

# The Relative Influence of Psycho-Social Factors on Urban Edible Gardening

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Growing fruit, vegetables and herbs on one's residential property has many benefits. This paper first reviews the benefits of urban edible gardening and factors determining this behaviour, and then reports an empirical study quantifying the relative influence of psycho-social factors on edible gardening of Eastbourne residents, New Zealand. Predictor variables explained 58% of variance in behavioural intention, with perceived behavioural control having the strongest influence, followed by subjective norms and attitudes. Behavioural intention and perceived behavioural control together explained 42% of variance in self-reported gardening behaviour. Gardening was significantly higher for respondents with exclusive use of their yard, living in a house, and long-term residents. Available time, space and sun, practical skills, and gardening knowledge were perceived as barriers to gardening. Our results identify motivators and barriers to gardening that behaviour change campaigns can target to encourage this beneficial behaviour, and we highlight research gaps.

Although agriculture typically occurs in rural areas, recent work recognises that urban agriculture may also contribute significantly to global food supply (Smit, Ratta, & Nasr, 1996). One global estimate asserted that urban agriculture produced 15% of total food supply, and involved over 800 million people, with 200 million producing food primarily for market (Smit et al., 1996). Indeed, previous studies have found that a substantial portion of the urban population participates in some form of urban agriculture. For example, 46% of respondents in Waterloo and 52% of Toronto residents grew food on their Canadian properties (Fisher, 2009; Kortright, 2007). Similarly, 30-40% of households in Victoria, Australia, and 23-33% of metropolitan households in Western Australia grew vegetables (Gaynor, 2005).

Mougeot (2000, p. 10) proposed one of the most quoted definitions of urban agriculture (Ambrose-Oji, 2009):

Urban agriculture is an industry located within (intraurban) or on the fringe (periurban) of a town, a city or a metropolis, which grows or raises, processes and distributes a diversity

of food and non-food products, (re-) using largely human and material resources, products and services found in and around that urban area, and in turn supplying human and material resources, products and services largely to that area.

In this study, we focus on urban agriculture related to the activity of growing fruit, vegetables and/or herbs on urban residential properties. Following previous authors (e.g., Appleby, 2008; Foes-lamb, 2007; Chiang, 2005), we refer to this subset of urban agriculture as urban edible gardening (or just edible gardening). Others have labelled the same activity homegardening (Drescher, Holmer, & Iaquina, 2006), house-lot gardening (Winklerprins, 2002), backyard gardening (Kortright, 2007), or kitchen gardening (Leach, 1982). We first provide a review of the key benefits of edible gardening. Given these benefits of urban edible gardening, we argue that understanding factors influencing rates of urban gardening is critical. In turn, our second objective is to review major factors noted in the literature and empirical evidence, or lack thereof, supporting the role these factors play in determining urban edible gardening.

Finally, we present the first empirical study aimed at quantifying the relative influence of psycho-social factors on edible gardening.

## Benefits of Edible Gardening

The extent to which edible gardening is beneficial or harmful depends on the behavioural context and gardening methods (Gomiero, Paoletti, & Pimentel, 2008), and some researchers make unsubstantiated claims about benefits of urban agriculture because they assume, rather than demonstrate, that required gardening methods will be used (Nugent, 2006). Nevertheless, the benefits of urban edible gardening can be summarised in four broad categories reviewed below. Our brief review considers both community gardens in urban areas and edible gardening done on private sections because the overall benefits are likely to affect both.

### *Environmental benefits*

Several environmental benefits can result from urban edible gardening. Rural industrial agriculture has diminished soil quality by exporting nutrients to the city in the form of food (Girardet, 2005), which has led to increasing dependence on petroleum-based fertilizers (Nelson, 1996). Urban edible gardening, when it includes a composting component, provides an opportunity to recycle soil nutrients within the urban area, creating the potential to establish a sustainable urban metabolism (Gaynor, 2006).

Urban edible gardening can also contribute to biodiversity conservation and ecological health. For example, Boncodin, Prain and Campilan (2000) have shown that home gardens can play a role in the conservation of indigenous crops. Also, due to the intensive nature of urban agriculture, it often results in higher yields per unit area (Heimlich,

1988, cited in Heimlich & Bernard, 1993), leading Smit (2000) to argue that increasing urban production can reduce rates of rural land conversion to agriculture, thereby limiting impacts on rural biodiversity. Furthermore, small scale urban agriculture is often less chemically dependent and more biologically friendly (Smit, 2000), due to its ability to make use of techniques such as companion planning and biological pest control. Edible gardening can also displace lawns, thereby reduce use of chemicals required to grow green, weed-free grass. Urban edible gardening can also potentially decrease environmental costs of transport. When food producers and consumers are one and the same, transport-related carbon emissions and pollutants are eliminated (Church, 2005).

