博士論文

The Impact of Potted Street Gardens on Neighborhood Perception, Human Behavior, and Human Health. Case of Tangier, Morocco.
（街路の鉢植えが住民意識や人間の振る舞い、健康に与える影響 - モロッコ・タンジールを例に）

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Chapter 1 : Introduction

1. Research background

A consistent body of research suggests that exposure and interaction with urban green space (UGS) has a positive impact on neighborhood perception, human behavior, and human health. These studies showed the vital role neighborhood greenspace (GS) plays in increasing residents' life satisfaction (Houlden et al. 2018; Kiani, Javadiyan, and Pasban 2014), social capital (Jennings and Bamkole 2019a), and perceived safety (Garvin, Cannuscio, and Branas 2013; Gorham et al. 2009; Kuo, Bacaicoa, and Sullivan 1998), and in reducing crime rates and antisocial behaviors (Bogar and Beyer 2016), and alleviating noise annoyance physically and psychologically (Van Renterghem and Botteldooren 2016). Immersion in green environments was also positively associated with altruistic and prosocial behaviors (Guéguen and Stefan 2016). Findings revealed also GS role in reducing stress, depression levels, and Post-traumatic stress disorder (PTSD) symptoms (Bezold et al. 2018; Bratman et al. 2015; Jiang et al. 2016; Koga and Iwasaki 2013; Kotozaki 2013; Ulrich et al. 1991), increasing physical activity levels (Akpinar 2016; Schipperijn et al. 2013), reducing obesity (Nielsen and Hansen 2007), improving senior citizens longevity, (Takano, Nakamura, and Watanabe 2002), and reducing recovery time after surgery (Ulrich 1984). Research quantifying and measuring the benefits of greener neighborhoods revealed impressive results. Kardan et al. for instance, in a study of street trees association with perceived health in Toronto, found that ten more trees in a residential block improved perceived health condition equal to a 10.000 dollars increase in personal annual income or being seven years younger (Kardan et al. 2015). Furthermore, a large scale study by Engemann et al., investigating UGS correlation with mental health in Denmark, revealed that children raised in environments with the lowest levels of green space had up to 55% more risks of developing a mental disorder compared to other children, even after controlling for other known risk factors (Engemann et al. 2019). Moreover, in a longitudinal study spanning from 1997 to 2007, Donovan et al. investigating the impact of the progressive loss of 100 million threes (due to a forest pest), on mortality rates, found a significant increase in mortality related to cardiovascular and lower-respiratory-tract illnesses in areas infested with the forest pest. The size of this effect increased as infestation progressed and was associated with a total of 21.193 deaths related to a deterioration of the respiratory and cardiovascular systems (Donovan et al. 2013).

Figure 1-1. Nairobi area, Kenya © Johnny miller (source. www.archdaily.com)

Figure 1-2.Mumbai area, India. © Johnny miller (source. www.archdaily.com)

These impressive results are both promising and alarming; promising for communities with easy access to greenspace, and alarming for all others, as UGS shortage represents a significant health risk factor, and consequently, an environmental injustice (Wolch, Byrne, and Newell 2014), affecting mainly disadvantaged communities.

The world health organization (WHO) acknowledges the critical role of UGS, and recommends 9 m^2 per capita green space within 15 minutes of walking distance from residential neighborhoods (Pafi et al. 2016). However, reaching that milestone is still a significant challenge, as UGS is not equitably distributed through urban environments in terms of quantity, quality, and proximity (Wolch et al. 2014), with wealthy neighborhoods favored over the deprived dense ones despite government efforts (Figures 1-1, 1-2). This situation is in part due to UGS perception as an expensive luxury (Cilliers and Timmermans 2012) compared with residential and commercial developments, which leads to the loss of existing UGS and the difficulty of creating new ones, especially in dense neighborhoods. This is especially true in developing countries (Wolch et al. 2014), where most of the urban population growth of the 21st century will occur (Nations 2018).

Consequently, more interest needs to be addressed to the already existing cheap spontaneous solutions developed by urban communities as coping mechanisms to overcome UGS shortage. Potted street gardens (PSG), in particular, represent a very promising substitute to formal UGS in dense neighborhoods. Previous research associated PSG with UGS scarcity and increased greenery perception (青木義次 and 湯浅義晴 1993), which in turn is associated with improved health, prosocial behavior, and neighborhood perception, and suggests that PSG might be as function in the same way as UGS in improving these three variables, in addition of being low-cost, easy to implement, and do not need any significant investments from governments.

Moreover, according to WHO, defining UGS as any private or public land of any size and function covered by vegetation of any type (Organization (WHO) 2017), PSG can be considered as an UGS form. However, PSG received very little attention as such by academics and officials. This might be because PSG are not officially recognized by governments as a form of GS due to its illegal (but tolerated) occupation of public space like pedestrian sidewalks or traffic roads itself (Jonas 2007), its disordered appearance, and its anecdotic size compared to public parks and gardens.

Figure 1-3. Potted street gardens and street trees and shrubs side by side in Tsukishima (by author)

However, in this research, we argue that these characteristics are specifically what makes studying PSG-human interaction interesting.

First, as private property present on public grounds and accessible to locals and outsiders, PSG requires continuous care and protection from theft and vandalism, especially in unsafe environments, and induces daily routines that change its owners' and outsiders' behavior and perception of their neighborhood and neighbors.

Second, as a form of green space or as a tool that increases perceived greenery, PSG has the potential to transform dense residential neighborhoods into green spaces. It thus might bring the psychological, physical, and environmental benefits of UGS to disadvantaged communities that do not have access or cannot commute to public parks and gardens like the elderly, for instance. Finally, as a personal, low-cost, and easy alternative to UGS, PSG might empower deprived urban

communities, by reducing environmental injustice, and involving members in the co-creation of cleaner, safer and more sustainable neighborhoods. This is especially applicable in developing countries, where most of the urban population growth of the 21st century will be happening (Nations 2018), in contexts where UGS planning is not a priority.

