



Original article

Psychosocial outcomes as motivations for urban gardening: A cross-cultural comparison of Swiss and Chilean gardeners

Robert Home^{a,*}, Lorena Vieli^{b,c}^a Research Institute of Organic Agriculture FiBL, Ackerstrasse 113, Postfach 219, 5070, Frick, Switzerland^b Departamento de Ciencias Agronómicas y Recursos Naturales, Universidad de la Frontera, Temuco, Chile^c Center of Applied Ecology and Sustainability (CAPEs), Santiago, Chile

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ABSTRACT

The range of benefits provided by urban greenspaces is reasonably well understood and a broad consensus has been reached that they provide habitats along with social ecosystem services, such as restoration, health and food. Domestic gardens, which are a primary node of contact between city residents and nature, typically represent a significant portion of the urban greenspaces, so the gardeners who manage them play an important role in maintaining the greenspaces within a city. In this way, gardeners voluntarily provide a public service so should be encouraged, but the motivations of individual gardeners have not been sufficiently studied. In this study, we address this research gap by using a 14 item 'motivations for gardening' scale to evaluate the motivations for gardening held by gardeners in different cultural contexts. We used questionnaires to collect data in three Swiss cities (Lausanne, Bern and Zürich; N = 409) and one Chilean city (Temuco; N = 167) and analysed the responses at both item and scale levels. Although significant differences between Swiss and Chilean responses were found for all individual scale items, a principal component analysis revealed nearly identical component structures for both the Swiss and Chilean samples. Three clear components were identified; restoration as the motivational component receiving the strongest agreement, followed by socialization, and then food production. Nearly identical component structures were found, with the same scale items loading against the same components, when the sample was divided according to age, gender, education and income. These results suggest that motivations for gardening are not context dependant but rather represent an inherent human condition that frames how gardeners manage and interact with their gardens. Acknowledgement of these human needs: especially regarding the restoration benefits that people gain from these spaces, in public policies related to management and regulation of green urban areas has the potential to contribute to the survival of urban gardens.

1. Introduction

Urban greenspaces are patches of vegetation in and around human settlements, which range from remnant patches of native plant communities through to intensively managed gardens with exotic plants (Kowarik, 2011; Taylor and Hochuli, 2017). Such spaces can be managed by public local authorities, communities of urban residents or private owners and are increasingly attractive options to release for development as cities and towns increase in density due to urban population growth with associated increases in needs for housing and services (Haaland and van den Bosch., 2015; Lewis et al., 2018; Home et al., 2018). However, the benefits that urban greenspaces provide to human health and well-being (Lewis et al., 2018; Niemelä et al., 2010), and for biodiversity conservation (Frey et al., 2018; Frey and Moretti,

2019) are widely recognized by a growing body of literature. A broad consensus has been reached that they provide habitats along with social ecosystem services, such as restoration, health benefits and food (Home et al., 2018).

The majority of studies of urban greenspaces have focused on public greenspaces, such as parks; semi-public green spaces, such as privately owned but communally accessible areas (Home et al., 2018); and community gardens (Sanchez and Liamputtong, 2016), with insufficient attention having been given to domestic gardens (Taylor and Lovell, 2014). However, domestic gardens, which are privately managed, cumulatively account for large proportions of the greenspace in many cities (Garin Contreras et al., 2009; Lin et al., 2015), so the lack of study represents a major gap in the existing knowledge of urban greenspaces. Taylor and Lovell (2014: 1) wrote that "the home food garden

* Corresponding author.

E-mail addresses: robert.home@fibl.org (R. Home), lorena.vieli@ufrontera.cl (L. Vieli).<https://doi.org/10.1016/j.ufug.2020.126703>

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represents a major lacuna in the rapidly expanding academic literature on urban agriculture in the developed world” and that the contrast between a concentration of research on community gardens and a lack of research on urban home food gardens is puzzling. Galluzzi et al. (2010) proposed the explanation that the lower number of studies addressing domestic gardens is probably due to limitations of access, which suggests that the research gap is due to inconvenience rather than domestic gardens being unworthy of study.

For many urban residents, their primary point of contact with nature is in their own garden, over which they have direct control through management and design. Garden owners, or gardeners, can produce different private greenspaces based on their perceptions and motivations for their management. They regulate competition through weeding and pruning to maintain desired plants and control trophic interactions by removing herbivores, such as slugs, and creating conditions to favour their predators, such as by increasing habitat heterogeneity (Frey et al., 2018). Gardeners enable plants to overcome dispersal barriers by planting and seeding, encouraging pollinators and by transporting and exchanging materials and substrates (Frey and Moretti, 2019). Additionally, gardeners overcome environmental barriers by measures such as exploiting local microclimatic niches, watering, and applying fertilizers and/or pesticides (Kendal et al., 2012). The management of such gardens therefore influences what is grown, which is driven by the choices made by gardeners and has implications for the social and ecological effects of the gardens.

