64) are both higher in Oslo. However, these differences in urban livability are not as large as one might expect by looking at the results of Eurobarometer survey (European Commission, 2016) or development indices such as the Human Development Index.

4.2. Determinants of neighborhood satisfaction

Table 2 and Table 3 present the structural equation modeling results on neighborhood satisfaction in Thessaloniki and Oslo respectively. Goodness-of-fit measures (RMSEA < 0.08, CFI > 0.93, GFI > 0.93) indicate that the models fit the data well. Results in Tables 2 and 3 show direct, indirect, and total statistical effects as well as their significance levels. Findings offer support to our suggestion that physical neighborhood characteristics are linked to neighborhood satisfaction in a direct way but also indirectly via perceived neighborhood characteristics.

Tables 2 and 3 indicate several similarities between Thessaloniki and Oslo pertaining to the potential contributors to neighborhood satisfaction. Some important differences are also identified. Proximity to city center, safety, and neighborhood attachment are all positively associated with neighborhood satisfaction in both Thessaloniki and Oslo. The association between proximity to city center and neighborhood satisfaction is relatively strong and similar in size in Thessaloniki and Oslo. Safety and neighborhood attachment are more significantly associated with neighborhood satisfaction in Oslo than in Thessaloniki. The number of amenities in the neighborhood is positively associated with neighborhood satisfaction in Thessaloniki, but not in Oslo. The total area of parks and neighborhood social cohesion are positively associated with neighborhood satisfaction in Oslo, but not in Thessaloniki. Tree cover is found to be negatively associated with neighborhood satisfaction in both cities. In Thessaloniki, proximity to city center and neighborhood attachment are the most significant predictors of neighborhood satisfaction. In Oslo, neighborhood attachment is the most significant predictor of neighborhood satisfaction.

Findings in Tables 2 and 3 also shed light on the interrelationships between neighborhood characteristics. Findings from both Thessaloniki and Oslo confirm that proximity to the city center and high neighborhood density contribute to a larger number of amenities in the neighborhood. Similar trends are observed for park area in the neighborhood. Public parks tend to be located in denser urban neighborhoods in both urban regions. This is reasonable since low-density suburbs include mostly private green spaces. Lower neighborhood densities and longer distance to city center relate to higher tree cover in both urban regions, since low-density suburbs tend to have more trees and some of them are close to forest areas in the outskirts. In Thessaloniki, neighborhood density is associated with lower perceived safety. In Oslo, proximity to city center, neighborhood density, and neighborhood amenities are

Table 3
Structural equation modeling results on neighborhood satisfaction in Oslo.

	Endogenous variables							
	Amenities	Park area	Tree cover	Safety	Noise	Neighborhood social cohesion	Neighborhood attachment	Neighborhood satisfaction
Direct effects								
Distance to city center	0.028**	-0.033*	0.114**	-0.034	0.032	0.030	-0.035	-0.151***
Neighborhood density	0.935**	0.884**	-0.701**	-0.136	0.219**	0.025	0.213*	-0.141[a]
Amenities				-0.577**	0.268**	-0.118	-0.234**	0.095
Park area				0.350**	-0.178**	-0.034	0.092	0.096
Tree cover				0.003	-0.142**	-0.026	-0.051	-0.091*
Safety								0.183**
Noise								0.030
Neighborhood social cohesion								0.103**
Neighborhood attachment								0.364**
Indirect effects								
Distance to city center	-0.677**	-0.640**	0.507**	0.240**	-0.301**	0.066*	-0.095**	-0.089**
Neighborhood density				-0.233**	0.193*	-0.122	-0.102	0.212**
Amenities								-0.195**
Park area								0.089**
Tree cover								-0.025
Total effects								
Distance to city center	-0.648**	-0.672**	0.621**	0.205**	-0.268**	0.095**	-0.131**	-0.240**
Neighborhood density	0.935**	0.884**	-0.701**	-0.369**	0.412**	-0.098*	0.110**	0.071
Amenities				-0.577**	0.268**	-0.118	-0.234**	-0.100
Park area				0.350**	-0.178**	-0.034	0.092	0.184**
Tree cover				0.003	-0.142**	-0.026	-0.051	-0.116*
Safety								0.183**
Noise								0.030
Neighborhood social cohesion								0.103**
Neighborhood attachment								0.364**
Summary statistics								
Squared Multiple Correlation (SMC)	0.837	0.824	0.619	0.172	0.186	0.092	0.099	0.288