Finally, urban edible gardening also offers unique environmental benefits when non-greenspace areas (such as balconies or roofs) are converted to food growing. For example, replacing impervious surfaces with soil for growing crops reduces the effects of flashflooding, such as sewer overflows and erosion (Getter, & Rowe, 2006; VanWoert et al., 2005), and can mitigate the urban heat island effect (i.e., cities being warmer than surrounding rural areas) and improve local air quality (Oberndorfer et al., 2007). Growing food in urban areas may also increase other non-gardening related pro-environmental behaviour (Dunn, Gavin, Sanchez, & Solomon, 2006).

#### *Health and social benefits*

Urban edible gardening also has potential dietary benefits. Urban edible gardening in the Philippines increased the variety of fruits and vegetables consumed (Miura, Kunii, & Wakai, 2003), and in Uganda it improved the nutritional status of children (Maxwell, 1995). In developed countries, urban agriculture has also been shown to improve the diet (e.g., Alaimo, Packnett, Miles, & Kruger, 2008; Blair, Giesecke, & Sherman, 1991) and physical health of growers (Pate et al., 1995).

Urban edible gardening can also contribute to other health and social benefits. Brogan and James (1980) reported that the percentage of front yards with vegetable gardens was a positive predictor of psycho-social

health of neighbourhood residents. Kuo and Sullivan (2001) found that in urban areas, the greener a building's surroundings were, the fewer crimes reported at the address. Urban edible gardening can also contribute to social cohesion by creating networks to trade, barter or gift the products of edible gardening (Winklerprins, 2002).

#### *Economic benefits*

Although the main economic benefits of urban edible gardening may be income and employment generation, and therefore fall outside this discussion of the benefits of non-commercial production, economic benefits for non-commercial producers include reductions in expenditure on food (e.g., Maxwell, 1995). In developing countries people can spend 60-80 percent of their income on food (Halweil & Nierenberg, 2007). The 1991 Solomon Island National Nutrition Survey showed that by growing food, families in the capital city of Honiara saved up to 20% of their food bill (Sommers & Smit, 1994). Urban edible gardeners that produce on roofs can also reduce a building's heating and cooling costs, save on roof replacement costs due to green roofs' increased durability (Oberndorfer et al., 2007), save on reduced storm water management costs due to green roofs' water retaining capacity (Peck & Kuhn, 2001), and may also increase property values (Banting et al., 2005).

#### *Food security and resiliency benefits*

Population dynamics and peak oil are both major threats to our food system. Total population is expected to increase by 2.5 billion by 2050, and due to increased rural-urban migration, urban populations will increase by 3.1 billion in the same timeframe (Department of Economic and Social Affairs of the United Nations, 2008). Peak oil will make it hard to increase production and meet distribution needs using industrial methods. Our current agricultural system relies on fossil-fuel based fertilisers, pesticides and herbicides, but peak oil will likely lead to a struggle to maintain current food yields, let alone increase them (Heinberg, 2003).

Urban edible gardening has the potential to ameliorate some negative

effects of a growing and urbanising population, peak oil, climate change and financial crisis, by providing a degree of resilience for participating communities. The practice of urban edible gardening requires knowledge, skills, and inputs, which may take considerable time to acquire. In this regard, participation in urban edible gardening may not confer large current benefits, particularly in terms of caloric output; however, participation helps build the skills that may be required to cope with future social and ecological change.

Urban edible gardening can also contribute to food security, and examples of this were observed in Kenya (Mwangi, 1995) and Cuba (Buchmann, 2009). Even more developed countries have significant sectors of the population suffering from food insecurity. For example, in New Zealand, despite the production of an over-abundance of food, 11% of males and 16% of females reported in the 1997 National Nutrition Survey that "Food runs out in my/our household due to lack of money, sometimes or often" (Parnell, Reid, Wilson, McKenzie, & Russell, 2001). This vulnerability of citizens in food abundant nations highlights the importance of community food resilience.