Nevertheless, most of the existing research on PSG-Human interaction focused on its association with territoriality and community life, neglecting its other potential interactions as a green space, with human health, prosocial behaviors, or neighborhood perception.

To our best knowledge, PSG were studied mainly in Japan, Jonas (Jonas 2007) attributed this fact to a long history of container gardening in the country, and PSG significant presence in Japanese urban landscape in general, and residential neighborhoods, in particular, that is incomparable to any other country in the world. Previous research associated PSG ownership in residential areas with good relationships between neighboring housewives, territoriality manifestation, overflow of private life to public space (Kobayashi 1992; Kobayashi and Suzuki 1981; Suzuki 1984), and increased neighborhood greenery perception (青木義次 and 湯浅義晴 1993). These findings suggest that PSG might be a coping mechanism to UGS shortage, and a tool to modify and adapt the living environment to dwellers' needs as suggested by Golant's theoretical model of residential normalcy and the theory of person-environment fit (P-E fit).

Golant's theory (Golant 2011) suggests that a bad residential environment can cause poor psychological well-being, which triggers a process of adaptation using accommodative and assimilative strategies to achieve residential normalcy, either by changing the way they perceive their residential environment or by changing its physical characteristics. This theoretical model was specifically developed to explain how older adults adapt to the residential environment, not fitting their unique needs. However, it presents an interesting model that might be generalized to other underprivileged communities.

Similarly to the residential normalcy theory, the central idea of the P-E fit theory is that when the environment's characteristics do not meet individual needs or expectations, this misfit results in decreased residential satisfaction and increased stress, resulting in poorer mental health (Edwards, Caplan, and Harrison 2002). In this theory, environmental characteristics are the

physical as well as the social features characterizing a defined area. Physical features may comprise home characteristics in general, as well as, building, neighborhood, or community environmental factors including safety, green space, cleanliness, calmness, among other variables (Kahana et al. 2003) while social features include levels of interaction and homogeneity between locals among other variables. The P-E fit theory suggests that when a misfit happens between a person and a defined environment (people and physical characteristics), two mechanisms are employed in order to achieve the P-E fit or congruence; coping and/or defense (Edwards et al. 2002). Coping represents the efforts employed in order to either self-adapt to the environment's characteristics or to modify and master the environment characteristics to meet specific needs. In contrast, defense can represent the efforts employed in order to change oneself perception or environment perception.

In line with the residential normalcy and the P-E fit theory, PSG can be considered as a spontaneous answer to a P-E misfit, and a coping mechanism to the shortage of UGS in the neighborhood.

Therefore, the objective of this research will be to study PSG potential associations with neighborhood perception, human behavior, and human health, as a substitute to mainstream GS in dense neighborhoods.

2. Objective and research question

As we have seen, no research measured or quantified PSG ownership direct association or moderation effects on neighborhood perception, behavior, or human health.

Therefore, our research's objective is to fill this gap through the study of PSG ownership in a dense Moroccan neighborhood. Our study area benefitted from a governmental program that encouraged PSG ownership, resulting in a significant increase in PSG presence on neighborhood streets. The outcome of this study will guide and inform urban policy and urban design in order to bring UGS benefits to dense deprived residential areas and highlight the role of informal green space. In line with our literature review, we extend prior research by investigating PSG efficacity as a substitute to formal UGS, our main research question (RQ) being:

RQ: **What are the associations between PSG and neighborhood perception, human behavior, and human health?**

The main question is divided into three sub-questions:

- What are the associations between PSG and neighborhood perception?
- What are the associations between PSG ownership and human behavior and neighborhood attachment?
- What are the associations between PSG ownership and human health?

3. Literature review

In the literature review, we focused on existing research findings studying PSG and linking UGS and PSG in particular with our domains of interest. We used the findings to develop our study's methodology, investigate the limitations of existing literature, and identify adequate measures that will allow us to assess our three domains of interest neighborhood perception, human health, and human behavior. We summarize our findings in the next section.

The methodologies used in the reviewed research varied from cross-sectional surveys, experimental designs, qualitative interviews, and mixed methods, results, and methods used in the most interesting consulted literature are summarized in tables. The consulted literature was obtained through the search of databases, mainly google scholar, CINII, and Ph.D. theses.

3.1. Street potted gardens

The most striking result of our literature review was that the vast majority of PSG related studies were undergone in Japan, written in Japanese, and focused on its nature as a typical component of residential areas. The initial research using English keywords revealed very few studies written in that language. We focused our review on papers addressing PSG-human-space interaction. See Table 1-1 for the methodologies and findings of the principal papers consulted.

Most studies identified PSG as territoriality display objects, used in part to subtly warn potential intruders that a defined space is claimed by specific individuals, similarly to the way the presence of a book in a public library signals a seat is occupied by someone else (Kobayashi and Suzuki 1981; Suzuki 1984). PSG continued presence on public space also serves in the distribution of territories and areas of influence between neighbors (Ikkai, Shimizu, et al. 1999), which has the effect of "suppressing unnecessary conflicts between friends"[1] and leads to a better relationship between neighboring housewives living in the same area (Kobayashi 1992). PSG were more abundant in areas suffering from a shortage in UGS. They were also associated with increased

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[1] (Suzuki 1984) p:25

neighborhood greenery perception (Mizukami and Hagihara 2001), and in front of low-rise buildings with narrower streets (Masuda and Hino 2018).