Gardening has become increasingly popular in cities worldwide, but the motivations for gardening can vary strongly between contexts (Winkler et al., 2019). Much of the literature on privately managed domestic gardens focuses on their outcomes, such as ecosystem services (Cabral et al., 2017), restoration (Cervinka et al., 2016; Home et al., 2010), and food production (CoDyre et al., 2015). However, less literature has addressed the motivations behind gardeners’ management decisions in domestic gardens. Included in this research gap is a lack of understanding of the motivations that drive the decisions that are made for the design and management of domestic gardens (Lewis et al., 2018), which means there is uncertainty on how to motivate garden managers “to keep or improve green space quality on private properties” (Haaland and van den Bosch., 2015, p. 767). Ruggeri et al. (2016: 8) appear to agree and point out that, “while multifunctionality of urban gardening is well documented; only a few studies have investigated individual gardeners’ motivations, which can be subjective and heavily affected by the local context in which it takes place”.

2. Contextual differences in motivations for gardening

Several scholars have argued that preferences for natural landscapes are a human characteristic that is biological in origin and therefore consistent across cultures. Kaplan and Kaplan (1989)’s Attention Restoration Theory proposes that humans naturally prefer landscapes that are fascinating yet legible, and offer escape while remaining compatible. Such landscapes are proposed to be similar to those that stimulated and facilitated primitive man’s gathering of information and thus promoted the development of power of reasoning (Bourassa, 1990). Appleton (1975) offered an alternative explanation for landscape preference, with Prospect Refuge Theory, which claims that humans gained evolutionary advantage by being attracted to landscapes with a wide, open view that allows observation of approaching predators, and simultaneously provides protected settings that prevent the viewer from being seen. Chamberlain (2000) however pointed out that explanations of landscape preference based on evolutionary advantage are oversimplified, and that the earlier human species were not optimally adapted to any particular and singular environment. Livingston (1981, p. 117) claimed that appreciation of the beauty of nature is a biologically-driven human characteristic and concluded that appreciation of nature is found in the “sub-rational sense, lodged within the very core of being of unalienated humans, of a deep complicity in the beauty, that

is life, possesses.” Wilson’s (1993) Biophilia hypothesis similarly proposes that human possess a deep-seated biological need for the connections with the rest of life that are gained by contact with nature. Home et al. (2010) however, suggested that there are both cultural and biological ways of reacting to nature, which dictate our preferences.

A range of studies have investigated motivations for natural gardening (e.g. Goddard et al., 2013; Kiesling and Manning, 2010; Kettle, 2014) but far fewer studies have addressed the motivations of gardening *per se*. Lewis et al. (2018) identified three major themes as motivations for gardening, which they labelled ‘restoration’, ‘social aspects’, and ‘outputs’, such as producing food. Rogge et al. (2018), however, found that the social components are primarily a motivation for community gardening. Winkler et al. (2019) listed personal motivations for urban gardening in Germany including the experience of nature, protection of the environment, healthy nutrition, being part of a community, and spending (free) time meaningfully. They found that some urban gardeners seek food self-sufficiency, are politically motivated, or wish to teach others, but earning money through urban gardening is not a motivation for the vast majority of gardeners.

The motivations for gardening can vary strongly between contexts. Even within cultures and between neighbours, different attitudes lead to different motivations (Lewis et al., 2018). The result of these different motivations is that the management of domestic gardens also varies greatly (Winkler et al., 2019). As the gardener can readily influence the design of gardens, it is reasonable to assume that gardens will at least partly reflect the landscape preferences of the gardener. Gardens are, after all, human managed and garden design is part of the appeal of gardening (Lewis et al., 2018). However, Winkler et al. (2019) pointed out that aesthetic preferences for landscapes might not be immediately transferrable to the human dominated garden setting because of a range of restrictions and barriers. For example, adopted concepts will depend on a combination of the gardeners’ attitudes and goals; the sociocultural context and informal rules at the neighbourhood level; and restrictions on behaviour such as local regulations and economic constraints (Home et al., 2018; Frey and Moretti, 2019). This further suggests that different motivations are likely to be found between cultures. Orsini et al. (2013) take a similar position by pointing out that urban gardening by poorer people in countries of the global South is often driven by the motivation of becoming food secure to satisfy the basic human need of food consumption.

Addressing the aim of this study by evaluating the motivations of gardeners to engage in gardening must therefore include consideration of the contexts in which the gardeners are located. A second aim of this study is to evaluate whether motivations for spending time interacting with domestic gardens are contextual or whether they represent a human condition that transcends context. There have been however too few cross-cultural studies to draw conclusions as to whether there are cultural differences in motivations for gardening, so primary research is necessary.

3. Methodology

3.1. Study locations

The study was conducted in three Swiss cities: Lausanne, Zürich and Bern, and in Temuco in Chile. Lausanne, Zürich and Bern are all located on the Swiss plateau (approx. 450 m above sea level) and have populations of 138,000, 380,000, and 133,000 respectively (FSO, 2019a). All three cities are experiencing steady population growth of approximately 1.2% per year. Mean household income in Switzerland is approximately US\$6500 per month with little local or regional spatial segregation by socioeconomic factors (FSO, 2019b). Although Swiss cities are predominantly made up of apartment buildings with communal greenspaces, there are approximately 1 million domestic gardens in Switzerland that collectively account for 46 000 ha (Van Wezemaal, 2018).