In summary, urban edible gardening can provide an array of benefits. In turn, it is important to understand the factors that may influence participation in this activity.

#### **Factors influencing participation in urban edible gardening**

The extant literature on factors influencing participation in urban edible gardening can be organised into four domains: (1) studies focusing on broad external factors, (2) studies proposing typologies to group individuals already engaging in edible gardening, (3) studies examining specific socio-demographic factors, and (4) studies examining motivations for urban edible gardening.

External factors that influence participation in urban edible gardening include: access to sufficient land, water, seeds, fertilizers, pesticides, herbicides, tools, and gardening stores (Drescher, 1999; Nugent, 2000; Sander-Regier,

2008); local climate and topography, and prevalence of plant pests and diseases (Drescher 1999; Nugent, 2000); urban planning regulations and building codes (Brown & Carter, 2003); and land-tenure laws (Kortright, 2007). Other external factors proposed to influence edible gardening include political and economic stability and culture of gendered responsibilities (Mongeout, 2000), as well as the presence of household and local networks which provide support and demand for the agricultural products (Winklerprins, 2002).

Other researchers have used surveys to group respondents into types of urban agriculturalists. For example, Koirenko and Hoermann (2008) conducted factor analyses to create a typology in which urban agriculturalists were grouped into “seekers of leisure activities” (37%), “urban and peri-urban agriculture dependent” (37%), “recreational growers” (17%), or “little engaged growers” (9%).

Other studies have examined the influence of socio-demographic factors. Longer residence time has been linked to higher probability of participation in urban agriculture (e.g., Maxwell, 1995; Mwangi, 1995). Additionally, Maxwell (1995) found that larger households were more likely to grow food. Blaylock and Gallo (1993) reported that the size of a household residence, home ownership, race, source of income, the number and ages of adults in the household, and the potential for saving money all had a significant influence on the decision to produce vegetables at home.

Other studies sought to compare the degree to which different factors (e.g., enjoyment, health, economics, food security, recreation, and food quality) motivate urban residents to engage in urban agriculture. In the perhaps most comprehensive study of this kind, covering 16 developing countries and one developed country, Nugent (2000) found that reasons for growing food in urban areas included: production for home consumption, income enhancement, economic crisis, high prices of market food, income or asset diversification, supplementary employment, conflict, and poor weather.

## The present study

Although numerous studies have identified possible factors influencing gardening behaviours, none have quantified the relative influence of psycho-social determinants, such as attitude, subjective norms and perceived behavioural control. Filling this research gap contributes to a greater understanding of participation in edible gardening which can then be used to promote this behaviour.

We conducted our research in the community of Eastbourne, New Zealand. New Zealand is a developed, highly urbanised, agricultural nation, known internationally for rural dairy and sheep farming. Eastbourne is part of the Greater Wellington metropolitan area and has a relatively small population (4,719; Statistics New Zealand, 2006). The area has a history of food production, which is evidence that edible gardening is possible in the region (Beaglehole & Carew, 2001). Census data showed that 20% of households in Auckland grew more than 25% of the vegetables they consumed in 1956, but that dropped to 15% in 1971 (Vale, 1980, cited in Gosh, Vale, & Vale, 2008). The census no longer includes questions regarding vegetable production, and, as is the case in most countries, little is known about the present extent of urban edible gardening in New Zealand today. However, the importance of urban edible gardening has been recognised. For example, Gosh et al. (2008) investigated how edible gardening affects the sustainability potential of residential developments in Auckland, and concluded that community behaviour change measures were critical to increase its uptake.

Nevertheless, urban edible gardening has not been a frequent subject of research in this country, and the resiliency benefits of edible gardening may be undervalued. For example, in 2008 the then Minister of Agriculture Jim Anderton said: “I can confirm that the Labour-Progressive Government does not have a food security strategy because New Zealand is a nation that produces many times more the quantity of food than is required to sustain our own domestic needs, and there is, therefore, demonstrably no food security risk for New Zealand”

(New Zealand Parliament, 2008). In this statement, the Minister of Agriculture failed to acknowledge that the issue of food security is not only a matter of production but that of distribution, and edible gardening can also contribute in this context.