Table 1-1 key studies addressing PSG-human-space interaction.

Authors	Methods	Findings related to PSG
(Masuda and Hino 2018)	Study to determine the relationship between the physical characteristics of alleys and the distribution of potted plants using data on the neighborhood characteristics street width, length, distance to wide roads, building use, etc.	Potted plants are more abundant when the road and frontage are narrower; buildings are denser, setback distance shorter, distance to roads more than 6 meters or shorter, and the rate of buildings that are three stories or smaller is higher.
(Kobayashi 1992)	Survey and direct observation of residential neighborhoods' characteristics and population.	PSG are a display of territoriality and a way to dissuade intruders from misbehaving.
(Suzuki 1984)	Survey and direct observation of residential neighborhoods characteristics and population.	PSG presence in residential neighborhoods marks a space like a book reserves a seat in a library, in a subtle but clear way.
(Jonas 2007)	Qualitative research using in-depth interviews and direct observation This study explores the origin and the present condition of flowerpot gardens in the landscape of low-rise residential districts in Tokyo.	The author notes the good maintenance of flowerpot gardens and the public space where they are present. For her, flowerpot gardens blur the border between private and public spaces with its characteristic as green space.
(Mizukami and Hagihara 2001)	Study to investigate the relationship between the amount of green space and the volume of potted plants in a defined urban area using photos.	PSG presence increased neighborhood greenery perception.
(Ikkai, Shimizu, et al. 1999)	This study uses direct observation and a survey to identify elements used in partitioning public-private territories in residential areas and its psychological effect on the formation of the streetscape image.	Results show a high utilization of natural elements such as flower plants and trees as they give a good impression. The streetscape characteristics are essential factors in forming a community and an image of the street.

Jonas (Jonas 2007) remarked that PSG presence on the public ground had a hybridization effect on the surrounding space, changing its perception to semi-private, semi-public. Suzuki (Suzuki

1984) remarked that the overflow of personal objects like plant pots in the public sphere made it like "you are interring to someone's house"[2]. These findings suggest that PSG promotion may be an effective strategy to address UGS shortage in dense neighborhoods, at least from a landscape perspective.

Nevertheless, the existing literature presents some limitations:

- PSG were studied mostly in Japan, the third-largest economy, and one of the safest countries in the world, where crime and vandalism are rare (Johnson 2007). To our knowledge, PSG' association with neighborhood perception and human health and behavior has never been studied in a less advantaged context.

- No research measured the potential direct association and moderation effect of PSG ownership with prosocial behaviors, neighborhood perception or human mental and physical health, as a form of UGS, even though it does increase neighborhood greenery perception (Mizukami and Hagihara 2001)

- No experiment or longitudinal study was carried to assess the causality direction of PSG-human associations or to identify the cultural dimension of this phenomenon.

- The vast majority of theH papers were available only in Japanese.

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[2] (Suzuki 1984) p:62

3.2. Neighborhood perception

- **Life satisfaction**

Reviewed literature also suggests a strong relationship between life satisfaction and UGS. As reported by a cross-sectional study from Zhang et al. (Zhang et al. 2015), the degree of availability and accessibility of UGS in two otherwise similar Dutch neighborhoods were significantly positively associated with neighborhood satisfaction. A second study by the same author (Zhang et al. 2017) using the same data revealed the mediating role of neighborhood green space quality in defining neighborhood satisfaction, which suggests that UGS characteristics do play an essential role in defining neighborhood perception. Besides, a large-scale longitudinal study (White et al. 2013) covering 18 years and 10.000 British citizens, found that proximity to UGS increased life satisfaction, the effect size was week but stronger than neighborhood safety, and even average income in the neighborhood.

Among other variables positively related to neighborhood satisfaction level, we also find neighborhood physical and social characteristics and perceived safety (Grogan-Kaylor et al. 2006). In their cross-sectional study of neighborhood satisfaction correlation with landscape structure, Lee et al. (Lee et al. 2008) used these same variables to measure neighborhood satisfaction using a set of questions asking about overall satisfaction, neighborhood pride, and neighborhood perception.

- **Social capital**

Social capital is defined as the network of relationships among people who live, work, and interact in a specific society, allowing that society to function efficiently (Putnam 2000), and represents a central concept that was associated with a vast array of neighborhood life aspects and human health. De Silva et al., for example, analyzed twenty-one quantitative studies; the results, although mixed, associated increased social capital with a decreased likelihood of mental illness symptoms (De Silva 2005). While Takakura et al. cross-sectional study among high school students, revealed a positive association between increased social capital and increased school and neighborhood perceived safety, and physical activity levels (Takakura et al. 2014). Neighborhood perceived characteristics also had a significant association with social capital, as suggested by Ziersch et al. (Ziersch et al. 2005) as increased perceived cleanliness and decreased

noise annoyance were associated with increased social capital. Jennings & Bamkole suggested that UGS association with increased social capital, makes it a strategic way to increase neighborhood social capital (Jennings and Bamkole 2019a).

Mackenbach et al. highlighted measurement issues encountered by researchers aiming to operationalize social capital concept (Mackenbach et al. 2016), in their cross-sectional study they used a 13-item scale Items assessing the interactions and relationships in the neighborhood such as 'the people in my neighborhood get along with each other well,' developed by Beenackers et al. (Beenackers et al. 2013). We based our measure of social capital on this survey tool.