Temuco is a mid-size city of 342,000 inhabitants (Macrotrends, 2020) located in South-Central Chile (approx. 300 m above sea level). Temuco's population increased rapidly from 73,000 in 1960, with growth rates peaking at 5% annually between 1960 and 1970 before maintaining a growth rate of around 3% until 2000 and then slowing to the current rate of 1.2% (Macrotrends, 2020). It is the capital of Region Araucania, which is the poorest region of the country, with a mean income of about US\$690 per month (INE, 2017). Currently, high levels of spatial segregation by socioeconomic factors are evident in Temuco (Garin Contreras et al., 2009), with Western culture dominating the cultural background of the city but 27% of its inhabitants declared themselves as ethnic Mapuche (INE, 2017). The city is predominately made up of single-family houses: most of which have a surrounding greenspace, but the number and area of domestic gardens within Temuco is not known.

3.2. Sample

Data were collected in Chile by means of a questionnaire to a sample of 167 urban domestic gardens in Temuco city. Houses were selected randomly and were reached by personal visits by a team member. No apartment blocks or public buildings were included in the sample. Additional residents were reached by snowball sampling: again by being visited by a team member. If the resident agreed to participate, questionnaires were answered orally and the team member wrote down the answers.

Data were collected in Switzerland from Lausanne, Zürich and Bern by means of a mail-back questionnaire. There is no database of addresses of houses in Swiss cities that have a garden, so a visual assessment was needed to select houses with gardens. Data collectors travelled to predefined suburbs, to ensure representation of the whole cities, and placed a hand-written addressed envelope containing the survey instrument and a pre-paid return envelope, in the letterboxes of 900 houses with gardens. Respondents then self-completed the survey instrument and mailed them back. The response of 409 completed questionnaires represents a response rate of 44%. A breakdown of the responses by city is Lausanne (n = 92), Zürich (n = 198), and Bern (n = 119). For practical reasons it was not possible to implement the same sampling method in both countries. We are aware that using different approaches to reach respondents in Chile and Switzerland may incorporate response bias, and we have analysed our results considering this limitation in our study.

3.3. Survey instrument

The survey instrument consisted of a 14 item 'motivations for gardening' scale that was derived from the study by Lewis et al. (2018) and was designed to evaluate the themes: restoration (nine items to measure four factors), social aspects of gardening (two items to measure one factor), and food outputs (three items to measure one factor). To address 'restoration', we looked to the Perceived Restorativeness Scale (PRS) (Hartig et al., 1996), which was itself derived from Attention Restoration Theory (Kaplan and Kaplan, 1989). The cross-cultural comparison nature of this study suggested the value of including items for each of the four PRS factors: Being Away, Fascination, Compatibility, and Coherence (Hartig et al., 1996). There is no prescribed number of items in the PRS (Pasini et al., 2020) so we selected two items each for Being Away ('Escape from my everyday', 'Be in the fresh air'), Fascination ('Experience the beauty of nature', 'Learn about nature'), and Compatibility ('Identify with garden', 'Engage in reflection'), and three items for Coherence ('Structure my everyday', 'Perform a sensible activity', 'Engage in physical exercise'). The coherence items deviate from their usual application because gardens are designed and shaped by the gardener, which means they are created to meet the respondent's perceptions of coherence, so coherence questions were related to the coherence of the activity of gardening rather than the

garden itself. 'Social' aspects were represented by the items: 'Spend time with friends', and 'Provide a place for children to play'. 'Food outputs' were represented by the items: 'To teach children about food', 'Produce a large harvest', and 'Produce food'. Respondents were asked to indicate, on a Likert scale from 1 = completely agree through to 5 = completely disagree, how much they agree that the listed items are motivations for them to engage in gardening.

The survey also collected demographic data on gender, age, education and income. Data on the self-reported ethnicity of Chilean gardeners were collected and used to verify the representativeness of the Chilean sample by comparing it with the known percentage of Temuco residents who identify as Mapuche. However, ethnic background was not included as a demographic variable in the analysis of between-group comparisons because only nine gardeners reported that they identify as only Mapuche, which is insufficient for comparison. A further 27 gardeners reported that they identify as both Mapuche and Chilean so could not be readily classified, which illustrates the difficulties in dividing a sample based on ethnic origin in a multicultural society in which many people identify as one or more of several ethnic groups.

3.4. Data analysis

The first step in the analyses was to test for differences in responses between independent samples based on the place of residence of the respondents, which was carried out using Mann-Whitney *U* tests. In cases in which no differences were found, the samples could be considered to be homogeneous but in cases where between-group differences were found, further testing was needed. This procedure was followed for identifying between group differences based on:

- Gender: with the sample divided according to whether they reported identifying as male (n = 294) or female (n = 272);
- Age: With the sample divided into 'young' respondents who were 45 years of age or younger (N = 151) and 'old' respondents who were 46 years of age or older (n = 413);
- Education: With the sample divided into respondents with 'high' education who had completed technical college or university (n = 274) and respondents with 'low' education who had completed middle school or lower (n = 225); and
- Income: With the sample divided into respondents who reported that they receive a comfortable income or more (n = 453) and respondents who reported that they receive less than a comfortable income (n = 90).

