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Multicultural gardeners and park users benefit from and attach diverse values to urban nature spaces

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ABSTRACT

Cities across the world increasingly reflect the ethno-cultural diversity of a globalized society. How people interact with, and experience urban nature varies with the form, structure, and function of the space, but also with peoples' ethno-cultural identity. In this study, we investigated the values that gardeners and park users of different ethno-cultural identities associate with urban community gardens, parks and trees and the well-being benefits that they derive from them in Melbourne, Australia. We collected data from park users, and gardeners using intercept questionnaires with open-ended questions about motivations to garden and the importance of parks and trees to understand values, and standardized metrics on personal well-being to understand well-being benefits. The results show that gardeners and park users of different ethno-cultural identities than Australian and European, derived from the country of birth, language spoken, and region of origin, associate different motivations, importance, and well-being benefits to these different urban nature spaces. Community gardens provide food and a strong sense of community and security, particularly for gardeners that speak English as a second language. For these ethno-culturally diverse people, urban parks, like community gardens, are associated with sociocultural and psychological importance, but also with aesthetic importance. Finally, and also for these diverse people, urban trees are associated with aesthetic, naturalness and biodiversity importance rather than sociocultural importance. The results highlight that people involved in the planning and design of urban nature spaces should consider the many values associated with and benefits derived from different types of spaces for multicultural cities.

1. Introduction

Urban areas are growing in population and land area. As urban life becomes custom for a majority of the world's population (UN-Habitat, 2016), city governments are increasing urban greening efforts to improve the well-being of urban residents (Nesshöver et al., 2017; Tzoulas et al., 2007; UN-Habitat, 2017). Urban nature comes in various forms, including gardens, parks, and forest remnants, and is characterized and distinguished by various elements, including plants, rivers, and animals (de Vries et al., 2003; Kowarik, 2011). Such forms of urban nature or "urban green" are a significant medium of human-nature interactions and for human well-being improvements (Taylor et al., 2018); for many, contact with forms of urban nature may even be more frequent than with rural natural areas (Cox et al., 2017). The benefits of contact

with urban nature are plenty, including improving health outcomes and human well-being by stimulating physical activity and positive emotions (Hanski et al., 2012; Hartig et al., 2014, 2011; Rook, 2013; Taylor et al., 2018). A variety of external and internal factors may contribute to the benefits that humans can derive from urban nature, ranging from: enhanced security, access to basic resources, health, good social relations, and freedom of choice (Millennium Ecosystem Assessment, 2005); community involvement and identity, lifestyle, and socio-economic circumstance (WHO, 1998); and emotional and cognitive states (Davern et al., 2007).

People's identity can, in part, explain their relationship to urban nature – e.g., their uses of urban natural spaces, the benefits and ideas they associate with it – and the benefits they derive from it, including ethno-cultural identity (Fischer et al., 2018b; Jay and Schraml, 2009;

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Ordóñez-Barona, 2017). Ethno-cultural identity broadly relates to the ethnic, racial, language, religion, political beliefs, values, and national history of populations (Gelfand et al., 2011; Taylor, 1994). Recent studies have shown how peoples' ethno-cultural identity and geographical contexts influence their view of (i.e., attitudes towards, preferences of) and engagement with (i.e., frequency and type of use of natural spaces) urban nature (Fischer et al., 2018a, 2018b), but that such studies investigating human-nature relationships and multicultural citizenship are underrepresented (Botzat et al., 2016; Jay and Schraml, 2014). These findings highlight the necessity of an inclusive and culturally sensitive urban greening research and planning agenda for increasingly multicultural cities. Also, this calls for more evidence of how people of different ethno-cultural identities value urban nature and how they derive benefits from its multiple forms.

This work responds to this need by exploring how residents of different ethno-cultural identities in a multicultural city value and associate well-being benefits from three common forms of urban nature that vary in their ecological context and social purpose or use (community gardens, parks, and trees). In this study, we: (1) provide a theoretical background on human-nature relationships and multicultural citizenship; (2) discuss a case study in Melbourne, Australia that investigates how gardeners and park users of diverse backgrounds value and associate well-being benefits from community gardens, parks and trees; and (3) draw implications of this work for improving our understanding of how forms of urban nature spaces are important to residents of diverse backgrounds.

1.1. *The role of multicultural citizenship in relation to values and derived benefits from urban nature spaces*

Growing multiculturalism in cities across the world (Qadeer, 2016) requires a better understanding of how ethnicity and culture play a role in the urban nature experience to guide urban planning and resource management (Burayidi, 2000). Culture can be broadly defined as a common system of symbols (e.g., language) and values (e.g., religion) of a given group of people (Taylor, 1994). Ethnicity can be broadly defined as a social boundary that defines inclusion to a particular group of people based on shared cultural and physical (e.g., racial) characteristics (Amin, 2002). In this paper, we use the terms "ethno-cultural" to emphasize the cultural aspect behind people's ethnic diversity or identity. We consider multiculturalism as the socio-political condition and principle that acknowledges and accommodates ethno-cultural identities and their differences and aims for common ground in language and public values (Kymlicka, 2007).

The relationship between ethno-cultural identity and urban nature can be understood in many ways. This includes how different ethno-cultural groups use urban nature (Payne et al., 2002; Sasidharan et al., 2005; Tinsley et al., 2002); prefer biodiversity within urban nature spaces (Fischer et al., 2018b); derive benefits from interacting with urban nature (Sasidharan et al., 2005; Seeland et al., 2008; Tinsley et al., 2002); and assign values to elements within urban nature spaces (Hordyk et al., 2015; Jay and Schraml, 2014; Kendal et al., 2010; Main, 2013; Ordóñez-Barona, 2017). Relevant in this study is the idea that the relationship between ethno-cultural identity and urban nature is better understood not by focusing on what people prefer in urban nature, but on how people value urban nature and derive benefits from it according to their ethno-cultural background (Byrne, 2012; Jay and Schraml, 2009; Kendal et al., 2010; Ordóñez-Barona, 2017; Spartz and Shaw, 2011; Wynveen et al., 2010). Collectively, this informs our understanding of people's values, motivations, and the management of urban nature (Ives and Kendal, 2014). In addition, it adds value to the notion that nature in cities provides both ecological and cultural services (Vierikko et al., 2016).

Yet exploring how different ethno-cultural groups value and derive benefits from urban nature spaces is complicated because: (1) interpretations of what constitutes an ethno-cultural group varies with

context; and (2) how people of different ethno-cultural identities relate to urban nature differs by group (Dinnie et al., 2013; Peters et al., 2016a; Rishbeth, 2004), and by different physical forms of urban nature spaces that vary in ecological context and social purpose (Peters et al., 2010). To the first complexity, in the US, racial difference (i.e. "Black," "Latino," "Asian," "White", etc.) is often the explanatory factor driving urban nature use, preferences and derived benefits among different people (Byrne and Wolch, 2009; Gobster, 2002); yet, in Europe these differences are often described in terms of immigrant and citizenship background (e.g., Kloek et al., 2018). Some insightful European studies explore regional cultural variation, like those between Germanic and Mediterranean cultures (Fischer et al., 2018a), or classify ethno-cultural identities by the level of income of their nationality (Lindemann-Matthies, 2017). A person can culturally identify unbounded by the confines of formal definitions (e.g., transnational identities; see Veronis, 2015), segmenting patterns even further between age group and migration histories within cultural groups. Nonetheless, it is essential to ground the interpretation of what constitutes an ethno-cultural group in context (Qadeer, 2016).

To the second complexity, different physical forms of urban nature spaces (e.g., gardens, parks, and forests) are ecologically and socially important at different scales (Taylor and Hochuli, 2015). For example, home gardens in cities may be important at the scale of the individual, and various immigrant groups may create meaningful home gardens by growing food plants less accessible at the store (Taylor et al., 2016) or by practicing cultural rituals and traditions (Mazumdar and Mazumdar, 2012). On the other hand, community allotment gardens in cities may be important at the scale of a group because collective crop cultivation can facilitate social belonging and knowledge exchange through a shared language (Corlett et al., 2003; Kingsley et al., 2009; Krasny and Tidball, 2009). Different management between scales may in turn shape the biodiversity and ecological functioning of the ecosystem (Tresch et al., 2018). In urban parks and forests in the US context, Whites may value urban nature as a space for active engagement such as jogging or hiking whereas Latinos in the US may value urban nature as a social space for social gatherings and family celebrations (Byrne, 2012). To aid the understanding, planning and management of more inclusive and culturally sensitive urban greening, it is necessary to further explore the relationships of residents of different ethno-cultural identities to different forms of urban nature spaces because people often interact with multiple forms of urban nature over time and space.