Notes: [a]$p < 0.10$, *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$. All effects are standardized. Number of observations N = 1149.
Significance levels are calculated with bootstrapping. Bootstrap replications = 1000.
Goodness-of-fit measures: X2/df = 3.271 (p = 0.000). CFI = 0.993. GFI = 0.992. RMSEA = 0.044.
Standardized effect of distance to city center on neighborhood density = −0.724 (p = 0.002)
The model also includes individual sociodemographic characteristics as exogenous variables.

associated with lower perceived safety, while park area is associated with higher perceived safety. Proximity to city center, neighborhood density, and neighborhood amenities are associated with higher perceived noise in both Thessaloniki and Oslo. Park area and tree cover are associated with lower perceived noise in Oslo. Lower neighborhood density and longer distance to city center are associated with stronger social cohesion in neighborhoods of both Thessaloniki and Oslo. Neighborhood amenities are positively related to neighborhood attachment in Thessaloniki, whereas they are negatively related to neighborhood attachment in Oslo. Neighborhood density is negatively linked to neighborhood attachment in Thessaloniki, while it is positively linked to neighborhood attachment in Oslo. Proximity to city center is positively associated with neighborhood attachment in both urban regions.

4.3. Determinants of neighborhood happiness

Table 4 and Table 5 present structural equation modeling results on neighborhood happiness in Thessaloniki and Oslo respectively. Goodness-of-fit measures (RMSEA < 0.08, CFI > 0.93, GFI > 0.93) indicate that the models fit the data well. Results in Tables 4 and 5 show direct, indirect, and total statistical effects as well as their significance levels. Results on the interrelationships between neighborhood characteristics are substantially the same as those in Tables 2 and 3. Findings support our suggestion that physical neighborhood characteristics are linked to neighborhood happiness both directly but also indirectly via perceived neighborhood characteristics.

Tables 4 and 5 indicate both similarities and differences between Thessaloniki and Oslo pertaining to the potential contributors to neighborhood happiness. We found that neighborhood perceived safety, neighborhood social cohesion, and neighborhood attachment are positively related to neighborhood happiness in both urban regions. The association between perceived safety and neighborhood happiness is more significant in size in Thessaloniki than in Oslo. Neighborhood social cohesion is more strongly associated with neighborhood happiness in Oslo than in Thessaloniki. Neighborhood attachment exhibits the strongest association with neighborhood happiness in both Thessaloniki and Oslo. Neighborhood density and perceived noise are negatively associated with neighborhood happiness in both urban regions, although their coefficients are larger in size for Thessaloniki than for Oslo. The number of amenities is positively associated with neighborhood happiness in Thessaloniki (marginally significant), but strongly and negatively associated with neighborhood happiness in Oslo. Park area and tree cover are positively associated with neighborhood happiness in Oslo, but not in Thessaloniki. We also found a marginally significant positive relationship between distance to city center and neighborhood happiness in Oslo.

4.4. Discussion of main findings

Several important similarities in the determinants of urban livability between the two contexts emerged from the findings of this research. In both cities, *common determinants of neighborhood satisfaction* were found to be the proximity to city center, neighborhood perceived safety, and neighborhood attachment. These determinants of neighborhood satisfaction are in line with findings from previous studies (Buys and Miller, 2012; Davis and Fine-Davis, 1991; Grogan-Kaylor et al., 2006; Howley et al., 2009; Hur and Morrow-Jones, 2008; Hur and Nasar, 2014; Lee et al., 2017; Lovejoy et al., 2010; Mouratidis, 2018a; Parkes et al., 2002). It can be observed that although Thessaloniki is much denser than Oslo

Table 4
Structural equation modeling results on neighborhood happiness in Thessaloniki.