Two concepts are critical in ensuring methodological rigor in cross-cultural study: namely bias and equivalence (He and Van de Vijver, 2016). Bias refers to systematic errors that can be misinterpreted as substantive cross-cultural differences and thereby threaten the validity of the applied measures (He and Van de Vijver, 2016). Acquiescence is the tendency to respond to descriptions of conceptually distinct attributes or attitudes with agreement/affirmation (agreement acquiescence) or disagreement/opposition (counter-acquiescence) regardless of their content – has been widely recognized as a threat to the validity of questionnaire-based data (He and Van de Vijver, 2016). An example of bias is response style bias, which refers to different degrees of acquiescence, i.e. differing strengths of the expression of agreement or disagreement when the actual degree of agreement is the same (Rammstedt et al., 2017), between the compared cultural groups. It was therefore necessary to evaluate whether any identified differences were the result of response style bias or whether they represented a substantive cross-cultural difference.

Equivalence refers to the level of comparability of scores across cultures (He & de Vijver, 2016). An accepted procedure for demonstrating quantitative equivalence in quantitative studies is by using Principal Component Analysis (PCA) to confirm the cross-cultural

variance (identity) of the structure of the construct and the adequacy of items used for assessment (He and Van de Vijver, 2016). In order to compare the structure of the responses between our Chilean and Swiss samples, we conducted a separate PCA with Varimax rotation with Kaiser normalization for each sample, using the Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity. KMO values between 0.8 and 1 indicate the sampling is adequate (Cerny and Kaiser, 1977) and Bartlett's test of sphericity tests the null hypothesis that the correlation matrix is an identity matrix, so results with p values under 0.05 thereby indicate that the variables are not unrelated and are therefore suitable for structure detection. To further explore the consistency of the structure of the results, we applied the same PCA with Varimax rotation and Kaiser normalization to the samples by regrouping them according to demographic variables: gender, age, education and income.

To evaluate the degree of similarity, or to demonstrate equivalence, requires empirical confirmation of the identity of the structures identified in the PCAs from independent samples. The first step is to test for correlation between the components by calculating the Pearson correlation coefficient (Wuensch, 2016). A Procrustes rotation is then performed on strongly correlated components and Tucker's congruence coefficient is calculated, using the method described in Wuensch (2016), for both rotated solutions. To calculate Tucker's congruence coefficient, the loading in one group is multiplied by the corresponding loading in the other group, the products are then summed and divided by the square root of the sum of squared loadings for the one group times the sum of squared loading for the other (Wuensch, 2016). Although there is a degree of subjectivity in evaluating similarity on the basis of Tucker's congruence coefficient, Lorenzo-Seva and ten Berge (2006) suggest that "a value in the range 0.85–0.94 corresponds to a fair similarity, while a value higher than 0.95 implies that the two components compared can be considered equal". All statistical analyses were performed using SPSS version 23.

4. Results

Considerable differences in socioeconomic aspects were found between the Chilean and Swiss samples (Table 1). Chilean garden managers tended to be younger with almost half under the age of 45, while

Table 1

Demographic description of the Chilean and Swiss samples. The values for each level of each variable are expressed as a percentage of the total number of responses.

Variable (values in %)	Chile (N = 167)	Switzerland (N = 409)
Gender		
Female	71.9	37.9
Male	28.1	60.1
NA	0	2
Age		
18 – 30	18.1	1.2
31 – 45	30.5	17.8
46 – 60	29.3	41.1
61 – 75	19.8	26.7
> 75	1.8	10.8
NA	0.6	2.4
Education		
None	2.9	.5
Basic school	13.2	4.2
Middle level school	43.7	34.7
Technical	18	12.2
University	22.2	48.4
NA	0	
Income		
Comfortable	55.1	63.3
Just enough	35.3	28.4
Hardly	6	3.4
Impossible	3	0.2
NA	0.5	4.7

only 19% of the Swiss sample were in that age category. A smaller proportion of the Chilean sample had completed university education. In contrast to the 60.1% male Swiss sample, the Chilean sample was predominantly female (71.9%). The majority of respondents from both samples reported having either a comfortable income or an income that is enough to live on. Few respondents from either sample considered themselves as poor. Although self-reported level of satisfaction regarding income level seems similar between countries, this variable is context dependent. In reality, Swiss residents have considerably higher incomes than the residents of Temuco. For Chilean samples, 27% recognized themselves as ethnic Mapuche (although many also recognized themselves as Chilean), which corresponds to the proportions resident in the city (INE, 2017).

A scale reliability analysis returned a Cronbach's alpha of 0.855, which suggests adequate internal reliability and the scale alpha did not increase if items was deleted, so all 14 scale items were used in the analysis. No significant differences ($p > 0.05$) were found between the samples from Zürich, Lausanne, and Bern for any item, so these samples could be considered homogeneous, and are hereafter grouped and referred to as the 'Swiss' sample.