- **Perceived safety**

Findings concerning UGS association with neighborhood perceived safety were mixed. Several studies associated well-maintained green spaces, with more trees and grass, to increased feelings of safety and preference (Garvin et al. 2013; Gorham et al. 2009; Kuo et al. 1998), and decreased crime and violence rates (Bogar and Beyer 2016). While other studies revealed a null relationship between crime rates and UGS (Locke et al. 2017), for law enforcers, the presence of vegetation in urban settings was even perceived as a potential screen for criminal activities (Kuo et al. 1998). For Hideki Kobayashi & Suzuki, PSG represents a sign of increased territoriality and space monitoring that dissuades potential offenders (Kobayashi and Suzuki 1981; Suzuki 1984), which might potentially result in an increased neighborhood perceived safety. Although, to our knowledge, no study quantified or compared perceived safety and crime rates in neighborhoods with and without PSG.

These studies suggest that in general, green space has a high potential for increasing safety perception; the maintenance and type of green space do play a central role in its perception and its association with surrounding residential areas' perceived safety.

- **Noise annoyance**

An experimental study by Aylor (Aylor 1972) proved that vegetation could also reduce noise pollution significantly, by physically disrupting its propagation from the noise source to the receivers. While several other research unveiled its psychological effect in reducing noise levels annoyance, either by masking undesirable sounds or concealing the noise source (Dzhambov, Markevych, B. Tilov, et al. 2018; Van Renterghem 2019; Van Renterghem and Botteldooren 2016).

Riedel et al. also found that perceived control played a significant role in reducing noise annoyance especially for the elderly (Riedel et al. 2018), in that logic PSG association with territoriality as a tool separating areas of control between neighbors, and as "keep out" signs for outsiders might be an inherent characteristic linking PSG ownership and noise annoyance levels.

- **Perceived cleanliness**

UGS's relation with neighborhood perceived cleanliness received much less interest from researchers. Very few (Jonas 2007; Kobayashi and Suzuki 1981; Suzuki 1984) noted that streets with PSG were clean and well maintained, but in general, we found no empirical research directly linking or measuring neighborhood green space association with perceived cleanliness.

The consulted research about the UGS-neighborhood perception association presents some limitations.

- The vast majority of these studies were undergone in developed countries, mainly in North America and Europe, and focused only on the effect of formal UGS like street trees, grass, and community gardens, and did not include informal green space like PSG.

- UGS association with neighborhood perceived cleanliness did not receive enough interest despite its importance for mental and physical health (Bennett 2012).

- The majority of studies were cross-sectional and cannot assume any causal direction between studied variables.

Table 1-2 Urban green space and neighborhood perception

Authors	Methods	Findings
(Locke et al. 2017)	A quasi-experimental study, investigating the effect of street trees addition on crime levels.	The crime rate did not change after the addition of new street trees.
(Bogar and Beyer 2016)	A systematic literature review examining empirical and quantitative evidence of UGS association with crime and violence in the United States.	UGS has a negative association with violence and crime, towering trees, and high levels of vegetation demonstrate consistent decreases in crime and violence.

(Kuo et al. 1998)	An experiment where participants rated pictures of different trees densities and grass maintenance levels in term of preference and safety feeling	Participants preferred and imagined feeling safer in environments with more trees and well-maintained grass.
(Garvin et al. 2013)	A randomized controlled trial testing the impact of vacant lot greening on police-reported crime, and residents' perceptions of safety and disorder.	The intervention area had a significant increase in neighborhood perceived safety and a non-significant decrease in the number of total crimes and gun assaults compared to control.
(Gorham et al. 2009)	Comparison in crime rate between areas with and without community gardens using crime data from the Police Department.	No difference in crime rate between areas with community gardens and the randomly selected areas. Populations with community gardens felt safer in their neighborhoods.
(Dzhambov, Markevych, B. Tilov, et al. 2018)	A cross-sectional study measuring noise annoyance, UGS distribution and the noise level were assessed, before the cross-sectional survey.	UGS was associated with less noise annoyance, which suggests UGS reduces noise annoyance physically and psychologically.
(Aylor 1972)	Experimental design, studying noise transmission trough vegetation.	Vegetation can disrupt noise propagation from the source to the receiver.
(Van Renterghem and Botteldooren 2016)	Cross-sectional study in a residential area highly-exposed to road traffic noise, with either an abundance or a lack of vegetation.	View on outdoor vegetation reduced noise annoyance for survey participants near busy roads compared to those with no vegetation view.
(Riedel et al. 2018)	A cross-sectional study with elderly urban population measuring noise annoyance and perceived noise control controlling for dwelling related green.	The authors recommend fostering dwelling related green even though it was not significantly associated with noise annoyance reduction.
(Zhang et al. 2015)	A cross-sectional study of UGS availability and accessibility association with neighborhood satisfaction.	Availability and accessibility of UGS were significantly positively associated with neighborhood satisfaction.
(Zhang et al. 2017)	A cross-sectional study of UGS quality association with neighborhood satisfaction.	Neighborhood UGS quality mediated neighborhood satisfaction association with dwelling environment characteristics.
(White et al. 2013)	A large scale longitudinal study investigation UGS proximity association with life satisfaction	UGS proximity was significantly associated with life satisfaction, with an effect size stronger than perceived safety and income.
(Grogan-Kaylor et al. 2006)	A cross-sectional study of neighborhood characteristics association with satisfaction.	The environment's physical and social characteristics were positively associated with neighborhood satisfaction.

(Lee et al. 2008)	A cross-sectional study of urban landscape structure' association with neighborhood satisfaction	Survey measured neighborhood satisfaction using neighborhood pride and overall satisfaction among other variables.
(Mackenbach et al. 2016)	A cross-sectional study of neighborhood social capital' association with health, and its operationalization issues.	Social capital was associated with improved health; the study stressed the necessity of using adequate measures for social capital.
Takakura et al., 2014	Cross-sectional study among high school students, investigating school and neighborhood social capital association.	Social capital was positively associated with physical activity and school and neighborhood safety.
(De Silva 2005)	Analysis of twenty-one quantitative studies studying social capital association with mental illness.	Increased social capital was associated with a decreased likelihood of mental illness symptoms.