	Endogenous variables							
	Amenities	Park area	Tree cover	Safety	Noise	Neighborhood social cohesion	Neighborhood attachment	Neighborhood happiness
Direct effects								
Distance to city center	-0.380**	-0.414***	-0.415**	-0.161[a]	-0.068	-0.104	-0.105	-0.119[a]
Neighborhood density	0.277**	0.285**	-0.623**	-0.179*	0.186**	-0.244**	-0.234*	-0.239**
Amenities				0.035	0.215**	0.010	0.268**	0.055
Park area				-0.034	0.086	-0.055	0.016	0.025
Tree cover				0.010	-0.040	-0.024	-0.017	-0.019
Safety								0.340**
Noise								-0.114*
Neighborhood social cohesion								0.075[a]
Neighborhood attachment								0.263***
Indirect effects								
Distance to city center	-0.214**	-0.220**	0.481**	0.139[a]	-0.329**	0.216**	0.010	0.157*
Neighborhood density				-0.006	0.109**	0.002	0.090**	-0.118*
Amenities								0.058[a]
Park area								-0.021
Tree cover								0.002
Total effects								
Distance to city center	-0.594**	-0.634**	0.066*	-0.021	-0.397**	0.112*	-0.094*	0.038
Neighborhood density	0.277**	0.285**	-0.623**	-0.185**	0.295**	-0.242**	-0.144[a]	-0.358**
Amenities				0.035	0.215**	0.010	0.268**	0.113[a]
Park area				-0.034	0.086	-0.055	0.016	0.004
Tree cover				0.010	-0.040	-0.024	-0.017	-0.017
Safety								0.340**
Noise								-0.114*
Neighborhood social cohesion								0.075[a]
Neighborhood attachment								0.263***
Summary statistics								
Squared Multiple Correlation (SMC)	0.384	0.434	0.160	0.070	0.229	0.069	0.142	0.338

Notes: [a]$p < 0.10$, *$p < 0.05$, **$p < 0.01$, *** $p < 0.001$. All effects are standardized. Number of observations N = 513.
Significance levels are calculated with bootstrapping. Bootstrap replications = 1000.
Goodness-of-fit measures: X2/df = 2.404 (p = 0.000). CFI = 0.985. GFI = 0.988. RMSEA = 0.052.
Standardized effect of distance to city center on neighborhood density = −0.773 (p = 0.002)
The model also includes individual sociodemographic characteristics as exogenous variables.

thus enabling shorter distances, shorter distances to the city center are similarly important contributors to neighborhood satisfaction in both cities. *Common determinants of neighborhood happiness* were found to be neighborhood perceived safety, neighborhood perceived quietness, neighborhood social cohesion, neighborhood attachment, and lower neighborhood density. These determinants are in line with previous findings on neighborhood happiness (Mouratidis, 2019) and studies exploring environmental correlates of subjective well-being in cities (Gim, 2021; Kent and Thompson, 2014; Park et al., 2021; Pfeiffer and Cloutier, 2016; Shekhar et al., 2019). It is interesting that in both the more vibrant, denser Thessaloniki and in the more quiet, greener Oslo, perceived safety, quietness, and low neighborhood density are all positively linked to neighborhood happiness. One unexpected finding is that tree cover was negatively associated with neighborhood satisfaction in both Thessaloniki and Oslo. This seems surprising considering all the established well-being benefits of urban vegetation and tree cover (Ulmer et al., 2016) and previous studies finding positive links between tree cover and neighborhood satisfaction (Kweon et al., 2010; Lee et al., 2008). Our finding could be attributed not to tree cover itself, but to the fact that dwellings surrounded by high tree cover tend to be located in more remote locations that may result in lower neighborhood satisfaction. Another explanation could be the possible ecosystem disservices of trees including emissions of volatile organic compounds contributing to smog problems, allergic reactions to certain tree species, problems caused by birds, mosquitoes, rats or other animal species, fear of dark green areas at night, and blockage of views (Bolund and Hunhammar, 1999; Gómez-Baggethun and Barton, 2013).