There are few studies about how citizens of different ethno-cultural identities value urban nature that compare different forms of urban nature and different ethno-cultural identity groupings. Most work has focused on either one ethno-cultural group (e.g. Latinos; see Byrne, 2012; Asian immigrant population; see Corlett et al., 2003; Turkish and eastern European immigrants in Europe; see Jay and Schraml, 2009; 2014), one specific form of urban nature spaces (e.g., a single park; see Hordyk et al., 2015; Main, 2013; Neal et al., 2015) or garden (Mourão et al., 2019; Rishbeth, 2004); urban forests and trees (see Ordóñez, 2017)), or just one category of cultural identity (e.g., immigrant vs non-immigrant defined through citizenship status; see Kloek et al., 2018). Although what defines a cultural group is context-dependent, people's diversity is not monolithic; there is a variability among people who are classified equally under one ethno-cultural distinction (Gentin, 2011). More studies that compare urban nature-related values and benefits of many cultural groups and for many different forms of urban nature are needed to better understand the relationship between multicultural citizenship and forms of urban nature because evidence remains thin across many cultural or geographic contexts.

1.2. *Understanding the diverse values and derived benefits of diverse people in multicultural cities: the case of Melbourne, Australia*

The Greater Metropolitan Area of Melbourne (henceforth "Melbourne"; 37.49 S, 144.58 E) has the largest and fastest growing

population in Australia with approximately 4.9 million residents (2.7% growth from 2016 to 2017) (Australian Bureau of Statistics, 2018). Melbourne is one of the most multicultural cities in the world. In the Australian context, multicultural citizenship is characterized by several dimensions, including born in Australia, speaker of a second language other than English (excluding aboriginal Australian languages), the region of origin, and language (Australian Bureau of Statistics, 2016a). These dimensions aim to differentiate European from non-European migrants for immigration control and nation-building purposes (Walsh, 2008). About 40% of residents across Melbourne's 32 local government authorities were not born in Australia, and most speak another language other than English (Australian Bureau of Statistics, 2016a). In the central area of Melbourne alone, mostly comprised of the City of Melbourne local government authority, 48% of the residents were born overseas, and 38% of residents speak languages other than English at home according to the area's 2013 Multicultural Community Demographic Profile. Significant populations in this area include residents born in China (8%), Malaysia (5%), India (3%), Indonesia (3%), and England (3%) (City of Melbourne, 2013). The local government authorities of Melbourne are also currently coordinating efforts of urban-tree-canopy enhancement and tree planting through a metropolitan urban forest strategy (2020Vision Australia, 2019). Other issues of priority in the green agenda of Melbourne include the multifunctionality of urban green spaces including public parks, urban forests, and gardens (Ives et al., 2013). Thus, Melbourne provides an ideal system to explore how multicultural citizenship plays a role in values and derived benefits of forms of urban nature, with practical implications for inclusive urban greening efforts.

In this study, we explore how people of different ethno-cultural backgrounds value and derive benefit from three forms of urban nature. We use reported motivations to community garden and the importance of urban parks and trees to park users as measures of people's values. We use the Personal Well-being Index (PWI) as a measurement of derived well-being benefits. Guided by an ethno-cultural identity lens, we present three case studies on urban community gardens, parks, and trees that differ in their ecological characteristics (e.g. biodiversity, ecosystem structure) and thus hypothesized social engagement. We asked: 1) how do gardeners and park users of different ethno-cultural identities differ in the motivations and importance (i.e., indicating values) that they assign to community gardens, parks, and trees?; 2) how do gardeners and park users of different ethno-cultural identities differ in how they experience well-being in community gardens and parks?; and 3) are there similarities and differences in responses across these forms of urban nature? We asked these questions using an intercept questionnaire that utilized open-ended questions on motivations to garden and the importance of parks and trees and the PWI to measure how a person experiences well-being. We grouped gardeners and park users in ethno-cultural groups according to established Australian procedures (i.e., English and English as a Second Language (ESL) speaker; Australian and foreign-born; and Australian, European, and other non-Australian and non-European groups). Reported motivations to garden are used in the urban gardening literature as an indicator of values (Kirkpatrick and Davison, 2018; Kortright and Wakefield, 2011), while importance of a park to a visitor is used in the urban park literature as indicator of values (Ives et al., 2017), recognizing their limitations in predicting green space use. The PWI is useful as a measure of derived subjective well-being, as it is an instrument designed to understand peoples' subjective satisfaction with different life domains (e.g., health, safety), otherwise known as their subjective well-being (SWB) (Cummins et al., 2002; Davern et al., 2007). SWB is a relatively stable homeostatic construct that captures the emotional and cognitive states of people in a particular moment in time (Diener et al., 2003), and depends on people's circumstance and subjective experience of their lives (Cummins et al., 2002), although it is reasonably consistent across cultures (Diener et al., 2003). Thus the PWI can be useful to understand people's emotional states and as an indicator associated

with the environment in which people live (Villanueva et al., 2015) and can connect the environmental conditions of cities, especially those mediated by urban nature, with a complete model of psychological health (Coutts and Taylor, 2011). In the green space context, validated psychological measures of subjective well-being, such as PWI are often not used (Foo, 2016; Laforteza et al., 2009), although there is need for doing so to increase comparability across studies (Pedersen et al., 2019) and to strategize policy intervention (Davern, 2016). We use this approach to (1) provide a comparable way to improve understanding of the importance of community gardens, parks, and trees by gardeners and park users of different ethno-cultural identities; and to (2) inform inclusive planning and design of cities representative of contemporary multicultural cities.

2. Methods

2.1. Description of case studies in Melbourne, Victoria, Australia

The urban community gardens, parks, and trees in this study were each part of a more extensive study to examine the relationship between gardening and climate change and the effect of tree removal on park ecology and use (Egerer et al. 2019). For this study, we draw from the gardeners' and park users' responses on values (motivations, importance), subjective well-being, and ethno-cultural identity.

2.1.1. Urban community gardens in Melbourne

We studied 11 community gardens and their gardeners across six of the 32 local government authorities of Melbourne (Fig. 1). A form of urban agriculture, these community gardens are defined as "generally not-for-profit, local spaces that operate on designated land for residents and volunteers to grow fresh food, participate in sustainable urban practices, improve food literacy, learn horticultural skills, build community connections through shared activities, as well as enjoy the good harvest together" (City of Melbourne, 2018). Community gardens are encouraged as a form of community engagement and environmental sustainability by Melbourne's Community Garden Policy (City of Melbourne, 2018). The Policy supports access to land, funding support for management and establishment, and may assist with locating areas for community garden establishment.

We selected the community gardens for this study based on the criteria that they were community allotment gardens in which individuals or households lease and manage their plots. The community gardens are overseen by local government authorities and are locally managed by committees of gardeners. The community gardens studied are six to 38 years old, are from 584 to 6801 m² in size, and have 25 to 124 allotment plots. The gardens range in the species of crops grown and in how gardeners manage their plots.

2.1.2. Urban forests and parks in Melbourne

We studied five public urban parks, their trees and their users in central areas of Greater Melbourne, within the boundaries of two local government authorities: 1) City of Melbourne, which includes the central business district and has a population of 160,000; and 2) City of Yarra, a mixed commercial and residential area with a population of 86,657 (Australian Bureau of Statistics, 2018). The parks included University, Argyle, Darling, Macarthur, and Curtain Squares (Fig. 1). The urban forest in this area is dominated by a few dominant exotic European tree species, such as English Elms (*Ulmus procera* and/or *minor*) and London planes (*Platanus x acerifolia*), which are approximately 10% to 12% of all trees in both cities (City of Melbourne, 2012; City of Yarra, 2017). Both Melbourne and Yarra have ambitious plans for urban forest renewal and for implementing well-resourced urban forest precincts (Gulrud et al., 2018). This includes an overall target of increasing tree-canopy cover from 21% to 40% in publicly managed spaces by 2040 for Melbourne (City of Melbourne, 2012), and from 17% to 20.25% for Yarra (City of Yarra, 2017).