We used the Theory of Planned Behaviour (TPB) to model urban edible gardening. The TPB identifies intention as the primary antecedent of behaviour, and attitude, subjective norms and perceived behavioural control as antecedents of intention (Ajzen, 1991, 2002). To the extent that perceived behavioural control reflects actual control, perceived behavioural control can also predict behaviour directly. In the present study, intention is assumed to capture the motivational factors that influence individuals to engage in edible gardening, and is a measure of how much effort individuals are planning to exert to perform this behaviour. Attitudes measure the degree to which a person evaluates edible gardening favourably or unfavourably. Subjective norms measure a person’s perceived social pressure to perform edible gardening. Perceived behavioural control measures a person’s perceived ease or difficulty of performing edible gardening. The TPB has been used in hundreds of studies (Francis et al., 2004), including research on other pro-environmental behaviours (e.g., Fielding, McDonald, & Louis, 2008) and agricultural practices (e.g., Wauters, Biellers, Poesen, Govers, & Mathijs, 2010). To our knowledge, our study is the first to use the TPB on edible gardening.

## Method

Ethics approval was granted by Victoria University of Wellington, and a mixed methods approach was undertaken comprising focus groups and a survey-based questionnaire. The anonymous questionnaire was distributed to all households in the Eastbourne community as defined in the New Zealand census. During the study period, the first author was an active member of this community. Her familiarity with local issues, social norms and stakeholders was important for establishing that research questions were locally relevant and useful.

## Focus Groups

Exploratory-type focus groups (Kuniavsky, 2003) identified the salient behavioural, normative and control beliefs related to edible gardening within the Eastbourne community with the intent of including them in the questionnaire. Focus group participants were all current Eastbourne residents. Two separate focus groups were held for those residents who participated in edible gardening ( $n = 5$ ) and those who did not ( $n = 2$ ). This was to encourage people to speak freely about their behaviour and motivations without fear of judgement from someone with the opposite behaviour. Open-ended questions were used to begin the sessions and guided the discussion to ensure the group considered all the factors identified by the TPB.

Focus groups were tape-recorded and the comments later transcribed. The transcripts were analysed using an informal coding method by which all mentions of attitude, social norms and perceived behavioural control factors were highlighted for possible inclusion in the questionnaire. Based on focus group discussions, a draft questionnaire was created and piloted with 20 individuals. As a result of the pilot, minor wording changes were made to some questions in order to increase comprehension. A detailed description of the final, revised questionnaire and survey procedure is presented below.

## Questionnaire

### Participants and Procedure

Based on Dillman's (2000) recommendations, a booklet format was used and questions were grouped into parts. A pre-notice letter was hand-delivered to all households in the Eastbourne community a week before questionnaire delivery, which included a pre-paid return envelope. Of the 1,946 questionnaire delivered, 684 (35%) were returned and comprised the final sample. This is a reasonable response rate considering that the questionnaires just appeared in people's letterboxes. Most of the participants were female ( $n = 458$ , 67%), New Zealand-born ( $n = 494$ , 73.8%), and in the 46-65 age bracket ( $n = 316$ , 47%).

## Measures

*Edible Gardening.* We used Ajzen's (2002) TACT method—(T)arget, (A)ction, (C)ontent and (T)ime—to define edible gardening as “growing (action) fruit, vegetables and/or herbs (target) on one's residential property (context) in 2008 (time). Three questions were used to measure edible gardening. Participants were asked to indicate which category or categories of food they grew, the percentage of each food category they ate in 2008 that was produced on their property, and the percentage of their residential property devoted to edible gardening.

*Behavioural Intention.* Two questions were used to measure intention: one asking participants to indicate the extent to which they agree/disagree with the statement “In 2008, I intended to grow fruit/vegetables/herbs” [*q28* in Figure 1]; and another asking participants to indicate the extent they agree/disagree with the statement “I intend to grown fruit/vegetables/herbs in 2009” [*q29*].

*Attitudes toward edible gardening.* Four semantic differential questions served as direct measures of attitude. Participants answered: “For me/In my opinion, growing fruit/vegetables/herbs is (or would be)”, with enjoyable/unenjoyable [*q43*] and good/bad [*q51*] semantic pairs to measure experiential attitudes, and with valuable/worthless [*q47*] and beneficial/harmful [*q50*] semantic pairs to measure instrumental attitudes. Indirect measures of attitude emerged from the focus group discussion and literature review of salient beliefs about outcomes of edible gardening, including six topics with two questions each: freshness, safety, saving money, reducing profit of commercial growers, environmental benefits, and climate change mitigation. These indirect measures were computed by aggregating all the salient beliefs about the likely outcomes of the behaviour (measured on a scale of 1-7) and evaluations of these outcomes (measured on a scale of -3 to +3), and two item parcels were then created.