3.3. Prosocial behaviors and neighborhood attachment

- **Prosocial behavior**

Previous research finding suggests the possibility of engineering prosocial behaviors by manipulating the physical context. The presence of images of eyes increased the subject's generosity in dictator games resulting in more generous donations and a more significant contribution to the public good (Burnham 2003; Burnham and Hare 2007; Oda et al. 2011). In urban contexts, it was also found to limit littering behavior (Bateson et al. 2013). The studies suggest that feeling observed or perceiving signs of being observed might be associated with more prosocial behaviors. In that line, PSG presence on the street might have a similar effect on outsiders' behavior, inducing a feeling of being observed.

According to Nassauer (Nassauer 1995) "cues of care" or the orderliness of a defined landscape might play the same role as the images of eyes used in the previous experiments, in subtly hinting that that area is under the care of individuals that will come back any time, or to the presence of observers eying the intruders. Which means that cues of care that appear trough the condition of a defined landscape, might also be interpreted as cues of surveillance inducing a more prosocial behavior.

Guéguen & Stefan's experiment studying the association between altruistic or prosocial behaviors and the immersion in a natural green environment found that helping behavior was significantly higher after a walk in a natural park. These results suggest that interaction with green elements might be associated with prosocial behaviors (Guéguen and Stefan 2016).

- **Place attachment**

Place attachment can be defined as a set of positive emotional bonds to physical and social settings, characterizing a defined place (Florek 2011), and implying the willingness to stay in a place or intention to return to a place when away (Manzo and Devine-Wright 2013b). Manzo & Devine-Wright stressed that a large number of studies used intention to stay as a measure to assess place attachment levels (Manzo and Devine-Wright 2013a). While Clark et al. associated intention to stay in the neighborhood with higher place attachment (Clark, Duque-Calvache, and Palomares-Linares 2017).

Place attachment occupies a vital role in urban life as attested by the findings of Brown et al. cross-sectional study, undergone in a deteriorating neighborhood in Salt Lake City. The study acknowledged its potential as a revitalization tool while highlighting its strong association with perceived neighborhood characteristics (Brown, Perkins, and Brown 2003).

Studies that investigated UGS association with place attachment revealed a strong correlation between the two (Arnberger and Eder 2012), with the relationship being more important for less socioeconomically privileged residents (Łaszkiewicz, Kronenberg, and Marcińczak 2018), while other others found a null relationship between proximity to UGS and neighborhood attachment (Kimpton, Wickes, and Corcoran 2014).

Table 1-3 Cues of monitoring effect on human behavior

Authors	Methods	Findings
(Nassauer 1995)	Essay about Landscape and how it communicates human intention to care for the landscape, "cues to care," and demonstrate how these cues can be used in design.	"Cues of care" is defined as the orderliness of a defined landscape or the front yard of a house, and implies that a a place is under the care and surveillance of a person.
(Bateson et al. 2013)	Experiment exploring littering behavior associated with the presence of images of eyes.	Images of eyes were associated with reduced littering behavior, and more pro-social behavior.
(Oda et al. 2011)	Experiment measuring allocated money to strangers in the presence or absence of a painting of stylized eyes. The participants filled a questionnaire investigating why they decided the amount of money to offer.	Stylized eye painting presence was associated with more money allocated to recipients than in control condition. Participants expected their actions would enhance their reputation.
(Burnham and Hare 2007)	An experiment measuring images of eyes impact on individual's contribution to the public good.	Subjects "watched" by the eyes contributed 29% more to the public good than subjects without the eyes watching.
(Burnham 2003)	The dictator game was used to examine the role of anonymity and perceptions of anonymity in the choice of sharing 10 dollars.	Subjects that viewed pictures of recipients gave more money, than those that didn't view any pictures.
(Kimpton et al. 2014)	Cross-sectional study investigating contextual greenspace influence on place attachment in an Australian context	There was a null relationship between proximity to green space and place attachment.
(Brown et al. 2003).	Cross-sectional study in a Salt Lake City deteriorating neighborhood.	Place attachment was associated with neighborhood perceived safety, and is a potential tool for urban revitalization.
Guéguen & Stefan, 2016	Experiment studying immersion in a green environment association with altruistic behaviors	Findings suggest a significant positive association between altruistic behavior and immersion in green environment.

3.4. Human health

UGS association with human health was found to be mainly positive, GS and vegetation in general has a vast array of benefits on physical and mental health. Interaction and proximity to public parks and gardens reduced stress levels (Bratman et al. 2015; Jiang et al. 2016; Koga and Iwasaki 2013; Ulrich et al. 1991), post-traumatic stress disorder (PTSD), and depression symptoms (Bezold et al. 2018; Kotozaki 2013). Proximity to public gardens was also associated with increased senior citizens' longevity (Takano et al. 2002). The regenerative effect of green space was also deduced by Ulrich's famous study, where he measured the recovery time for patients after the same kind of surgery in two identical types of hospital rooms, one with a window giving to a garden and the other having a window view on a brick wall (Ulrich 1984). The findings revealed that patients with the garden view recovered faster and required fewer painkillers medications.

Our literature review investigating UGS' association with physical activity revealed mixed findings. The vast majority of studies associated GS proximity with increased physical activity levels and less obesity (Akpinar 2016; Nielsen and Hansen 2007; Schipperijn et al. 2013). Nevertheless, Wilhelmsen et al. (Wilhelmsen et al. 2017) found that the percentage of overweight and obese adolescents increased significantly when the percentage of green areas in the participants' surrounding increased, the authors explained the finding by the unattractive nature of available UGS. All of these associations suggest a psychological and physical regenerative effect of UGS on human health and wellbeing in general, and the importance of GS condition.