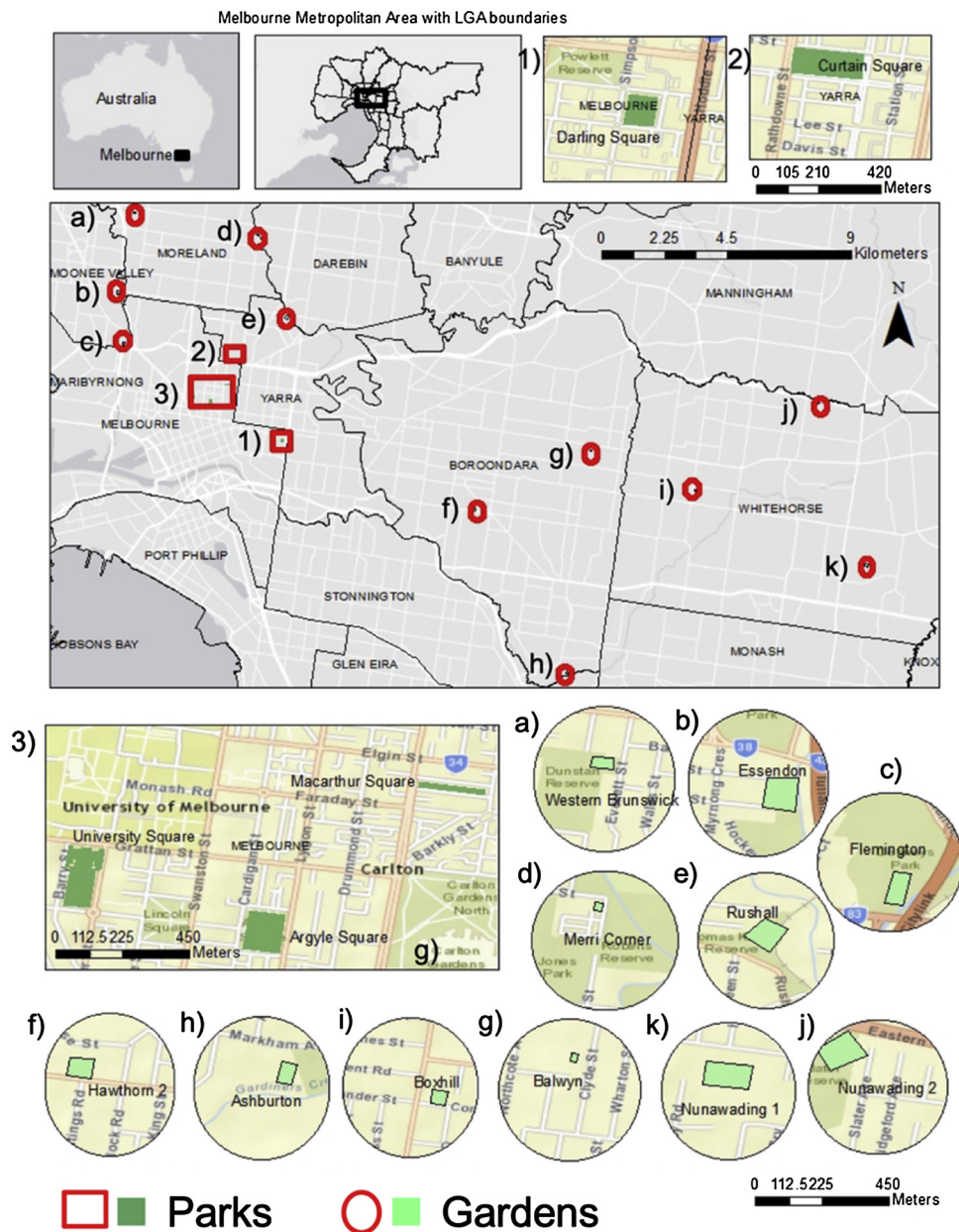


Fig. 1. Spatial distribution of parks and community gardens across the Melbourne Metropolitan Area. The parks sampled in the study include: (1) Darling Square; (2) Curtain Square; (3) University Square and Argyle Square. The gardens sampled in the study shown in (a–j) within their local government authority context (black outlines in map). Green shading relates to size of the park or community garden (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article).

The parks were selected for this study based on size (~20,000 m² each), location (< 2 km from the city center), access (all public and within commercial areas), and similitude in arrangement (a few trees with significant lawn spaces) and tree populations (dominated by mature > 50-year-old *Ulmus* spp. with a few other species). The first four parks are managed by the City of Melbourne government authority, while Curtain Square is managed by the City of Yarra government authority (hence the provided context for both areas). In our study, we chose to separately consider urban parks and urban trees because parks may not necessarily have trees, and urban trees can be considered outside of a park context in the urban forestry and urban greening field.

2.2. Data sources and collection

In the selected community gardens and the urban parks, we used intercept questionnaires based on a convenience recruitment sampling

(i.e., non-probabilistic sampling) with adult gardeners and park users to collect information on: (1) the importance of parks and trees to measure values; (2) the motivations to use community gardens to measure values; (3) subjective well-being associated with community gardens and parks; and (4) demographic information. We employed the intercept questionnaire method because it is based on non-selective recruitment and is common in social-science urban park research (Veitch et al., 2018; Zhai and Baran, 2017). The method is useful because it allows researchers to gain quick access to people’s information in direct contact with their surroundings (e.g., when contact with urban nature is occurring, not remembered or imagined (Veitch et al., 2018). In addition, the method garners a reliable sample size of park users when it is systematically delivered (Veitch et al., 2015), and it provides information about urban nature when it is designed around an urban nature form or element (e.g., forests and trees instead of nature in general; see Ordóñez et al., 2016). We describe the questionnaire design

Table 1

The three main data components of each of the questionnaires distributed to park users and gardeners that were analyzed in the study.

| Data component | Aim | Variables | Method |
|-------------------------------------|-------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|
| 1. Demographic information | To collect information on cultural identity according to the Australian criteria/ context | Whether born in Australia; whether they speak another language besides English Region of origin; language spoken at home; occupation Level of education (technical, undergraduate, postgraduate, PhD); gender (male/female/other) | Binary yes/no Open-ended, in own words Choice of items |
| 2. Values (motivations, importance) | To collect information on values associated with community gardens and urban parks | What motivates gardeners to participate in urban gardening (gardens only); why are urban parks and urban trees important (parks only) | Open-ended, in own words (3 responses allowed) |
| 3. Subjective well-being | To collect information on the gardener ¹ or park user's subjective well-being | Satisfaction across seven well-being domains that collectively contribute to overall life satisfaction: health, personal relationships, safety, standard of living, achievements, community connectedness, and future security | Likert-based SWB scale ratings for adults (PWI-A) (Davern, 2016; International Wellbeing Group, 2013) ² |

¹ On the gardener questionnaire, the question specifically asked how much gardening positively contributed to their well-being in those seven well-being domains.

² The answers to the seven domains were used to calculate a psychometric index value for each respondent to represent subjective well-being.

and the data collection protocol in the community gardens and parks below.

2.2.1. Questionnaire design

The questionnaires included three main components designed to collect information on ethno-cultural identity, values (motivations or importance), and subjective well-being of gardeners and park users (Table 1). The questionnaire format was structured differently for the gardeners and park users, but both questionnaires had the same data components designed together by the authors. Both questionnaires were designed to take under 10 min. Answers to the questions in the garden were recorded on the questionnaire by the researchers or the gardeners; answers to the questions in the parks were recorded by the researcher. Face-to-face interactions between researcher and participants have the potential for social desirability bias (Hay, 2010), however we aimed to minimize this bias through the use of a structured questionnaire, in contrast to semi-structured interview techniques that depend on a negotiated process of knowledge co-creation between researcher and participant (Hay, 2010; Creswell and Poth, 2017). One difference between the gardener and the park user questionnaires was the inability for the park intercepts to gather responses on the geographical region of origin. A pilot run of the park questionnaire (N = 25) found that respondents were unwilling to answer this question, as they found it intrusive, in contrast to the gardeners. This question was removed from the final park questionnaire and gathered using other related responses (see 2.3.1).