Important *differences between the two cities* were also observed. Numerous local amenities seem to positively contribute to urban livability in Thessaloniki, as they were found to be positively associated with both neighborhood satisfaction and neighborhood happiness. In Oslo, on the other hand, numerous local amenities seem to be a negative contributor to urban livability, as they were negatively associated with neighborhood happiness. Other attributes seem to be more important for Oslo residents: neighborhood social cohesion (positively linked to neighborhood satisfaction only in Oslo) and parks and trees (positively linked to neighborhood happiness only in Oslo). These differences support the idea that some of the links between neighborhood characteristics and livability may depend on the local context, as also suggested by other scholars (e.g. Kourtit et al., 2020; Kyttä et al., 2016; Yang, 2008).

4.5. Discussion of local context and urban livability

Based on the above outcomes, certain characteristics such as safety, lack of noise, and place attachment seem to positively contribute to urban livability independently of the context. However, the local context may play a role in how some other neighborhood characteristics are experienced and perceived. The particularities of the local context in terms of built environment, culture, and attitudes may contribute to whether certain neighborhood characteristics are experienced and perceived as positive, negative, or indifferent. For example, the finding that numerous local amenities are appreciated more in Thessaloniki than in Oslo might be attributed to differences in the local culture, attitudes, and preferences but also differences in the built environment. The considerably denser urban form of Thessaloniki, the greater number of local amenities, as well as geographical and historical reasons may have shaped culture, attitudes, and preferences, making local amenities important for Thessaloniki residents. On the other hand, the greener and quieter Oslo as well as geographical and historical reasons may have

Table 5
Structural equation modeling results on neighborhood happiness in Oslo.

	Endogenous variables							
	Amenities	Park area	Tree cover	Safety	Noise	Neighborhood social cohesion	Neighborhood attachment	Neighborhood happiness
Direct effects								
Distance to city center	0.028**	-0.033*	0.110**	-0.030	0.031	0.025	-0.036	-0.081*
Neighborhood density	0.935**	0.883**	-0.703**	-0.135[a]	0.222**	0.023	0.216*	-0.024
Amenities				-0.580**	0.263**	-0.116	-0.239**	-0.139[a]
Park area				0.348**	-0.174**	-0.036	0.096	0.147*
Tree cover				0.000	-0.141**	-0.025	-0.050	0.150***
Safety								0.222**
Noise								-0.069*
Neighborhood social cohesion								0.078**
Neighborhood attachment								0.310***
Indirect effects								
Distance to city center	-0.677**	-0.640**	0.509**	0.240**	-0.302**	0.067[a]	-0.097**	0.132**
Neighborhood density				-0.234**	0.191**	-0.123	-0.103	-0.188*
Amenities								-0.230**
Park area								0.116**
Tree cover								-0.008
Total effects								
Distance to city center	-0.649**	-0.673**	0.619**	0.209***	-0.270**	0.092*	-0.133**	0.051[a]
Neighborhood density	0.935**	0.883**	-0.703**	-0.369**	0.413**	-0.100*	0.113*	-0.212**
Amenities				-0.580**	0.263**	-0.116	-0.239**	-0.369**
Park area				0.348**	-0.174**	-0.036	0.096	0.264**
Tree cover				0.000	-0.141**	-0.025	-0.050	0.142**
Safety								0.222**
Noise								-0.069*
Neighborhood social cohesion								0.078**
Neighborhood attachment								0.310***
Summary statistics								
Squared Multiple Correlation (SMC)	0.837	0.823	0.618	0.173	0.185	0.092	0.099	0.312

Notes: [a]$p < 0.10$, *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$. All effects are standardized. Number of observations N = 1149.
Significance levels are calculated with bootstrapping. Bootstrap replications = 1000.
Goodness-of-fit measures: X2/df = 3.110 (p = 0.000). CFI = 0.993. GFI = 0.992. RMSEA = 0.043.
Standardized effect of distance to city center on neighborhood density = −0.724 (p = 0.002)
The model also includes individual sociodemographic characteristics as exogenous variables.