*Subjective norms.* Three questions were used to measure injunctive norms: “It is expected of me that I grow [fruit/vegetables/herbs]” [*q12*], “I feel under social pressure to grow [...]” [*q25*],

and “Most people who are important to me (think that I should/think that I should not) grow [...]” [*q48*]. One question measured descriptive norms: “Of the people who are important to me (none/all) grow [...] on their residential properties” [*q45*].

*Perceived behavioural control.* Perceived capability over the behaviour was measured with two questions: “I am confident that I could grow [...] if I wanted” [*q15*], and “For me, growing [...] is or would be (easy/difficult)” [*q44*]. Perceived controllability was measured with the question “I feel that it is (possible/impossible) to grow [...] on my residential property” [*q49*]. Besides these direct measures, the questionnaire also included indirect measures for the following seven perceived behavioural control topics (two items each): time, soil quality, knowledge of what is good to grow, sun, wind, access to knowledgeable staff in garden centres, and physical ability. These indirect measures were computed by aggregating the salient beliefs about perceived control over the behaviour (measured on a scale of 1-7) and their evaluations (measured on a scale of -3 to +3), and two item parcels were then created.

*Socio-demographics.* The questionnaire also included questions regarding the demographics of respondents (e.g., age, gender), and questions about childhood exposure to edible gardening and participation in related activities.

### Data Analysis

We used structural equation modelling (SEM) to analyse how the TPB factors predict intention, and then logistic regression to analyse how intention predicts behaviour. We used the following model fit indices: Chi-square to degrees of freedom ratio ( $\chi^2/df$ ), root mean square error of approximation with 90% confidence interval (RMSEA with 90% C.I.) standard root mean square residual (SRMR), and comparative fit index (CFI). We used the following cut-off values determined by Hu and Bentler (1999): a cut-off value close to 0.06 for RMSEA, close to 0.08 for SRMR, and close to 0.95 for CFI. We also used a cut off value of 3 for the  $\chi^2/df$  statistic, as recommended by Schumacker and Lomax (2006).