2.2.2. Participant selection and recruitment

In the community gardens, the questionnaire was given in paper format by the researchers and garden managers opportunistically during regular garden work days and through weekly convenience sampling from December 31, 2017 – February 28, 2018. For gardeners that we did not reach through in-person sampling, a digital copy of the questionnaire was sent to gardeners by the garden managers to the community garden e-mail list. The questionnaire was administered in English (easy language, ~6-grade level), and professional translators or other garden members assisted with questionnaire distribution for non-English speakers including in Mandarin, Turkish and Tigrinya languages. Language barriers may nonetheless have prevented more ESL gardeners from participating in the questionnaire, or some of the questions may have been misunderstood by ESL gardeners, even if translators were present for gardeners to participate. Gardeners received a pack of seeds in gratitude for their participation. Our aim to reach all ~700 gardeners (estimated by reported total gardeners from managers) was limited by language (English), time constraints, and the temporal aspect of community garden use that may affect responses.

In the urban parks, the questionnaire aimed to collect data from regular park users. Researchers delivered the questionnaire to park

users orally using GoogleForms® via Smartphone and iPad between January and July 2018 to systematically account for variability in weather (i.e., Summer, Fall, and Winter, before and after leaf fall in the Southern Hemisphere) and visitor density (i.e., because of day and time). Because park user visitation may be influenced by a lot of factors, we followed protocols used in previous research to systematize park observations (e.g., SOPARC tool; (McKenzie and Cohen, 2006); for examples see (McDonald and Price, 2009; Sreetheran, 2017). We delivered questionnaires in 1 h intervals in the morning (8:00-10:00), noon (11:30-13:30), and afternoon (16:00-18:00), on Tuesdays, Wednesdays, Thursdays, and Saturdays (no morning hours on Saturdays), and recorded all intercepted park users to estimate response rates. We chose this protocol to achieve a more standardized questionnaire delivery and to account for variation in park visitation due to the following factors. We avoided Mondays, Fridays, and Sundays because the parks that we studied are in central areas that are visited mostly in the weekdays by people working in the city, in contrast to Melbourne's bigger Metropolitan parks that are visited mostly on the weekend by tourists (Veitch et al., 2018). Therefore, we avoided national holidays and business closures. The parks in this study also have little parking, a factor that has been shown to affect weekend park usage for Melbourne residents (McDonald and Price, 2009; Shores and West, 2010), thus standardizing this factor of influence. Overall, the goal of using this protocol was to achieve reliability in delivery and representativeness of day-to-day regular park users, and to account for as many factors as possible that affect park user visitation. Two researchers were present at all times during delivery and each coordinated their responses to spend the same amount of time at each park in terms of the number of 1 h intervals and time of day (morning, noon, afternoon), and to achieve at least > 25 responses per season (Summer, Fall, Winter) per park. The park questionnaire was limited to English due to the requirements of oral delivery and interception.

2.3. Data analysis

2.3.1. Data preparation

We reviewed, cleaned and quality checked the questionnaire data of gardeners and park users for the analysis. This resulted in 185 gardener questionnaires and 379 park user questionnaires. For the open-ended verbatim responses (gardener motivations, park user assigned importance), we coded responses using interpretative, inductive coding grounded in the data (Appendix 1). We used this method because assigning pre-determined codes, a common technique in inductive content analysis (Krippendorff, 2018), would have resulted in data insensitivity (i.e., forcing codes upon intended or assumed meaning). Here we coded verbatim responses into themes and units of meaning (Corbin and Strauss, 2015), allowing for three codes per open-ended response. We coded the open-ended responses at two levels: a specific

Table 2

Examples of individual verbatim responses to survey questionnaire questions used in the study and how responses to these questions were coded and then put into thematic clusters of codes. The codes and their clusters were used to analyse: 1) gardener open-ended responses to the question “why do you garden?” (a); 2) park users stated reason of why the park is important to them (indicating why they visit the park) (b); and 3) park users stated reason of why trees are important (c). Both responses reported in verbatim. An asterisk (*) indicates clusters that were only used for the gardener’s motivations.

| Survey Question | Respondent’s verbatim response | Codes | Clusters |
|------------------------------------------|------------------------------------------------------------------------------------|-------------------------------------------------|-------------------------------------------------|
| a) <i>Why do you garden [here]?</i> | “I enjoy growing vegetables and herbs. It’s good for body and mind. Good exercise” | Food provision Feel good Exercise | Food provision* Psychological Health |
| b) <i>Why is this park important?</i> | “Not good backyard. Close to home” | No backyard Close by No response | Sociocultural Sociocultural No response |
| c) <i>Why are these trees important?</i> | “Good for the environment. Get sticks for kids to play as toys. Good shade” | Environmental quality Children play Shade | Environmental Sociocultural Environmental |

code and a higher-level cluster (Appendix 1; Table 2). We then aggregated the clusters associated with the three responses for each gardener and park user questionnaire. The cluster of “food provision” was absent in the park user data, yet all the other clusters were the same for community gardens, parks, and trees. We clustered codes mentioned fewer than ten times as “other”.

For the well-being responses, we followed the guidelines established by the International Wellbeing Group (IWG, 2013) to handle PWI-A data. Following Davern et al. (2007), we converted the one to five ratings of the metric into a zero to 100 scale following the formula:

$$\frac{X - K^{min}}{K^{max} - K^{min}} \times 100$$

X is the well-being response value converted (values one to five)

K^{min} is the minimum value in the scale (one)

K^{max} is the maximum value (five)

We eliminated average values of zero to avoid response bias (Capic et al., 2015), but retained average values of 100. This resulted in a PWI well-being index score (PWI-A) for each respondent that encapsulates their responses to the seven well-being domains. We confirmed the construct validity of the SWB metric according to IWG using regression analysis (IWG, 2013). The partial coefficient contributions of each component to the response variable were squared to calculate their unique and shared contributions, established at 14% and 37%, respectively, as based on PWI-A Australian data (IWG, 2013). The construct validity of the data is comparable to national (Australian) standards, and we report the results of these analyses for reference in Appendix 2.

For the demographic responses, we developed a classification technique to derive geographical region of origin of gardeners and park users. We classified respondents by (1) language spoken (English vs. ESL); (2) Australian born (Australia vs. other); and (3) Australian, European, and Non-Australian/Non-European. These classification groupings allowed us to statistically compare responses across questionnaires by overcoming low responses in some language groups (e.g., African languages, such as Zulu, were only spoken by four respondents). Also, these classifications are consistent with Australian demographic classifications (Australian Bureau of Statistics, 2016a) and with other Australian studies (e.g., Morgan et al., 2005) while still being comparable to European studies on multicultural citizenship and urban green space (Buijs et al., 2009; Gentin, 2011; Kloek et al., 2017; Peters et al., 2016b, 2010). In our cases in the Australian context, the differences between Australian/European/Non-European are more important than that between, for example, Greeks and Italians.

Furthermore, the classification provided a broader way to look at differences based on ethnicity and not just cultural practices. For the classification, the self-reported geographical region of origin and language spoken was used in the gardeners’ dataset. Three sources were used in the park user datasets given the inability for park users to identify their geographical region of origin: self-identified ESL speaker and language spoken, and whether Australian born. Using these data, we classified respondents as Australian, European, and Non-Australian/Non-European. In most cases, a respondent’s region of origin or language spoken provided us with the information to assign the classification (e.g., Italian speakers become European; Mandarin speakers become East Asian, then become Non-Australian/Non-European).