shaped culture, attitudes, and preferences of Oslo residents, placing greater importance on green space, vegetation, and visits to the forest. These findings are to some extent related to findings from a study in Helsinki, Finland, where access to amenities was positively associated with well-being in urban areas, and negatively associated with well-being in suburban areas (Kyttä et al., 2016). The quality of neighborhood characteristics may have also contributed to differences found between the two urban contexts: Thessaloniki and Oslo (see e.g. Kothencz and Blaschke, 2017; Stessens et al., 2020; Wu et al., 2020; Zhang et al., 2017). For example, public parks might be better maintained or perceived as safer in Oslo compared to Thessaloniki. Thessaloniki residents would then enjoy and appreciate public parks to a lesser extent compared to Oslo residents. The specificities themselves of the urban form may also play a critical role in how residents perceive their neighborhood. Urban form interacts with the socio-spatial structures and hence with social perceptions, an issue that has been discussed by Yiannakou and Hatziprokopiou (2019) in the context of Thessaloniki urban region.

4.6. Discussion of cognitive and affective measures of urban livability

This study has assessed urban livability at a neighborhood level using both cognitive (neighborhood satisfaction) and affective (neighborhood happiness) measures. Considerable differences in their determinants were found. Proximity to city center is a determinant of neighborhood satisfaction but not of neighborhood happiness. High density and noise perception are negatively associated with neighborhood happiness but not with neighborhood satisfaction. These differences support our claim that neighborhood happiness should complement neighborhood satisfaction in studies on the subjective evaluation of urban livability at a neighborhood level. As also suggested by previous studies, findings on urban livability may depend upon how livability is measured (Ala--Mantila et al., 2018). The vast majority of studies had so far focused only on cognitive evaluations such as neighborhood or residential satisfaction. A more complete assessment with both cognitive and affective measures can offer a more complete picture of urban livability.

5. Conclusions

This study has used data from Thessaloniki and Oslo to investigate urban livability in two cities from South and North Europe respectively. A structural equation model was developed (based on theoretical considerations) and tested. The model examined relationships between physical neighborhood characteristics, perceived neighborhood characteristics, and urban livability at a neighborhood level. Urban livability was assessed subjectively with both cognitive (neighborhood satisfaction) and affective (neighborhood happiness) measures.

Findings indicate several common determinants of urban livability in Thessaloniki and Oslo, but also some important differences. Proximity to city center, neighborhood perceived safety, and place attachment were positively associated with *neighborhood satisfaction* in both cities. Neighborhood perceived safety, neighborhood perceived quietness, neighborhood social cohesion, place attachment, and lower neighborhood density were positively associated with *neighborhood happiness* in both cities. Nevertheless, numerous local amenities were positively associated with neighborhood satisfaction and neighborhood happiness in Thessaloniki, but negatively associated with neighborhood happiness in Oslo. Parks and trees were positively associated with neighborhood happiness in Oslo, but not in Thessaloniki.

These findings can offer a platform for discussing planning and

policy implications. It is evident that urban environments that promote safety, lack of noise, place identity and place attachment, and local social connections may contribute to livability at a neighborhood scale. Other findings however provide more complicated insights that need further considerations from a land-use planning point of view, especially with regard to the quest for urban sustainability. Shorter distances to the city center seem to positively contribute to neighborhood satisfaction, while higher neighborhood densities seem to negatively contribute to neighborhood happiness. Nevertheless, shorter distances are enabled by higher urban densities, so it is not feasible to have both short distances and low neighborhood densities, at least to a great extent in a city. Besides, densely inhabited neighborhoods, usually located within the inner parts of the compact cities, are sometimes characterized by an old building stock, lack of open spaces, and poor infrastructure, issues which in turn may negatively contribute to urban livability. The implications of findings on local amenities, parks, and trees are also less straightforward. To propose urban planning and policy strategies, these findings should be evaluated together with considerations of other assessments of urban livability (e.g. overall quality of life) as well as considerations of sustainability and social equity. The compact city, a city of short distances and higher densities, is considered the most environmentally friendly urban form (Ahlfeldt et al., 2018; OECD, 2018) so it is critical to ensure that is also livable. Moreover, there is strong evidence that urban green space and access to at least some amenities both provide benefits related to livability, equity, and sustainability. All these complex problems highlight the need for innovative land-use planning tools adaptive to the specificities of the compact city.