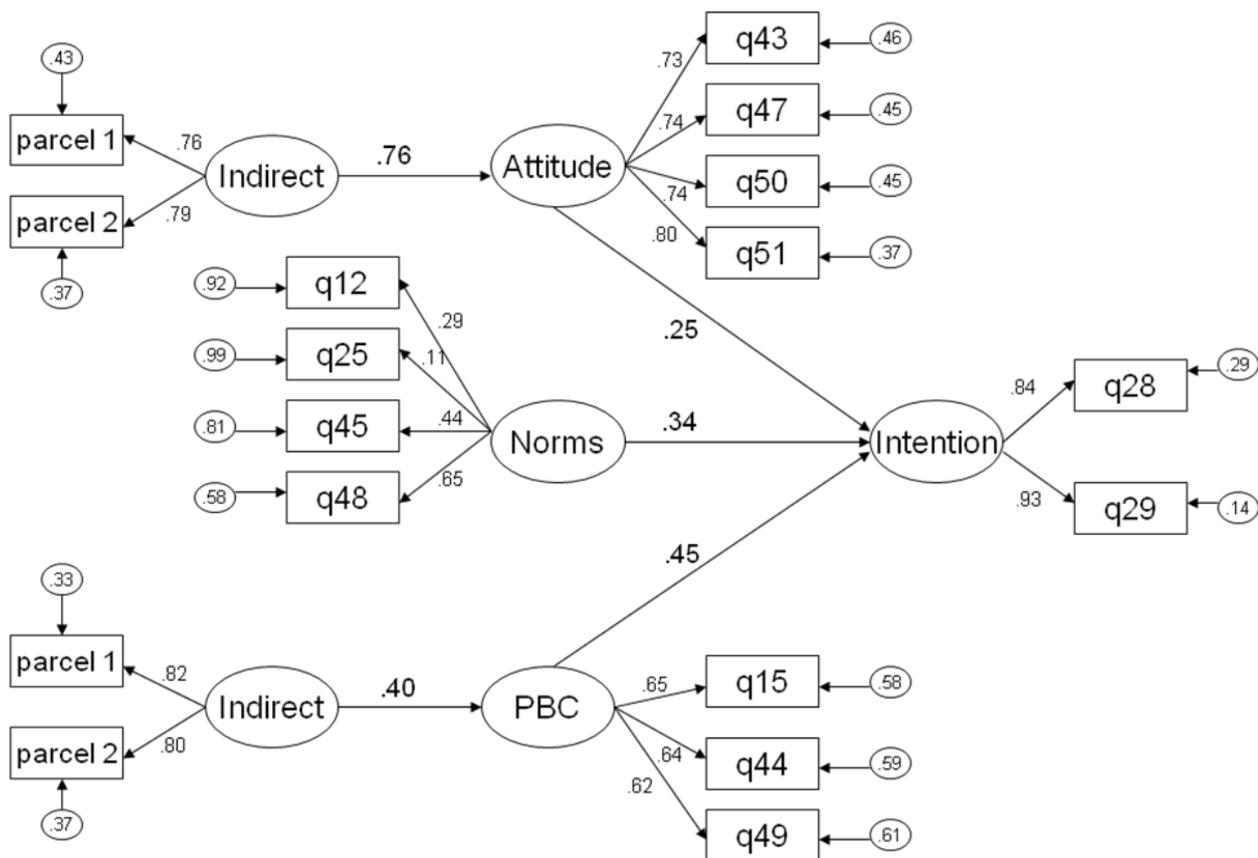


Figure 1. Standardised multiple regression coefficients for the TPB-based full latent variable model of intention to participate in urban edible gardening. Arrows from latent variables represent significant causal paths ( $t < 1.96$ ,  $p > .05$ ). PBC = perceived behavioural control. Description of the questions is provided in the Methods section.

As suggested by Francis et al. (2003), we also dichotomised intention and conducted a series of *t*-tests to determine which specific beliefs discriminated between intenders and non-intenders of edible gardening. Similarly, we conducted a series of *t*-tests to determine which beliefs discriminated between those who grew fruit, vegetables and/or herbs and those who did not.

## Results

### Quantifying edible gardening

The vast majority of respondents (89.6%) participated in edible gardening. Further, 42.2% of respondents grew all three types of food (fruit, vegetables and herbs), 31.1% grew two types (2.0% fruit and vegetables only; 7.1% fruit

and herbs only; and 22.0% vegetables and herbs only), and 16.3% grew only one type (3.3% fruit only; 2.3% vegetables only; and 10.7% herbs only). However, the majority of respondents reported growing less than 15% of their yearly intake of fruit, vegetables and herbs. Furthermore, very few residents prioritised food growing on their land: only 0.2% of respondents grew food on greater than 40% of their residential property, whereas 81.8% grew food on less than 10% of their land. These findings show that while the overwhelming majority of respondents engage in the edible gardening, the extent to which they gardened was limited due to the majority of respondents prioritising non-edible gardening uses for their land.

### Predicting participation in edible gardening

*T*-tests were performed to compare scores of respondents who grew nothing ( $n = 69$ ) versus those who grew something ( $n = 594$ ).<sup>1</sup> As expected, participants who already garden reported positive intentions to perform the behaviour, whereas non-participants reported negative intentions. More importantly, gardeners reported stronger positive attitudes towards the behaviour, weaker negative social pressure against gardening, and stronger positive perceptions of behavioural control.

A TPB-based structural equation model (Figure 1) fit the data well:  $\chi^2(162) = 457.57$ ,  $p < 0.001$ ;  $\chi^2/df = 2.82$ ; RMSEA (90%CI) = .058 (.052-.064); SRMR = .088; CFI = .96. The predictor

<sup>1</sup> The specific results are not shown but available upon request. To reduce Type I error the alpha level was set at  $p < .01$  for all reported *t*-tests. It is worth noting that of the 69 participants who did not grow fruit, vegetables and/or herbs, 16 lived in apartments or dwellings other than houses, and 14 did not have exclusive use of their yard. However, of the participants who did grow food, 45 lived in apartments or dwellings other than houses, and 23 did not have exclusive use of their yards. Type of residence might influence the decision to engage in edible gardening, but clearly motivational factors are also at play.

variables explained 58% of the variance in intention to participate in edible gardening. The strongest influence on intention was perceived behavioural control, followed by subjective norms and attitude.