One limitation of the classification was classifying respondents of Latin-American origin (i.e., most common languages spoken: Portuguese and Spanish) as European, but this maintained consistency in the classification. In some cases, gardeners and park users identified two or more languages spoken. While we recorded all of their answers, for the garden data, we selected the language that is spoken in the reported region of origin for the analysis (i.e., if the gardener’s region of origin was Italy but they spoke Italian and Russian, we chose Italian). In one case, the region of origin was Australia; here we used the first language the gardener reported. In the case of the park users, only the first response was used for analysis. When a region of origin or language spoken were missing, the data were classified either as: (1) missing (i.e., NA); (2) Australian if Australian born without another language; or (3) unknown if non-Australian born without another language. We committed these unknowns and NAs ($N = 56$) from the dataset to analyze common themes in motivations and importance of garden and parks across these classifications, as explained below.

2.3.2. Data analyses

We used multivariate analyses to determine whether gardeners and park users of different cultural identities (language group, region of origin group) differ in their motivations to garden and the importance that they assign to parks and trees. First, we tested for differences in the means of cluster frequency using a Welch Two Sample t -test for gardener motivations or park and tree importance by language group (English vs. ESL) and region of origin group (Australia vs. other). Second, we used a constrained redundancy analysis (RDA) to emphasize variation in the combination of clusters for community gardens and parks with binary responses (0 or 1) among respondents of different language groups and region of origins. We tested for significant differences in combinations of clusters between language groups and region of origin groups in each analysis using Analysis of Dissimilarity tests (ADONIS), and permutations were constrained by garden site ($n = 11$) or park site ($n = 5$) in the models with significance at $\alpha = 0.05$.

We used multiple regression analysis and an unconstrained non-multidimensional scaling (NMDS) model to test whether gardeners and park users of different ethno-cultural identities (language group; region of origin) differ in their reported well-being index scores. We used a one-way Analysis of Variance (ANOVA) with Tukey’s Honestly Significant Difference (HSD) test (significance at $\alpha = 0.05$) to test for mean differences in each of the well-being index scores and for the calculated mean score in the R statistical environment (v. 3.4.4) (R Development Core Team, 2016). The NMDS model was used to determine gradients of maximum variation in the combination of reported well-being values by respondent language groups and region of origin. We tested for significant differences in the combinations of responses between language groups and region of origin groups in each analysis using ADONIS and permutations were constrained by garden site ($n = 11$) or park site ($n = 5$) in the models with significance at $\alpha = 0.05$.

To determine whether there are similarities and differences in responses across these forms of urban nature, we evaluated the distribution of clusters (motivations of gardeners, importance to park

Table 3

The number (N) of gardeners (of N = 189 total) and park users (of N = 379 total) that responded to the questionnaire for each self-reported socio-demographic characteristic.

| Socio-demographic characteristics from questionnaire (self-reported) | Gardeners (N) | Park users (N) |
|----------------------------------------------------------------------|---------------|----------------|
| Total questionnaire respondents (N) | 189 | 379 |
| Number of nations of origin | 27 | NA |
| Number of languages spoken by respondents | 15 | 38 |
| Female respondents | 98 | 202 |
| Male respondents | 82 | 176 |
| English speaking respondents | 146 | 238 |
| ESL (English as Second Language) respondents | 36 | 141 |
| Australian born respondents ¹ | 120 | 219 |
| Not born in Australia respondents ¹ | 62 | 160 |

¹ This information was interpreted by the researchers from reported language spoken, not by self reported information from park users.

users) by language groups and region of origin groups.

3. Results

3.1. Demographics of gardeners and park users

Gardeners and park users are diverse in the languages they speak and the nations that they come from (Table 3), with nearly a third of the gardeners born abroad. Most of the surveyed gardeners live in the neighbourhood of the garden because it is required by the council-run community gardens, and most are educated: 35% bachelor degree; 29% postgraduate degree; 13% diploma; and 11% completed year 11 or 12. Most of the surveyed park users either work (33%), live (30%), or study (12%) nearby the park, but few do both (work and live, 5%; study and live, 2%). Response rates for park intercepts were on average 67% (SE = 0.03%).

3.2. Motivations to community garden and the importance of parks and trees

3.2.1. Motivations to community garden

Nearly all surveyed gardeners associated food provision motivations and sociocultural motivations with gardening (Table 4). Other motivations representing value of gardens varied in frequency (Table 4; Fig. 2). English native speaking gardeners reported aesthetic motivations ($t_{145} = 2.3$, $P = 0.02$) and naturalness and biodiversity motivations ($t_{107} = 2.3$, $P = 0.02$) significantly more frequently than ESL gardeners (Welch Two Sample t -test). Foreign born gardeners stated food provision motivations significantly more frequently than Australian born gardeners ($t_{142} = 2.1$, $P = 0.03$). There were no significant differences in how motivations were reported together among English versus ESL speaking gardeners (Permutation test: $F = 0.39$, $P = 0.89$), or Australian born versus foreign born gardeners ($F = 1.9$, $P = 0.08$).

Table 4

The number (N) and percentage (%) of all gardeners (of N = 189 total) or park users (of N = 379 total) that assigned a motivation or importance (coded into a cluster) to each form of urban nature.

| Motivations or importance assigned to urban nature space (clusters of coded responses) | Community gardens (N and % gardeners) | Parks (N and % park users) | Trees (N and % park users) |
|----------------------------------------------------------------------------------------|---------------------------------------|----------------------------|----------------------------|
| Aesthetic | 5; 3% | 222; 36.4% | 258; 40.7% |
| Environmental | 29; 16% | 21; 3.4% | 210; 33.2% |
| Food provision* | 129; 68% | NA | NA |
| Health | 44; 23% | 5; 0.8% | 2; 0.3% |
| Naturalness and biodiversity | 18; 10% | 23; 3.7% | 85; 13.4% |
| Psychological | 88; 48% | 108; 17.7% | 47; 7.4% |
| Sociocultural | 129; 68% | 230; 37.6% | 30; 4.7% |
| Other | 4; 2% | 3; 0.5% | 1; 0.2% |

* Gardens only.

3.2.2. Importance of urban parks and trees

A majority of surveyed park users associated sociocultural, aesthetics, and psychological importance to parks (Table 4). The same park users associated aesthetics, environmental, and psychological importance to trees (Table 4). Park users associated health, naturalness and biodiversity importance of trees less frequently. No responses (NAs) accounted for 31.9% of all mentions. ESL park users reported psychological importance (e.g., relaxation, feels good) significantly more frequently than English native speaking park users ($t_{244} = 3.3$, $P = 0.001$). This significant relationship was also found for foreign born park users versus Australian born park users ($t_{299} = 3.4$, $P < 0.001$). Importance clusters significantly differed in how they were reported together among English versus ESL speaking park users (Permutation test: $F = 2.5$, $P = 0.04$), but not among Australian born versus foreign born park users ($F = 1.97$, $P = 0.10$). The proportional representation of clusters associated with parks and trees were similar across the three cultural identity groups (i.e., Australian-born, ESL, and region of origin).

3.3. Subjective well-being of gardeners and park users

3.3.1. Community gardens

Community gardeners responded variably to how garden participation contributes to dimensions of their subjective well-being (Fig. 3). ESL speaking gardeners reported significantly higher well-being index scores (PWI-A) than English native speaking gardeners ($t_{52} = 2.7$, $P = 0.01$). Comparing the individual well-being domains by each cultural identity group to understand what may be driving this relationship, ESL gardeners rated personal safety ($t_{38} = 2.9$, $P = 0.007$) and community ($t_{55} = 1.9$, $P = 0.05$) domains significantly higher than English native speaking gardeners in the way that community garden participation has positively contributed to their subjective well-being. None of the well-being responses significantly differed with region of origin group. The NMDS analysis found that well-being domain responses significantly differed in the similarity of how they are reported together among English native versus ESL speaking gardeners ($F = 6.39$, $P = 0.003$; Fig. 4a) and among gardeners from Australia versus other regions ($F = 2.66$, $P = 0.048$; Fig. 4b).

3.3.2. Urban parks

Well-being domain responses of park users were generally high (> 3) across domains (Fig. 3), but did not differ in frequency nor in the similarity of how they are reported together by language group (English vs ESL; $F = 0.48$, $P = 0.75$; Fig. 4c) or by region of origin group (Australia vs other; $F = 0.15$, $P = 0.93$; Fig. 4d).