Studies that empirically measured the impact of UGS on human health revealed even more interesting results. Kardan et al. (Kardan et al. 2015), for instance, found that the addition of ten more trees in a Toronto city block was associated with an improved perceived health condition equal to a ten thousand dollars increase in personal annual income or being seven years younger. Engemann et al. (Engemann et al. 2019) research, investigating the correlation between green space and mental health in Denmark, revealed that children who grew up with the lowest levels of green space had up to 55% more risks of developing a mental disorder even after controlling for other known risk factors. Furthermore, Donovan et al. longitudinal study spanning form 1997

and 2007, and investigating the impact of the progressive loss of 100 million threes (due to a forest pest), on mortality rates, found a significant increase in mortality (a total of 21.193 deaths) due to cardiovascular and lower-respiratory-tract illness in areas infested with the forest pest (Donovan et al. 2013).

The main two variables investigated in previous studies and fitting our research scope are depression and physical activity. These two variables present the advantage of being easily measurable using a questionnaire; they also occupy a central role in defining the human health condition. According to the world health organization (Who 2010), physical inactivity is the leading cause for more than a quarter of all breast and colon cancers and diabetes, it is also responsible for 6% of deaths globally, making it the fourth leading mortality risk factor in the world, while depression is the leading cause of disability in the world (Depression 2017).

The results of the literature review suggest that increasing UGS quality, quantity, and accessibility would be an effective way to improve the urban population's physical and mental wellbeing and decrease risk factors for their health.

The available research about the UGS-health association presents some limitations.

- Most of the research consulted, studied data gathered in developed countries even though most of the world's urban population will be living in developing countries (Chan 2008), where the urban culture, living conditions, and needs are significantly different.
- The vast majority of the existing literature focused on the effects of formal UGS on health. To our knowledge, no research investigated PSG potential association with physical and mental health.

Table 1-4 Research on the effects of green space on human health

Authors	Methods	Findings
(Jiang et al. 2016)	Experimental design. Subjects participated in a Trier Social Stress Test to induce stress, watching three-dimensional videos of street scenes with varied density of tree cover, and afterward filled a Visual Analog Scale questionnaire.	The density of urban street trees was positively associated with self-reported stress recovery.

(Bratman et al. 2015)	Experimental design, measuring affective and cognitive functioning on 38 participants before and after a walk of 90 minutes.	walking in a natural setting decreased rumination in depressed and healthy individuals, whereas a walk in an urban setting has no such effects.
(Kardan et al. 2015)	High-resolution satellite imagery with individual tree data in Toronto, combined with a survey measuring self-reports of general health perception, cardio-metabolic condition, and mental illness.	Ten more trees in a city block improve health perception comparably to a $10,000 increase in annual personal income or being seven years younger.
(Koga and Iwasaki 2013)	Experimental study using cerebral blood flow to investigate the psychological and physiological effects of touching plant foliage.	Touching a leaf of natural pathos caused people to experience an unconscious calming response and relaxing feelings.
(Kotozaki 2013)	Experimental design. Older female adults with PTSD divided into two groups; one received a horticultural therapy and a control group.	Horticultural therapy had a positive effect on PTSD's mental and physiological symptoms.
(Nielsen and Hansen 2007)	Cross-sectional study exploring access to and usage of green space, and its impact on stress and obesity.	Access to gardens and short distances to green space is associated with less stress and obesity.
(Takano et al. 2002)	A longitudinal study using five years of survey data from 3144 Japanese older adults.	Living in areas with walkable green spaces influenced the longevity of the senior citizens positively.
(Gorham et al. 2009)	Cross-sectional study among community gardeners, investigating garden benefits and gardeners' perception of quality-of-life based on Maslow's hierarchy of human needs.	Community gardens are essential to all racial/ethnic backgrounds and are meeting quality-of-life needs on the higher levels of esteem and self-actualization.
(Ulrich et al. 1991)	An experimental study where participants watched stressful films followed by videos of natural or urban scenes. The effect of follow up video on stress was assessed using Heart rate, muscle tension.	Watching natural scenes was associated with faster recovery from stress compared with watching urban scenes.
Ulrich, (1984)	A longitudinal study conducted between 1972 and 1981 using the medical record of 46 patients. The study compared recovery time after surgery for patients in rooms with either view of brick wall or trees.	Patients who had views of trees had shorter stays in the hospital, required fewer pain relief drugs, and received fewer negative reports compared to patients with a wall brick view.

4. Research Hypotheses

We hypothesize that PSG association with neighborhood perception and human health and behavior follow the same pattern as its association with formal UGS. We argue that PSG presence on neighborhood' streets, the necessary daily routines related to PSG maintenance (like cleaning and watering), in addition to the optional recreational activities (like sitting or chatting or eating) undergone next to it:

- Affect how locals and outsiders perceive the neighborhood

- Affect locals' behaviors and health.

- Define territories of cleaning and protection responsibility that make the neighborhood cleaner, safer, and calmer (by reducing outsiders' noisy activities like children playing soccer, or loud chatting).

- Induce more presence on neighborhood streets, resulting in more interactions and better relations with more neighbors, and more profound knowledge of neighborhood characteristics.

- Induce more physical activity and more contact with green vegetation resulting in better mental and physiological health.