Significant differences ($p < 0.05$) between the Swiss and Chilean samples were found for 12 of the 14 evaluated items (Table 2). Both samples gave their highest ratings to the aspects that derive from the passive interaction with the garden: 'Be in the fresh air', 'Experience the beauty of nature' and 'Escape from the everyday'. The items related to food production: 'Produce food', and 'Teach children about food', were among the four lowest rated motivations for both samples. However, the item 'Produce a large harvest' was the second lowest rated item in the Swiss sample, while it received the seventh lowest rating from the Chilean sample.

The PCA with Varimax rotation and Kaiser normalization resulted in three components for the Chilean samples (KMO = 0.85, Bartlett's test < 0.001) explaining 59.9% of the variance, and four components for the Swiss sample (KMO = 0.788, Bartlett's test < 0.001) explaining 62.2% of the variance (Table 3).

The analysis of correlation between the loadings from the Chilean and Swiss samples revealed strong and significant ($p < 0.001$) correlations for the following pairs: Chile1/Swiss1 (Pearson Correlation = 0.888); Chile2/Swiss2 (Pearson Correlation = 0.816); and Chile3/Swiss4 (Pearson Correlation = 0.912). The items that loaded most strongly against each of the strongly correlated components were the same in both samples (shown in Table 3), except for Chile1/Swiss1, in which 3 items that loaded most strongly against the Chile1 component did not load most strongly against the Swiss1 component. Instead, these three items formed the Swiss3 component which does not have a corresponding component in the Chilean sample ($p > 0.05$). The Tucker's congruence coefficients (TCC) suggest that the Chile1 and Swiss1 components, which contain 'restoration' items, can be considered to be equal. Chile2 and Swiss2, which contain the 'food output' items, and Chile3 and Swiss4, which contain the social items, returned TCC scores that suggest they are similar. The Tucker's congruence coefficients (TCC) improved slightly with the Procrustes rotation for the Chile3/Swiss4, while remaining almost the same for the remaining two pairs of components (Table 4).

4.1. Demographic comparisons

By regrouping the gardeners according to demographic variables, results show that for all demographic variables three or four components explained over 50% of total variance (Table 5; for details on these results see Supplementary data). For each analysis, the KMO was found to be > 0.79 and Bartlett's test < 0.001 . Considering the highest loadings for each item for all demographic groups, the components were composed of the same components that were found in the Chilean/Swiss comparison; corresponding to restoration items, food output items and social items. Significant correlations were found between the

Table 2

Means of responses from the Chilean and Swiss samples for each item of the survey instrument. Responses range on a Likert scale from 1 = completely agree through to 5 = completely disagree. The results of Mann–Whitney *U* tests for differences are shown for all items.

Item	Factor	Chilean		Swiss		Mann–Whitney <i>U</i> P-value
		N	Mean	N	Mean	
Be in the fresh air	Being away	167	1.19	399	1.57	< 0.001
Experience the beauty of nature	Fascination	167	1.44	396	1.66	0.007
Escape from the everyday	Being away	167	1.57	393	1.90	0.012
Identify with the garden	Compatibility	167	1.84	397	2.16	< 0.001
Spend time with friends	Social	167	2.25	400	2.26	0.965
Engage in physical exercise	Coherence	167	2.01	395	2.30	0.014
Learn about nature	Fascination	167	1.60	393	2.54	< 0.001
Engage in reflection	Compatibility	167	1.72	393	2.69	< 0.001
Perform a sensible activity	Coherence	167	1.84	393	2.76	< 0.001
Provide a place for children to play	Social	167	2.38	387	2.81	0.004
Produce food	Output	167	2.58	400	3.15	0.160
Teach children about food	Output	167	2.65	386	3.54	< 0.001
Produce a large harvest	Output	167	1.95	391	3.68	< 0.001
Structure my everyday	Coherence	167	2.28	390	3.95	< 0.001

Table 3

Rotated component matrices from the PCA applied to Chilean and Swiss samples. Values less than 0.3 are omitted to facilitate interpretation.

	Component	Chile			Swiss			
		Chile1	Chile2	Chile3	Swiss1	Swiss2	Swiss3	Swiss4
		% of variance explained						
Restoration items	Experience the beauty of nature	.800			.785			
	Escape from the everyday	.747			.723			
	Engage in reflection	.730			.543		.375	
	Identify with the garden	.687			.521			
	Engage in physical exercise	.638	.343		.468		.404	
	Be in the fresh air	.611		.318	.621			
	Learn about nature	.759			.448	.335	.492	
	Perform a sensible activity	.565	.437		.330		.740	
	Structure my everyday	.496	.437				.834	
	Food items	Produce a large harvest		.760			.833	
Produce food			.701			.877		
Teach children about food			.669	.476		.728		.416
Social items				.752				.810
Social items	Spend time with friends			.752				.810
	Provide a place for children to play		.314	.735		.378		.760

Table 4

Tucker’s congruence coefficients between the Chilean and Swiss samples of the strongly correlating components loadings that were derived from the PCAs with Procrustes and Varimax rotations.