Finally, logistic regression was performed to examine the prediction of self-reported behaviour, showing that intention to participate in edible gardening strongly predicted edible gardening behaviour ( $\beta = .73$ ), while perceived behavioural control had a weaker predictive value ( $\beta = .31$ ). The combined effect of these variables explained 41.6% of the variance in edible gardening behaviour (Nagelkerke's  $R^2 = 0.416$ ).

#### *Additional predictors*

In order to determine which perceived behavioural control beliefs had the greatest influence on intention, a series of *t*-tests were performed comparing those who intended to grow in the future with those who did not intend to grow. Eight of the ten behavioural control beliefs discriminated between the intenders and non-intenders (not shown). Beliefs about having sufficient time, practical skills, physical ability, access to edible gardeners for support, knowledge of food types to grow on property, wind, space, and sun were higher for intenders. This finding indicates that individual factors (knowledge and ability), social support, as well as environmental factors (wind, space, sun) were perceived as barriers to edible gardening.

Considering that perceived behavioural control can predict behaviour directly according to TPB, another series of *t*-tests were performed to identify which of the perceived barriers represented actual barriers to participation in edible gardening. Results indicate that only five of the eight perceived barriers discriminated between growers and non-growers. Beliefs about having sufficient time, practical skills, knowledge of good types to grow, space, and sun were higher for growers. Due to their direct and indirect (mediated by intention) influence on edible gardening behaviour, these perceived barriers are logical areas to target interventions designed to increase edible gardening.

Finally, *t*-tests were performed to assess whether demographic variables would influence edible gardening. Rates of participation in edible gardening were assessed over nine demographic variables: age, gender, ethnicity, presence of children in the home, are of residence, type of dwelling, status of ownership, length of stay, and exclusive versus shared use of yard. Results indicate the influence of three demographic variables. Rate of participation in edible gardening was significantly higher ( $p < .01$ ) for respondents who: lived in a house (versus an apartment or other structure), lived in the same residence for more than 10 years, and had exclusive use of their yard.

#### **Discussion**

We sought to quantify and predict participation in edible gardening in a New Zealand community in order to generate a greater understanding of the behaviour on which to base recommendations for its effective promotion. People worldwide already engage in edible gardening but understanding and promoting participation in this activity is important because it has numerous environmental, health and social, economic, food security and resiliency benefits that we have reviewed above. With the advent of likely changes to the global food system, the behaviour may become even more beneficial.

#### *Theoretical and practical implications*

The number of respondents who participated in edible gardening in Eastbourne (89%) was far higher than in previous studies (e.g., Fisher, 2009; Gaynor, 2005; Kortright, 2007). A self-selection bias, in which gardeners may have been more likely to respond, may have caused some problems in measuring levels of participation in our sample. Nevertheless, the high rate of participation is a positive outcome given the many potential benefits of the activity reviewed in the introduction.

Our findings indicated that the TPB model explained 58% of the variance in intention to participate in edible gardening, whilst logistic regression showed that intention and perceived

behavioural control explained 41% of the variance in self-reported participation in edible gardening. Armitage and Conner (2001) reviewed 185 independent studies which showed that the TPB accounted for 39% and 27% of the variance in intention and behaviour, respectively. Thus, our edible gardening model fit the data well and is in line with past research. Our results indicate that increases in perceptions of behavioural control, attitudes and subjective norms would increase intention to participate in edible gardening, which would then lead to increases in actual participation. However, perceptions of control were more likely to sway people to intend (or not intend) to participate in edible gardening than were their attitudes or subjective norms.

Attitudes often have the strongest influence on intention (Armitage & Conner, 2001), but Ajzen (1991) states that the relative influences of the TPB constructs on intention may vary across behaviours. In our study, perceived behavioural control would be the logical first construct to target for interventions to increase intention to participate in edible gardening, and the importance of perceived behavioural control has also been observed in other studies addressing environmental behaviour (e.g., Mannetti, Pierro & Livi, 2004).

More specifically, the strong influence of perceived behavioural control on intention indicates that edible gardening is not entirely under volitional control (Ajzen, 1991). The control of a behaviour lies on a continuum from complete volitional control in which all people have the requisite skills, resources, and opportunities to perform the behaviour, to non-volitional control in which no one has the requisite skills, resources, and opportunities. An individual is unlikely to form a behavioural intention for an action that the individual believes he or she cannot perform (Staats, 2003). Because perceived behavioural control strongly influenced intention to garden, it indicates that at the time of intention formation some people perceived barriers to the behaviour.