4. Discussion

Ethno-cultural identity is relevant to the values and well-being benefits that gardeners and park users associate with community

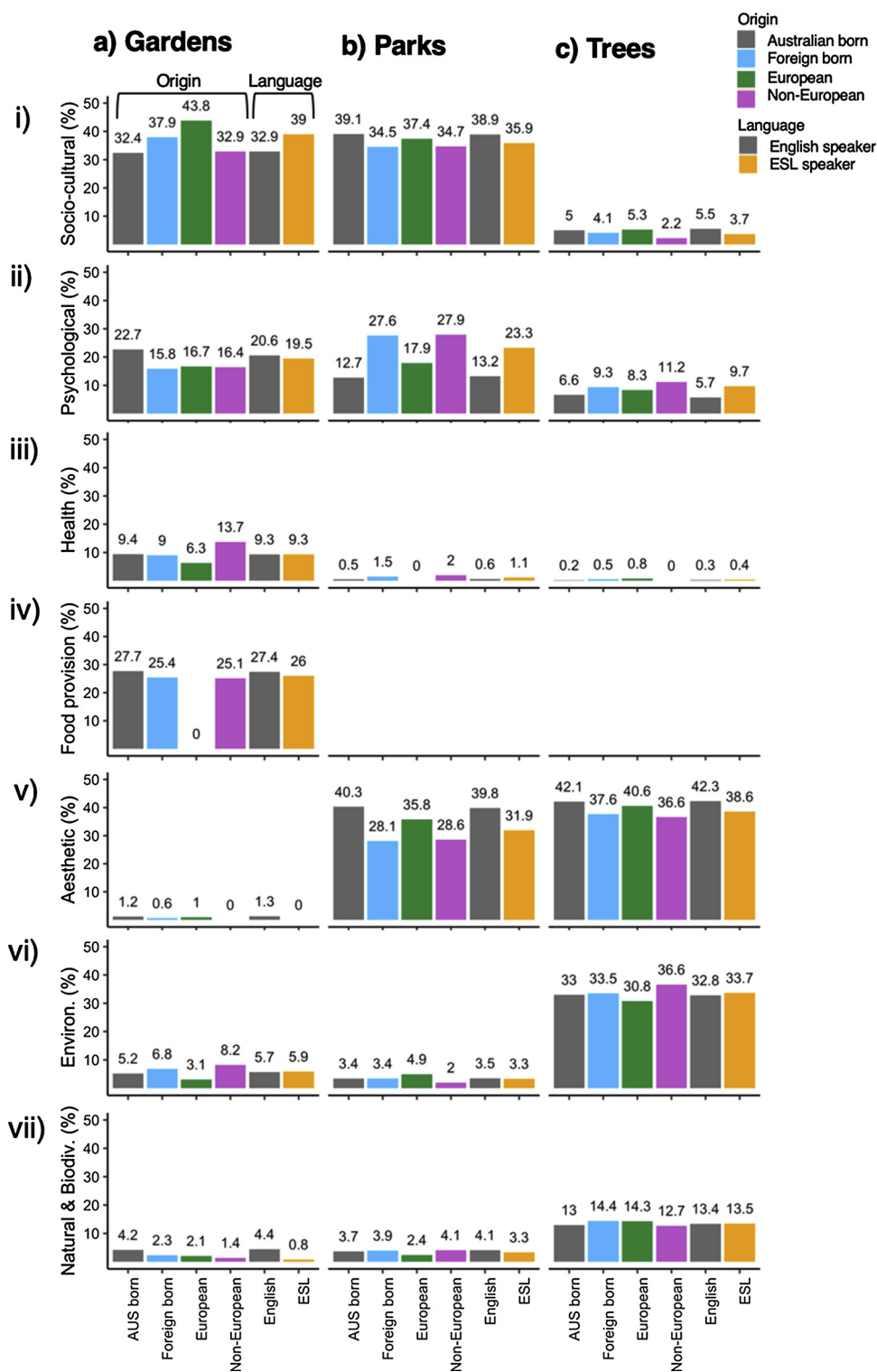


Fig. 2. Percentages of the seven reported clusters associated with (a) community gardens, (b) parks, and (c) trees. Percent values also reported above the bar line for each cluster. Percentages of each cluster (i-vii) are based on the total of all mentions, and presented according to region of origin and language groupings (subset indicated by brackets): Australian born vs. European vs. Non-European born; and English speaking vs. English as a Second Language (ESL). The percentage (%) of the cluster according to the total of all mentions excludes no responses (does not contribute to total of % clusters). Note that: food provision was not used as a cluster in parks or trees; totals do not equal 100% because not every respondent (gardener or park visitor, respectively) is included in each of the variables; no responses and other responses not included for ease of figure interpretation.

gardens, parks, and trees in Melbourne – a vibrant multicultural city. These forms of urban nature are valued in many ways by their users, measured here by motivations to community garden and the importance assigned to urban parks and trees. But the frequency of reported importance and motivations varies with the ethno-cultural identity of their users, measured here by language spoken, country of birth, and/or geographical region of origin. Furthermore, the subjective well-being derived by gardeners and park users differs from these ethno-cultural identities. Below we discuss: (1) how gardener and park user motivations and importance of different forms of urban nature

(community gardens, parks, trees) vary with identity, and (2) how these different forms of urban nature are differentially associated with subjective well-being of gardeners and park users.

4.1. Values of gardeners and park users differ among urban nature spaces and ethno-cultural identity groupings

We found that community gardens, parks, and trees are valued by gardeners and park users in Melbourne for sociocultural and psychological reasons. Our findings support the growing body of literature that

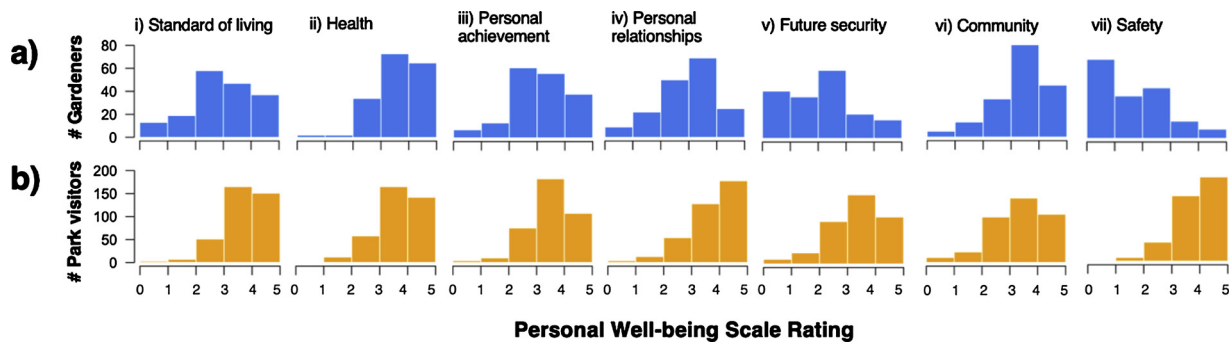


Fig. 3. Distribution of (a) gardener responses (n = 189) to the 5-point Likert questions on the seven domains of the personal wellbeing index (PWI; domains shown in i-vii) in relation to community garden participation (i.e. “On a scale of 1–5, how much has gardening positively contributed to you or your family’s well-being in the following ways?”), and (b) park user responses (n = 379) to the Likert scale questions on general (non-garden specific) subjective well-being.