	Procrustes rotation	Varimax rotation
Chile1/Swiss1	0.959800562	0.95445903
Chile2/Swiss2	0.896033913	0.89963819
Chile3/Swiss4	0.936255036	0.90884724

pairs of components and the TCC values suggest that all three components are equal in the comparisons based on age and income, while they are at least similar in the comparisons based on gender and education (Table 5). For gender, the motivations to spend time in the garden were consistent in three dimensions across the two samples, with (Female1 + Female2)/Male1 appearing to represent a ‘restoration’ component and containing the same items as the Chile1/Swiss1 component (Supplementary Table 1). The Female3/Male2 component contains the same items as the Chile2/Swiss2 component, which are items related to ‘producing food’ component. The Female 4/Male3 and Chile3/Swiss4 component also contain the same items that make up the ‘social’ component. This pattern was repeated with the comparisons of samples divided according to age, education level, and income (Supplementary Tables 2–4). The items that correspond to the ‘restoration’ component loaded strongly against Young2/Old1, EduHigh1/EduLow2, and In-High1/IncLow1. The items that correspond to the ‘social’ component loaded strongly against Young3/Old3, EduHigh3/EduLow4, and In-High2/IncLow2. The items that correspond to the ‘food’ component

Table 5

Synthesis of results of the PCA with Varimax rotation with Kaiser Normalization applied to the samples after regrouping the respondents according to demographic variables. For all variables Bartlett’s test < 0.001. Details of each analysis are provided in Supplementary Data.

Demographic variable	N	Dimension			Total variance explained	KMO		
		Restoration	Food	Social				
Gender	Variance explained	Female	272	15.62%	14.88%	13.02%	43.5%	0.79
		Male	294	28.2%	20.47%	12.35%	61.0%	0.88
	Correlation			0.786	0.855	0.984		
		TCC		0.911	0.902	0.972		
Age	Variance explained	Young	151	24.06%	25.07%	12.33%	61.5%	0.85
		Old	413	18.74%	24.11%	11.85%	54.7%	0.82
	Correlation			0.965	0.923	0.914		
		TCC		0.989	0.971	0.938		
Education	Variance explained	High	274	22.71%	19.90%	13.47%	56.1%	0.79
		Low	225	16.48%	15.48%	13.58%	45.5%	0.83
	Correlation			0.764	0.817	0.883		
		TCC		0.904	0.906	0.913		
Income	Variance explained	Comfortable	453	24.75%	18.70%	12.12%	55.6%	0.82
		Less than comfortable	90	24.37%	21.08%	13.20%	58.7%	0.82
	Correlation			0.966	0.942	0.986		
		TCC		0.989	0.975	0.987		

loaded strongly against Young1/Old2, EduHigh2/EduLow3, and In-High3/IncLow3.

To evaluate whether food production is a more important motivational factor among people with lower incomes, we compared mean responses to the scale items after dividing the sample into those who have a comfortable income and those who do not. For the Chilean sample, there were no differences ($p > 0.05$) found between those who do have a comfortable income class ($N = 92$) and those who do not ($N = 75$) for any of the motivational items except for ‘Produce a large harvest’. This was a more important ($p = 0.023$) motivation for those with less income (mean = 1.22) than those with a comfortable income (mean = 1.84). For the Swiss sample, there were no differences found between people with a comfortable income ($N = 361$) and those without ($N = 15$) for any of the items.

5. Discussion

These results allow the conclusion that motivations to spend time in the garden are consistent in three dimensions across the two samples, with Chile1/Swiss1 appearing to represent a ‘restoration’ component, Chile2/Swiss2 a ‘food producing’ component, and Chile3/Swiss4 a ‘social’ component. The finding that these structures were virtually identical between the samples shows that these structures of motivations for gardening are fundamental and common to both the Chilean and Swiss samples and, remembering the demographic differences

between the samples, suggested they may also be consistent across gender, age, education level, and income. This suggestion of consistency of structure across each of these demographic variables was confirmed by the results of the comparison of the component structures when the PCAs were done for each subsample and then compared (Table 5). The consistency of the structure of responses between Chilean and Swiss samples reveals three dimensions that govern the relationship between urban residents and their domestic gardens: 'restoration', 'food outputs' and 'social interaction'. These results are in agreement with those of Lewis et al. (2018) who performed a qualitative study, based on interviews, and found that motivations for engaging in gardening activities could be classified under the dimensions of wellbeing, social aspects and outputs. Although our focus is somewhat broader in terms of understanding the relationship between residents and their gardens (i.e. it can include aesthetic appreciation, reflection, be in fresh air, play, etc.), the finding that motivations for gardening activities reflect the same dimensions that govern the motivations for spending time in the garden is not surprising. The activity of gardening is undertaken in every garden and performed (directly or not) to meet the aesthetic and practical goals of the manager of the garden.

The consistency of structure between the samples according to nationality, along with the results of the Mann-Whitney-U tests that found significant differences, in the same direction, between the Chilean and Swiss samples is evidence of a response style bias. We contend that cultural differences, combined with the differences in sampling methods, are likely to cause more, rather than fewer, differences in responses. Yet comparison of the component structures identified in the PCA of the scale responses were the same for both of the independent samples. In addition to providing evidence that the structures are independent of cultural context, it can also be seen as evidence that the sampling methods did not unduly bias the results.