It is also important to distinguish perceived and actual barriers. The TPB is a cognitive model representing a decision-making process at time 1

(intention formation) and a behaviour at time 2. In the time between forming an intention and performing the behaviour, new beliefs may form which moderate the intention-behaviour relationship. For behaviours that are not entirely volitional, the construct of perceived behavioural control holds predictive value for both time points: intention and behaviour (Armitage & Conner, 2001). Barriers which factored into the intention to participate are perceived barriers, whereas actual barriers are encountered after the intention was formed. In the case of edible gardening, both barriers existed.

Perceived barriers that differentiated between individuals intending to garden and those who did not intend to garden included: having sufficient time, practical skills, physical ability, access to edible gardeners for support, knowledge of good types to grow, lack of wind, sufficient space, and sun to participate. A subset of these perceived beliefs (sufficient time, practical skills, knowledge of good food types to grow, space and sun) were also actual barriers that differentiated between participants and non-participants in gardening. Both perceived and actual barriers should thus be considered in interventions to increase this behaviour.

Moreover, our results corroborate previous findings that highlight behavioural control as a key barrier to edible gardening. For example, Kortright (2007) identified gardening skills as a major barrier to edible gardening in Toronto, Canada. She also reported that participants mentioned other perceived behavioural control factors such as space, lack of sun, and soil quality as barriers. Similarly, Hujber (2008) reported perceptions of lack of space, water, finances and supportive policies as the major barriers for edible gardeners and community gardeners in Melbourne, Australia. Interestingly, through the use of the TPB model, our study was the first to consider systematically the combined effect of attitude, subjective norms and perceived behavioural control on gardening intention, and *still* found perceived behavioural control factors to be the biggest barriers. The similar conclusions reached by these studies, despite different research methods and context, suggest that perceived

behavioural control factors are major barriers to gardening and may be generalisable to different urban areas.

Results also indicate the influence of other socio-demographic factors. The type of dwelling, length of stay, and exclusive versus shared use of yard all showed significant differences in gardening participation, as has been found in other countries (e.g., Maxwell, 1995). These findings are important in light of increasing urbanisation globally. Given that the greatest food producers in our study and in previous research were long-term residents, the coming increase in demand for food in urban areas is unlikely to be met by recent immigrants growing food. In addition, the form of urban development may have a critical influence on rates of gardening. If new urban developments do not provide access to exclusive garden plots, then edible gardening rates may be limited. Overall, our study provides important information regarding the barriers and predictors of urban edible gardening which can be used to foster sustainable behaviour in community settings.

#### *Study limitations and suggested future research*

The understanding of edible gardening gained by this study is useful for increasing the number of participants in edible gardening, but we did not focus on how much people grow. The majority of respondents reported growing less than 15% of their yearly intake of fruit, vegetables and herbs. Therefore, interventions to increase the extent of edible gardening by existing edible gardeners would still be beneficial.

Eastbourne has a demographic profile different to that of the Wellington region or New Zealand as a whole (Statistics New Zealand, 2006). Although comparisons with other studies (Hujber, 2008; Kortright, 2007) indicate results may be generalisable, similar studies of edible gardening need to be conducted elsewhere in New Zealand, and worldwide, to determine how generalisable results may be. Furthermore, although perceived behavioural control is a barrier that appears to be generalisable, specific barriers may vary with location. Additional research would allow for a greater understanding of the context in which specific barriers exist and

allow for more targeted interventions. Because sustainability benefits of the gardening behaviour greatly depend on the methods employed (Gomiero et al., 2008), research into gardening methods would also be beneficial.

We have also focused on edible gardening and its benefits but have not addressed other actions which create environmental and social benefits and can build community resilience, such as community gardens and farmers' markets. Finally, future research should be conducted on the efficacy of interventions to increase edible gardening. Although the TPB model has predictive value for edible gardening, and therefore some explanatory power, interventions based on this model are not guaranteed to succeed.

#### **Conclusion**

This study was the first to use psycho-social variables within a predictive model of participation in urban edible gardening. The results indicate that perceived behavioural control factors are the biggest barriers to urban edible gardening. The current global food system is under threat by decreasing stocks of oil, climate change, financial crisis and increased urbanisation. Urban edible gardening has the potential to mitigate the effects of these threats and should thus be promoted.

#### **Authors' Note**

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