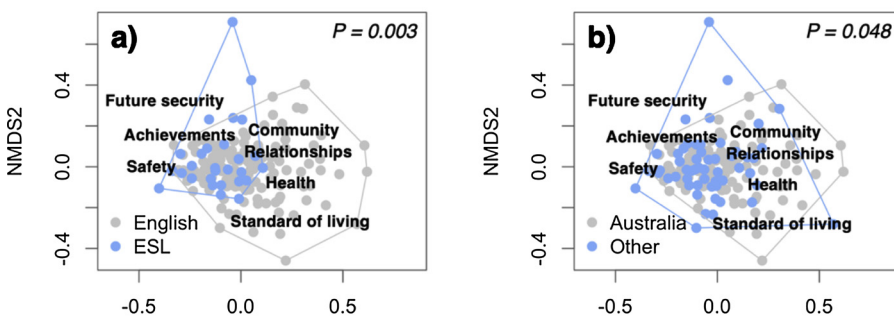
highlights the importance of urban nature for promoting psychological and physical health (de Vries et al., 2013; Hartig et al., 2014; Uhlmann et al., 2018), and social interactions across diverse urban populations (Taylor et al., 2018). Both gardening and walking through a park are ways that people interact with urban nature to reduce cortisone stress levels that can exacerbate chances of disease (Van Den Berg and Custers, 2011). Exposure to nature in gardens and parks can also spark intrigue in nature and strengthen connections to the natural world (Kingsley et al., 2009; Lin et al., 2018). Simply, being in forms of urban nature spaces with natural elements has a feel good factor on people (Pretty, 2004) and may lessen the negative impacts of urban life on human psychological well-being (Lederbogen et al., 2011; Veitch et al., 2018).

Our results generally confirm that gardeners and park users of diverse ethno-cultural identities associate a broad range of social values with urban nature spaces, but it also shows that these values vary depending on the form of urban nature and user’s identity. In the case of urban parks, psychological importance (e.g., relaxation) tended to be

more frequently mentioned for ESL park users and foreign-born park users than English native speakers and Australian born users. People of different cultural backgrounds may attach sociocultural importance to urban parks (Rishbeth, 2004) and urban forests (Jay and Schraml, 2014, 2009) due to recreational opportunities and places for social interaction (Buchel and Frantzeskaki, 2015; Metcalf et al., 2013; Sasidharan et al., 2005). Other studies show that people of different cultural backgrounds also relate positive psychological states to urban nature (Hordyk et al., 2015). However, we found that park users did not frequently mention a psychological value of urban parks. This may be due to differences in research design: researchers studying the importance of urban nature spaces to people of different ethno-cultural backgrounds are usually grounded in lines of inquiry related to leisure and recreation (Metcalf et al., 2013; Veitch et al., 2018). As such, these studies usually ask about how respondents use these spaces, rather than eliciting the values that they associate with them (Ordóñez-Barona, 2017).

Few to no gardeners related aesthetic, naturalness, and biodiversity,

Well-being domains: Community Gardens



Well-being domains: Parks

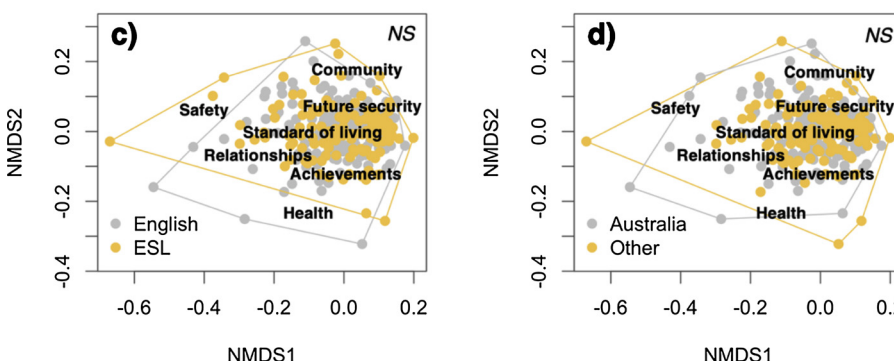


Fig. 4. Ordination of the gardener (a, b) and park user (c, d) responses to the series of questions on subjective well-being using non-metric multidimensional scaling. Each point represents a gardener or a park user and their language classification (ESL vs English speaking; a, c) or their region of origin (Australia vs Other; b, d). In bold black text, are the seven domains that make up the PWI, and their relation to one another based on bray-curtis distance among the responses. Differences among groups were assessed using analysis of dissimilarity (ADONIS) for significant differences in combinations of clusters between language groups and region of origin groups with significance at $\alpha = 0.05$ (“NS” = non significant results). Plots were created using the “ordiplot” functions of the R library vegan (Oksanen, 2015) for each group.

or environmental (e.g., shade, air quality) values to community gardens. As expected, a majority of park users related aesthetic values to both urban parks and urban trees (Fernandes et al., 2019; Gobster, 2002; Lohr et al., 2004), and environmental and biodiversity values to urban trees (Avolio et al., 2018; Ordóñez et al., 2016). Although plants in the home garden are often selected for their aesthetic attributes (Kendal et al., 2012a), the gardeners in this system are selecting plants with attributes linked to crop productivity more than aesthetics (Egerer et al., 2019). The high proportion of gardeners that stated food provision values – specifically associated with community gardens – indicates this as well. Thus, these community gardens are likely generally designed for crop production, and may not have the orderly design associated with aesthetically pleasing spaces to those who prefer orderly presentations of nature (Heerwagen and Orians, 1995). Rather, these community gardens are valued for food and sociocultural benefits across nearly all respondents, especially for foreign born non-European gardeners. This highlights that these community gardens are meeting their intended function as food production systems and community spaces and that values can vary with ethno-cultural identity. Our study supports findings on urban agriculture's food and social benefits around the world (Alaimo et al., 2008; Clarke and Jenerette, 2015; Diehl et al., 2019; Mcdougall et al., 2018; Zezza and Tasciotti, 2010).

4.2. Subjective well-being of gardeners and park users differs among urban nature spaces and ethno-cultural groupings

Gardeners and park users associate subjective well-being differently across the community gardens and parks. While differences in overall subjective well-being did not differ by language spoken or region of origin of park users, for gardeners the overall well-being index scores of ESL gardeners was higher than English-speaking gardeners. ESL gardeners associated the community garden more as a safe space and as a space of community interaction. Studies on the involvement of multicultural groups in community gardening corroborate how these spaces – heavily characterized by social interactions – create community through interactions in a shared space (Alaimo et al., 2010; Corlett et al., 2003; Glowa et al., 2018; Saldivar-Tanaka and Krasny, 2004). Interaction among gardeners, especially gardeners of diverse ethno-cultural identities, is a way in which people build connection to a new community (Baker, 2004; Corlett et al., 2003; Teig et al., 2009) through acts of sharing and knowledge exchange often grounded in shared language (Agustina and Beilin, 2012; Glowa et al., 2018; Okvat and Zutra, 2011). In Melbourne, previous studies have shown how community gardens are especially important to immigrant groups in the place-making process and acculturation to Australian society (Agustina and Beilin, 2012). Furthermore, community gardens can be spaces of place-attachment (Firth et al., 2011; Petrovic et al., 2019) – the bond of people to a place and their environment in which feelings of safety and community are essential to the attachment process (Altman and Low, 1992). In the Australian context, rather than as spaces of cultural preservation, community gardens may be more important as urban nature spaces that provide needed socialization, self-actualization and thereby place-attachment. Such social processes may support the well-being of otherwise vulnerable populations to social isolation and alienation as an immigrant. In our system, these processes are happening across multicultural groups.

The response to feelings of safety reflects the layered relationship between well-being, forms of urban nature and ethno-cultural identity. Overall, park users tended to rate parks as contributing greatly to their safety and security, while gardeners tended to overall rate community gardens as contributing little to the security domain of their well-being. In the case of community gardens, responses significantly varied between ethno-cultural groups, with ESL gardeners ranking the safety domain higher than English speakers. Although community gardens and parks are very different in form and function, the overall differences between gardeners and park users are interesting. The openness

of parks may provoke feelings of insecurity potentially due to perceptions of crime that may occur in parks (Kuo and Sullivan, 2001; Wilbur et al., 2002). The dense canopy in a park may also instigate feelings of crime and insecurity in park users (Maruthaveeran and van den Bosh, 2015). However, feelings of safety by park users have been found in other studies in both Western (Krenichyn, 2004) and non-Western regions (Özgüner, 2011) because park use by family and friend groups foster feelings of social intimacy rather than social isolation. The association of safety with parks by park users in our study may relate either to the general impression that Melbourne has low crime rates (Crime Statistics Agency, 2018), the lack of knowledge of the park due to low frequency of visitation, or the demographic factors of the questionnaire respondents (e.g., residency, age). For example, for long-term residents, the long-standing presence of a park over time in an otherwise dynamic urban landscape may provide a sense of stability and security to residents. Also, older residents consistently score lower in the safety domain of the PWI-A metric across Australia (Capic et al., 2015). Given that the age profile of community gardeners and park users differed (gardeners were on average > 50 years old; park users were on average < 50 years old), the elderly residents in these cases may feel more unsafe in their everyday than younger, abler residents. For gardeners of different ethno-cultural backgrounds, the high safety associated with community gardens may be because these gardeners feel safe due to the particular social and community building aspect of the space (described above) in comparison to the surrounding neighborhood (Glover, 2003). Aside from the literature supporting the idea of feelings of safety within gardens, it is also surprising that gardeners rated the safety domain low (< 3) because all of these community gardens had a fence and required a code or key. It seems that for many gardeners this does not necessarily contribute to their feelings of safety. Future studies could explore this relationship because, in our study, ratings of safety are significantly driving the overall well-being associated with community gardens and the way the metrics are reported in relation to one another.