- Induce a better perception of the neighborhood's physical and social characteristics by outsiders.
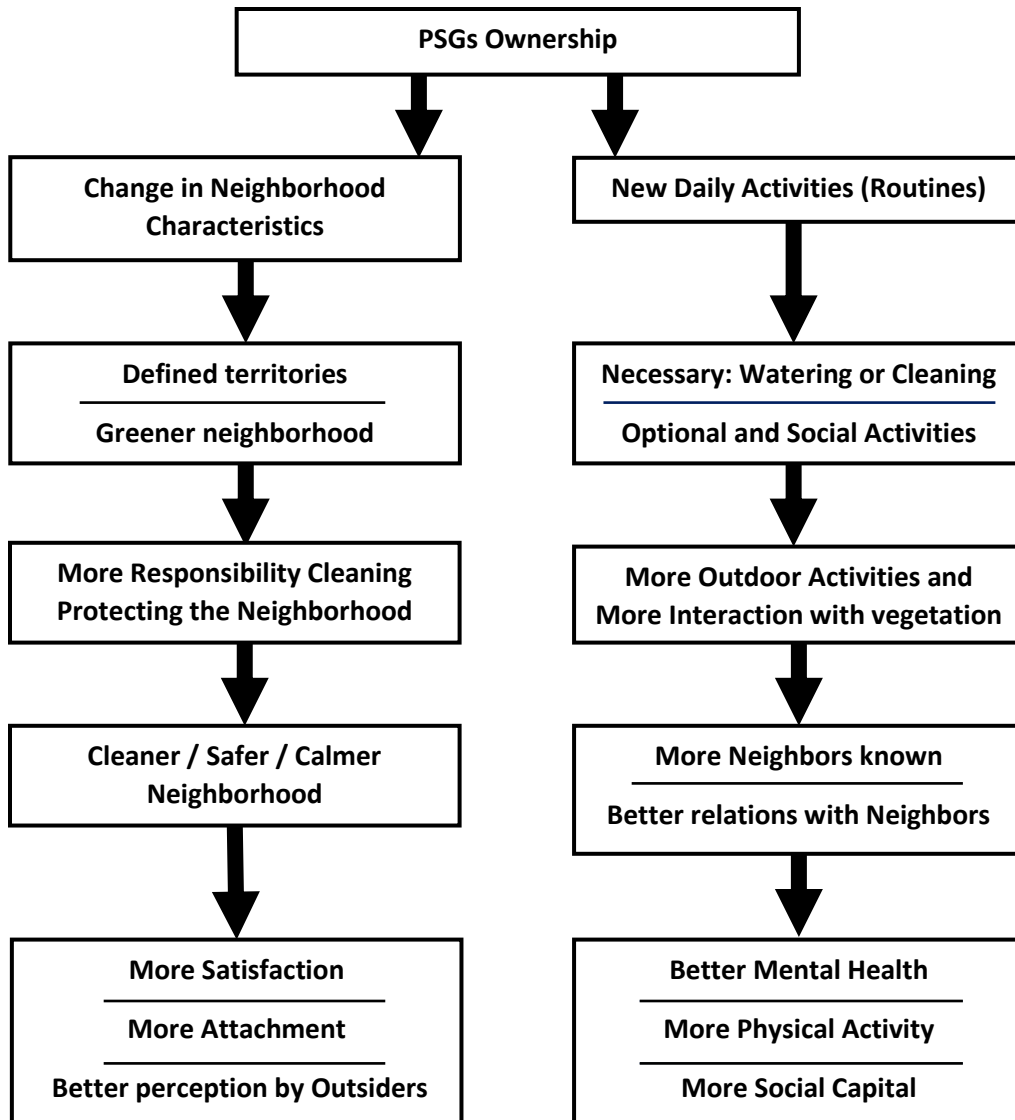
Figure 1-4. Diagram showing PSG hypothesized association with neighborhood perception by locals and outsiders, and human health and behavior (made by the author).

In order to operationalize our assumption, we propose a series of hypotheses to be verified through data collection and data analysis, categorized by three main domains of variables presented in the next section. We will focus on two types of correlations between our main variables; direct associations between PSG ownership and our dependent variables (DVs), and moderation effects of PSG ownership on the associations between our DVs and our independent variables (IVs).

4.1. Neighborhood perception hypotheses

For this first domain of variables, we will focus on neighborhood perception from two points of view, neighborhood residents or insiders, and nonresidents or outsiders. We will compare insiders and outsiders perceptions of the neighborhood physical characteristics, while outsiders perception of its social characteristics will be studied separately.

For insiders, we focused on five aspects related to neighborhood life: Neighborhood Life quality satisfaction, social capital, perceived safety, cleanliness, and noise annoyance.

While for outsiders, we focused on seven aspects; four related to neighborhood physical characteristics, (promenade enjoyment, perceived cleanliness, safety, and calmness), and three related to how outsiders perceive local's (feeling of being monitored by locals, neighbors' relationship quality, and neighborhood belonging pride).

Therefore, we hypothesize that:

Hypothesis 1: PSG ownership has a positive association with Neighborhood Life quality satisfaction, social capital, perceived cleanliness and safety, and a negative association with noise annoyance.

Hypothesis 2: PSG ownership has an enhancing moderation effect on the associations between each of our DVs and central IVs.

Hypothesis 3: PSG related daily routines and PSG perception are positively associated with Neighborhood Life quality satisfaction, social capital, perceived safety and cleanliness, and a negative association with noise annoyance.

Hypothesis 4: PSG presence on the street has a positive association with outsiders' perception of neighborhood cleanliness, safety, and calmness, feeling of being monitored, neighbor's relationship quality, locals' neighborhood belonging pride, and promenade enjoyment in the neighborhood.