The first component in the Chilean sample explained most (30.3%) of the variance and contained all of the items from Hartig et al. (1996)'s Perceived Restorativeness Scale. We therefore understand this component to represent 'restoration' as a motivational dimension for gardening. This result supports the findings of Lewis et al. (2018), who identified restoration as among the primary motivations for gardening. Three of these nine items: 'To be in the fresh air', 'A sensible activity', and 'To structure my everyday' loaded against a separate component (explaining 16.8% of the variance) in the Swiss sample, while the remaining six loaded against the first component (explaining 19% of the variance) which suggests that restoration is bi-dimensional in the Swiss sample. The item 'To be in the fresh air' was the item with the strongest agreement, while 'To structure my everyday' was the item with least agreement in the Swiss sample (Table 2). The first and third components for the Swiss sample cumulatively explain 33.2% of the variance, which provides strong evidence that restoration is an important motivational component for gardening.

Motivations related to the restoration dimension include performing physical and passive/experiential activities that provide wide benefits to human physical and mental health. This result is consistent with the findings of Dennis and James (2017) and Lin et al. (2018) who pointed out the wealth of research into correlations between personal health and environmental factors. Personal health is commonly expressed in terms such as reduced levels of morbidity, stress reduction, attention restoration, and increased social and physical activity (Dennis and James, 2017; Lin et al., 2018). Environmental factors are commonly expressed in terms such as living in proximity to green space and physical activity in nature (Dennis and James, 2017; Lin et al., 2018). Lin et al. (2018) further suggest that active experiences that arise from time physically spent in green spaces, which is typical behaviour of gardeners, can enhance the physical and mental health outcomes. On the other hand, Cameron et al. (2012) caution that generic links between health and green infrastructure have been found to be weak and dependent on factors such as the sample population studied and the nature of the 'green' activity undertaken. The consistency between the

rather different samples in this study, along with the activity under study: gardening, provide evidence that the motivation to achieve restoration outcomes is a major motivation for gardening that is culturally independent. The demographic comparisons further suggest that restoration, as a motivation for gardening, is also consistent across gender, age, education level, and income.

Items from the restoration component with the strongest agreement were those related to being away and fascination (Table 2). These suggest that the affinity to the nature in the green space provided by the garden contributes to a contrast to the everyday. The finding that these items received most agreement in both samples is in agreement with Wilson's (1993) Biophilia hypothesis, which suggests that a natural affinity with nature is part of the human condition. This result is also consistent with Kaplan and Kaplan's (1989)'s Attention Restoration Theory, suggesting that residents obtain mental restoration as a benefit when exposed to their gardens. In any case, the result that gardens provide an escape from the everyday where gardeners can be in the fresh air and experience the beauty of nature suggests that gardens contribute to the wellbeing of city dwellers who have access to such spaces.

The third component in the Chilean, and fourth component in the Swiss, samples (explaining 13.1 and 12.2% of the variance respectively) contained the 'social' items: "Children play" and "Spend time with friends", as might have been predicted by Lewis et al. (2018). The mean responses to items from this component (means between 2.25 and 2.81) indicated stronger agreement than for the food production items which suggests that the recreational role of urban gardens, represented by the restoration and social components, is more important than its role as a place of food production. The social component is different to the other components in that it is not strictly dependant on the interaction with the garden itself but rather that the garden provides a location for the activity.

The second component in the Chilean and third in the Swiss sample (explaining 16.8 and 14.2% of the variance respectively) was related to the tangible 'food outputs' and consisted of "Produce food", "Large harvest", and "To teach children about food". Although this component explained the second most variance, which supports Lewis et al.'s (2018) proposal that tangible outputs are a motivational component, the mean responses received among the lowest agreement for both groups. This suggests that food production is the least important motivation for these samples.

The third component in the Swiss sample consisted of the items: 'structure my everyday', 'learn about nature' and 'perform a sensible activity', and does not appear to have a corresponding component in the Chilean sample as these items are included in the 'restoration' component. This suggests that Swiss respondents see these items as a separate dimension from the rest of the items that make up the 'restoration' dimension. A possible explanation is related to the protestant work ethic in which busyness and lack of leisure time are considered to be an indication of status (Bellezza et al., 2016). Zweimüller (2018) pointed out that such a work ethic is strong and observable in Switzerland, which might lead to Swiss respondents perceiving an obligation to feel as if they are achieving: even when performing their voluntary 'restoration' activities. Chilean gardeners, on the other hand, might be better able to separate their work and leisure activities. These same three items: 'structure my everyday', 'learn about nature' and 'perform a sensible activity', also loaded against a component in the sample of female respondents that did not have a corresponding component in the sample of male correspondents. Again, these items were included within the restoration component by the male respondents, which suggests a merging of work and restoration by female gardeners. It is conceivable that women might also see gardening as having a work component: inextricably tied to learning, sensible activities and everyday structures. Women in most cultures are typically left with the majority of work in the household (Luxton, 2017), which includes the house garden. The other subsample in which this difference was found

was with the division according to education level in which respondents with lower education levels made a similar distinction between restorative motivations and motivations with a work component. This difference might be explained by people with lower education working in physically demanding jobs, so the gardening has a work component tied to sensible activities and everyday structures. Respondents with higher levels of education might work in less physically demanding jobs, so the work in the gardens is perceived as a restorative, rather than as a sensible activity. An absence of data about the type of work undertaken by respondents however means that this explanation could not be tested in this study so remains a challenge for future research.