Quality of life in the city is in theory at the heart of urban planning and concerns primarily the neighborhood scale. Through land-use planning and urban design as well as other community-oriented urban policies, this scale deals with critical issues such as densities, mix of land uses, provision of amenities, securing public spaces and their access by residents, local mobility patterns, and, generally, the spatial configuration of all aspects of everyday life. The neighborhood scale within a city in fact combines the built environment, its specificities, and planning features, with the social environment. However, urban planning has been often criticized for not dealing with life in the city per se. From the widely applied idea of neighborhood unit as a template for good neighborhood design to urban renewal initiatives at the local level, it had long become clear that physical solutions to social problems have their own limits (Rohe, 2009).

Therefore, exploring determinants of what makes cities livable from different urban contexts can provide important insights into how the built environment, with its various "forms" and intrinsic transitions over time, interacts with local social environments and influences livability perceptions of such interactive environments. Certainly, these determinants do not provide linear explanations of what make cities more livable or straight answers for planning policies. Livability is a multidimensional aspect and improving it at the neighborhood scale is perhaps more complicated than a set of urban planning measures and responses. Both similarities and differences between different urban contexts should be considered in ways that will increase quality of life in cities by making better use of the main livability determinants in each city as well as learning from what makes other cities more livable. Thus, the neighborhood scale may become a good laboratory for more community-focus urban planning, recognizing the advantages and disadvantages of different urban forms and patterns and building upon them. Besides, the neighborhood scale has proved to be crucial for sustaining quality of life during the COVID-19 pandemic crisis. This current crisis made citizens more aware of the value of the neighborhood, its functions, and its livability determinants, especially by rediscovering the value of green and public spaces, of local amenities, of short distances, and of staying connected with other people at this scale.

The study has investigated urban livability in Thessaloniki and Oslo and compared findings between South and North European contexts respectively. Future studies could explore and compare the determinants of urban livability in other geographical contexts. The model (Fig. 2) employed here could be further expanded with additional neighborhood characteristics in future research. This would reduce the risk of omitted variable bias that might be relevant when investigating determinants of urban livability. The use of both cognitive and affective measures of urban livability is recommended as explained in Section 5.3. The present study is based on cross-sectional data. The results, therefore, represent associations and should be interpreted with caution. Longitudinal research designs are recommended for future research (see e.g. Wang and Wang, 2019). Future research could investigate the extent to which neighborhood satisfaction and neighborhood happiness vary across gender and socio-economic groups. This can be relevant and informative for planning and neighborhood interventions.

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Appendix A

see Tables A1 and A2.

Table A1
Sociodemographic characteristics of survey participants in Thessaloniki.

	Survey participants (N = 523)	Population
	Mean	Mean
Female	55.8%	52.2%
Age (for aged 18 or older)	41.74	47.47
Living with partner/spouse	62%	49%
Unemployed	20.8%	17.4%
Personal net monthly income (Euros)	1062	782
Non-Greek citizenship	2%	6%
College degree or higher	70%	20%
Household size (persons)	2.55	2.52

Notes: Population data refer to the regional unit of Thessaloniki except for income that is at a country level.
Source: Hellenic Statistical Authority (2020)

Table A2
Sociodemographic characteristics of survey participants in Oslo.

	Survey participants (N = 1339)	Population
	Mean	Mean
Female[1]	53.5%	50.3%
Age (for aged 18 or older)[1]	50.14	46.30
Living with partner/spouse[1]	61%	48%
Unemployed[2]	2.5%	2.5%
Adjusted annual household income (NOK)[1]	642000	583000
Non-Norwegian citizenship[1]	9%	21%
College degree or higher[2]	79%	50%
Household size (persons)[1]	2.22	1.94

Notes: [1]Population mean for the counties of Oslo and Akershus. [2]Population mean for Oslo Municipality. *Source*: Statistics Norway (2019)

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