4.3. Management implications, limitations and future directions

This research shows that urban nature spaces and the values and benefits associated with them are embedded with cultural meaning, which supports the current literature on cultural services and urban green spaces (Bertram and Rehdanz, 2015; Botzat et al., 2016; Jay and Schraml, 2009). This means that urban nature spaces are not neutral of meaning, and not everybody experiences them in the same way or can derive the same benefits from them. While this idea can be misinterpreted as detrimental to urban greening, at its core, it highlights the need for the diversification of urban nature spaces rather than their homogenization. It is important for green space managers to avoid one-size-fits-all greening solutions, and rather to design many and diverse multifunctional spaces of social and ecological meaning where a variety of citizens can derive multiple benefits (Byrne, 2012; Gentin, 2011; Jay et al., 2012; Ordóñez-Barona, 2017). For example, having both parks and community gardens in a neighborhood can increase the potential for a greater variety of citizens to derive diverse benefits. Involving people of different ethno-cultural backgrounds in the planning and management of such spaces through community-led projects is also needed for diversifying and creating just and socially sustainable greening efforts.

A consideration in this study is how individuals have been grouped or classified. Ethno-cultural groupings usually emerge without consideration from the people themselves (Shinew et al., 2006) and can conflate race with ethnicity, discount interethnic variation, and stick only to one classification (Gentin, 2001). This is important because the way different ethno-cultural identities are categorized and grouped can influence how meanings are associated with different groups and thus broader implications. Here we explored various categorizations and groupings based on the collected data, including country of birth,

region of origin, and language spoken. We strived to be consistent with the Australian context for what constitutes an ethno-culturally diverse group (Australian Bureau of Statistics, 2016b). However, our groupings have limitations. We were limited by the small numbers of some categories, so we simplified their grouping, similar to other studies in the field (Ordóñez-Barona, 2017). We note that the method used here does not claim representativeness of the population across urban areas. In addition, some of our data collection techniques had to be adapted to different contexts, such as re-phrasing questions to be specific about parks, trees, or gardens, reducing comparability. Yet, many of our findings related to the meanings people in these groupings attach to community gardens, parks, and trees echo findings in qualitative studies that focus on one ethno-cultural group (Hordyk et al., 2015; Jay and Schraml, 2014; Ordóñez-Barona, 2017). Language is a useful factor to explore the ethnic variability of populations (Cavalli-Sforza, 1997) and can be useful in and urban nature context (Kendal et al., 2012b) and in multicultural cities, because it is one of the main characteristics that differentiate ethno-cultural groups (Qadeer, 2016). However, other identities depending on the geographic and nation context, including racial, religion, and values, among others, can also be indicative of ethno-cultural differences (Gelfand et al., 2011). Future research can utilize bigger datasets to help expand the categorizing and groupings that we explored here to look at finer and more diverse groupings.

5. Conclusions

Forms of urban nature will continue to be important for human-nature contact, increasingly contributing to the well-being and nature associations of multicultural urban populations. In multicultural cities with great ethno-cultural diversity, different forms of urban nature will likely mean different things to different people based on their ethno-cultural identities. Urban planners and city government must incorporate multiculturalism and differences in the values of residents of diverse ethno-cultural backgrounds in urban greening efforts in the Anthropocene. In this study in Melbourne, Australia, we have worked to explore different ways ethno-cultural identities could be understood, and how people of different ethno-cultural identities value and derive well-being from urban nature using community gardens, parks, and trees in Melbourne as a study system. This work complements qualitative studies on multicultural citizenship and urban nature relationships. More research based on validated metrics of derived benefits that

further explores the multiplicity of peoples’ ethno-cultural identities and how they relate to different urban nature spaces will help to understand and improve human-nature interactions in cities.

Ethics statement

All participants gave their informed verbal or written consent for inclusion before they participated in the study. The study was conducted in accordance with the University of Melbourne Human Ethics Advisory Group (HEAG) (Ethics ID #1750822), and the University of California-Santa Cruz (UCSC) Office of Research Compliance Administration (Ethics/IRB ID #HS2569). The UCSC operates under a Federal wide Assurance approved by the DHHS Office for Human Research Protections, FWA00002797.

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Appendix 1 Codes and their clusters used to analyze: 1) gardener open-ended responses to the question “why do you garden?”; 2) park users stated reason why they consider park important; 3) park user stated reason why they consider trees important. An asterisk indicates clusters that were only present for the gardener’s motivations. Justifications for clusters provided in methods

| Codes | Cluster |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| Aesthetic, ambience, amenity, beauty, big trees, established, flowers, green, healthy trees, love trees, nice, non-urban, old trees, open space, quiet, season change, tidy, unique, view | Aesthetic |
| Noise barrier, air, carbon, cool, environmental quality, outdoors, Shade, Shelter, sound barrier, sun, sustainability | Environmental |
| Food* | Food provision* |
| Exercise, health, mental health | Health |
| Alive, animal calls, biodiversity, connect to nature, conservation, ecosystem, essential, habitat, leaf litter, native, natural, wildlife | Naturalness and biodiversity |
| Other, property value, save money | Other |
| Break, challenge, feel good, interest, love gardening, nostalgia, nourishing, peaceful, purpose, refreshing, relax, satisfaction, sense of place, solitude | Psychological |
| Access, activity, children, close by, community, dog walking, eat, facilities, family, friendship, heritage, history, hobby, landmark, learning, no backyard, planning, public access, recreation, safe, sharing, sit, socialize, sport, walk | Sociocultural |

Appendix 2 Results from standard multiple regression analysis predicting the contribution of each subjective well-being element to “Life as a whole” for both garden and park surveys in Melbourne (significant values in bold). Reference values for unique and shared variances: 14% and 37%, respectively (IWG, 2013)

| Element | 1 | 2 | 3 | 4 | 5 | 6 | 7 | B | Standard Error _B | β | Sr^2 |
|---------------------------------|------|------|------|------|------|------|------|---------|-----------------------------|-----------------|----------|
| 1. Life as whole | | | | | | | | | | | |
| 2. Standard of living | 0.38 | | | | | | | −0.011 | 0.048 | −0.015 | 0.00006 |
| 3. Health | 0.46 | 0.38 | | | | | | 0.12 * | 0.050 | 0.14 | 0.0065 |
| 4. Achievements in life | 0.50 | 0.41 | 0.40 | | | | | 0.13 * | 0.054 | 0.16 | 0.0064 |
| 5. Personal relationships | 0.36 | 0.35 | 0.32 | 0.34 | | | | 0.03 | 0.025 | 0.054 | 0.0015 |
| 6. How safe you feel | 0.28 | 0.45 | 0.19 | 0.38 | 0.31 | | | −0.081 | 0.045 | −0.15 | 0.0035 |
| 7. Community connection | 0.43 | 0.24 | 0.29 | 0.29 | 0.27 | 0.19 | | 0.091 * | 0.048 | 0.12 | 0.0039 |
| 8. Future security | 0.41 | 0.49 | 0.31 | 0.48 | 0.32 | 0.62 | 0.33 | 0.002 | 0.047 | 0.004 | 0.000004 |
| * p < 0.05 | | | | | | | | | | Unique variance | 0.0218 |
| Adjusted R ² = 0.408 | | | | | | | | | | Shared variance | 0.386 |

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