Cameron et al. (2012), in their review of domestic gardens' contribution to urban green infrastructure, noted that several authors have suggested that the relationship of people with nature that arises from their interaction with domestic gardens is context dependent. For example, the result that Chilean respondents with less comfortable incomes placed more importance on generating a large harvest supports Orsini et al.'s (2013) proposition that urban gardens play a role in food security for the least affluent. Cameron et al. (2012) point out that food production is a major motivation for gardening during periods of economic austerity, and especially when food prices are high. Furthermore, recent arrivals and less wealthy residents in urban environments may see their gardens primarily as a means for providing their preferred food while wealthier gardeners may be motivated by the privacy and security provided by a domestic garden (Cameron et al., 2012). The results of this study however are counter to the arguments of Cameron et al. (2012) by providing evidence that have suggested that at least some dimensions of the relationship between people and nature that arises from their interaction with domestic gardens is a human condition that is independent of context. We acknowledge that cities are not culturally homogeneous, which is illustrated by 27% of the population of Temuco considering themselves as ethnic Mapuche, which allows question of whether being a citizen of a country is a reliable indicator of culture. However, the different dimensions of the motivations for spending time in gardens were found to be consistent between cities from different continents that are different in terms of historical background and cultural context, and are especially different in terms of socioeconomic aspects. These similarities were also found when comparing responses from samples divided according to demographic variables. Although attitudes to gardens *per se* may vary, this study has shown that motivations for gardening stem from outcomes that have universal appeal and demonstrate similarities between cultures, genders, ages, education levels and income.

6. Conclusions

The first aim of this study was to identify and evaluate the motivations of urban residents to engage in gardening. The 'motivations for gardening' scale that was used in this study appears to be a useful tool in evaluating motivations for gardeners. The scale reliability was found to be exceptionally high with scale items that were readily translatable and able to be understood by respondents from different cultures. The results were consistent with the qualitative results of Lewis et al. (2018) who cautioned that their results were based on a small and local sample, and therefore called for further quantitative study. The results of this study can be seen as confirmatory to those of Lewis et al. (2018): that restoration is the most important motivation, followed by social motivations, and then food production. These results also support the findings of Cervinka et al. (2016) who found that domestic gardens are among the most important places within a city for restoration. This suggests that, in the two samples, gardening can be primarily considered as a recreational activity rather than means of contributing to food security. They are also consistent with the findings of Winkler et al. (2019) who, in their study of German urban gardeners, included the experience of nature and spending (free) time meaningfully as motivations for gardening, while some are motivated by food self-

sufficiency.

The second aim of this study was to evaluate whether the motivations for urban residents to engage in gardening are contextual or whether they represent a human condition that is independent of context. Therefore, the study looked at responses from two different national cultures and compared responses across gender, age, education level, and income. The results of the Mann-Whitney-U tests for differences between independent samples found significant differences between the Chilean and Swiss samples, while the tests for equivalence of the structures using PCA and Tucker's congruence coefficients found that the structures were close to identical. These results combine to suggest that a response style bias indeed exists and that the uniformly stronger responses from the Chilean sample are artefacts of this bias rather than representing a substantive cross-cultural difference. There is no clear way of addressing this bias, other than simply to acknowledge that it exists. It does not however have any bearing on the findings of the equivalence of the structures and remarkable consistencies in the structures of responses were indeed found when the sample was divided by either nationality or the demographic variables: gender, age, education level, and income. These findings therefore do not support the conclusions of Ruggeri et al. (2016) who found that individual gardeners' motivations can be heavily affected by the local context. However, although the equivalence can be seen as evidence that motivations for gardening are common to urban dwellers, it is not proof and differences might have been found if urban dwellers from other cultures had been examined. It will be the challenge of future trans-cultural study in other contexts, and especially those further from Western culture to confirm whether the motivations to engage in gardening are indeed universal.

The role of gardening in restoration, and especially in providing places to escape the everyday, their social function, and their contribution to food security in times of need suggests that gardens can provide an important path to well-being of urban residents. The consistency of these findings, across both cultural context and a range of demographic variables including gender, age, education level and income, provides evidence that they are indeed contextually independent, which suggests that motivations for gardening represent an inherent human condition that frames how gardeners manage and interact with their gardens. Acknowledgement of these human needs: especially regarding the restoration benefits that people gain from these spaces, in public policies related to management and regulation of green urban areas has the potential to contribute to the survival of urban gardens.

CRedit authorship contribution statement

Robert Home: Conceptualization, Methodology, Validation, Formal analysis, Investigation, Resources, Data curation, Writing - original draft, Writing - review & editing, Visualization, Project administration, Funding acquisition. **Lorena Vieli:** Conceptualization, Methodology, Validation, Formal analysis, Investigation, Resources, Data curation, Writing - original draft, Writing - review & editing, Visualization, Project administration, Funding acquisition.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

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