4.2. Human behavior and neighborhood attachment hypotheses

For this domain of variables, we will measure PSG association with the "intention to move" out of the neighborhood as a variable related to neighborhood attachment. We will also investigate two prosocial behaviors, cleaning and protecting, as acts of altruism that lead to further similar acts and result in a cleaner and safer neighborhood according to the reciprocal altruism theory (Trivers 1971). We will also study the diffusion of these behaviors in neighborhood areas. We hypothesize that:

Hypothesis 1: PSG ownership has a positive association with the intention to stay in the neighborhood and cleaning and protection responsibilities and with a higher diffusion of neighborhood areas to clean and protect.

Hypothesis 2: PSG ownership has an enhancing moderation effect on the associations between neighborhood perceived characteristics and intention to stay in the neighborhood and cleaning and protection responsibilities and with the diffusion of neighborhood areas to clean and protect.

Hypothesis 3: PSG related daily routines and PSG perception are positively associated with intention to stay in the neighborhood and cleaning and protection responsibilities and with the diffusion of neighborhood areas to clean and protect.

4.3. Human health hypotheses

In this domain of variables, we will focus on depression and moderated physical activity to measure mental and physical health.

Hypothesis 1: PSG ownership has a positive association with moderated physical activity and a negative association with depression le vels.

Hypothesis 2: PSG ownership has an enhancing moderation effect on the associations between neighborhood perceived characteristics and moderated physical activity and a buffering effect on the associations between neighborhood perceived characteristics and depression level.

Hypothesis 3: PSG related daily routines and PSG perception are positively associated with moderated physical activity and negatively associated with depression levels.

The theories mentioned above are summarized in figures 1-5 and 1-6 and 1-7. In addition, we will be detailing each of these hypotheses in the introduction of every analysis we conduct in separate diagrams.
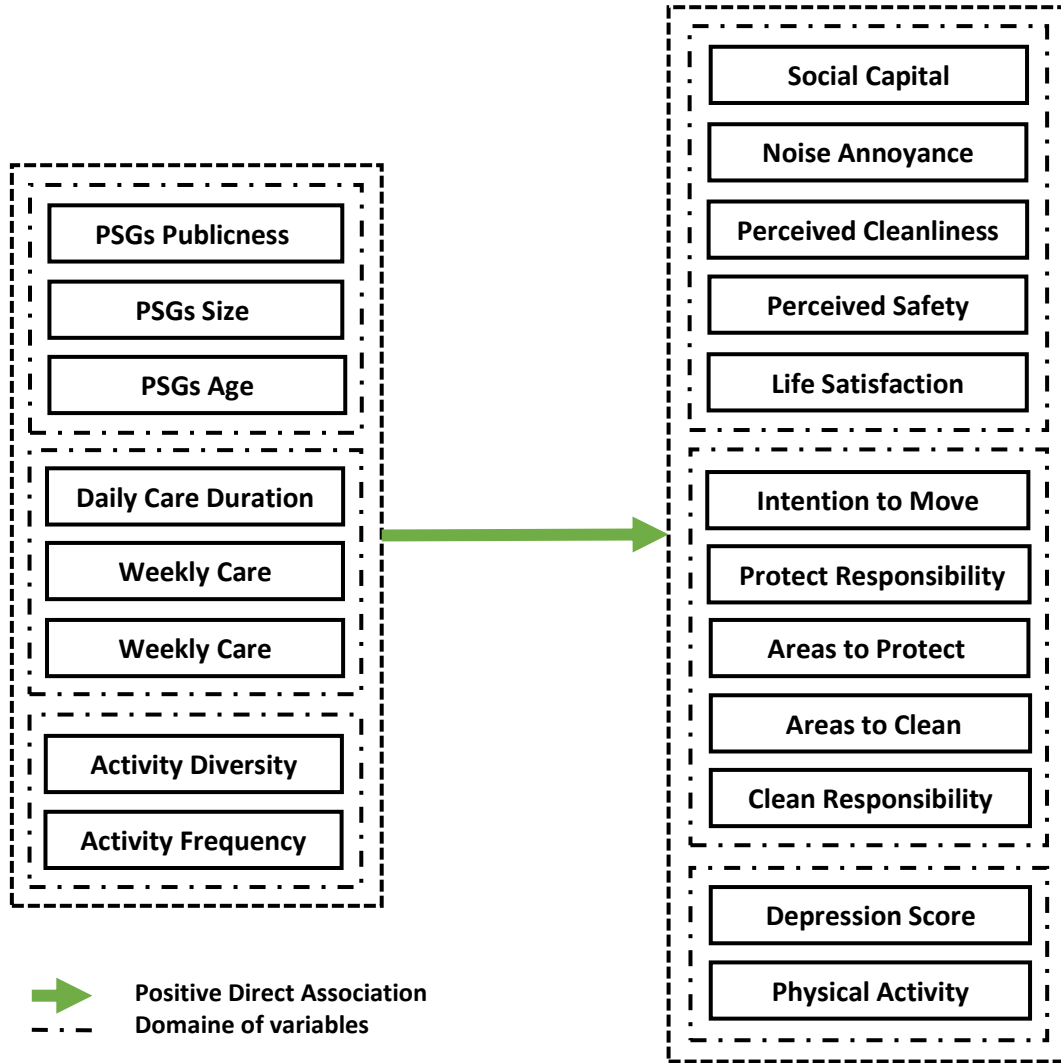
Figure 1-5. Conceptual model of the direct association between PSG perception, necessary maintenance activities, and recreational activities next to PSG (made by the author).

Figure 1-6. Conceptual model, representing the direct associations between our variables, and the moderation effect of PSG ownership on these associations. (made by the author).

Figure 1-7. Conceptual model representing the direct association between PSG presence and our variables (made by the author).

5. Thesis structure

In chapter I, we introduce our research background, and state the central problematic, in addition to our main hypotheses. We also present the main results of our literature review related to UGS associations with neighborhood perception, human behavior, and health.
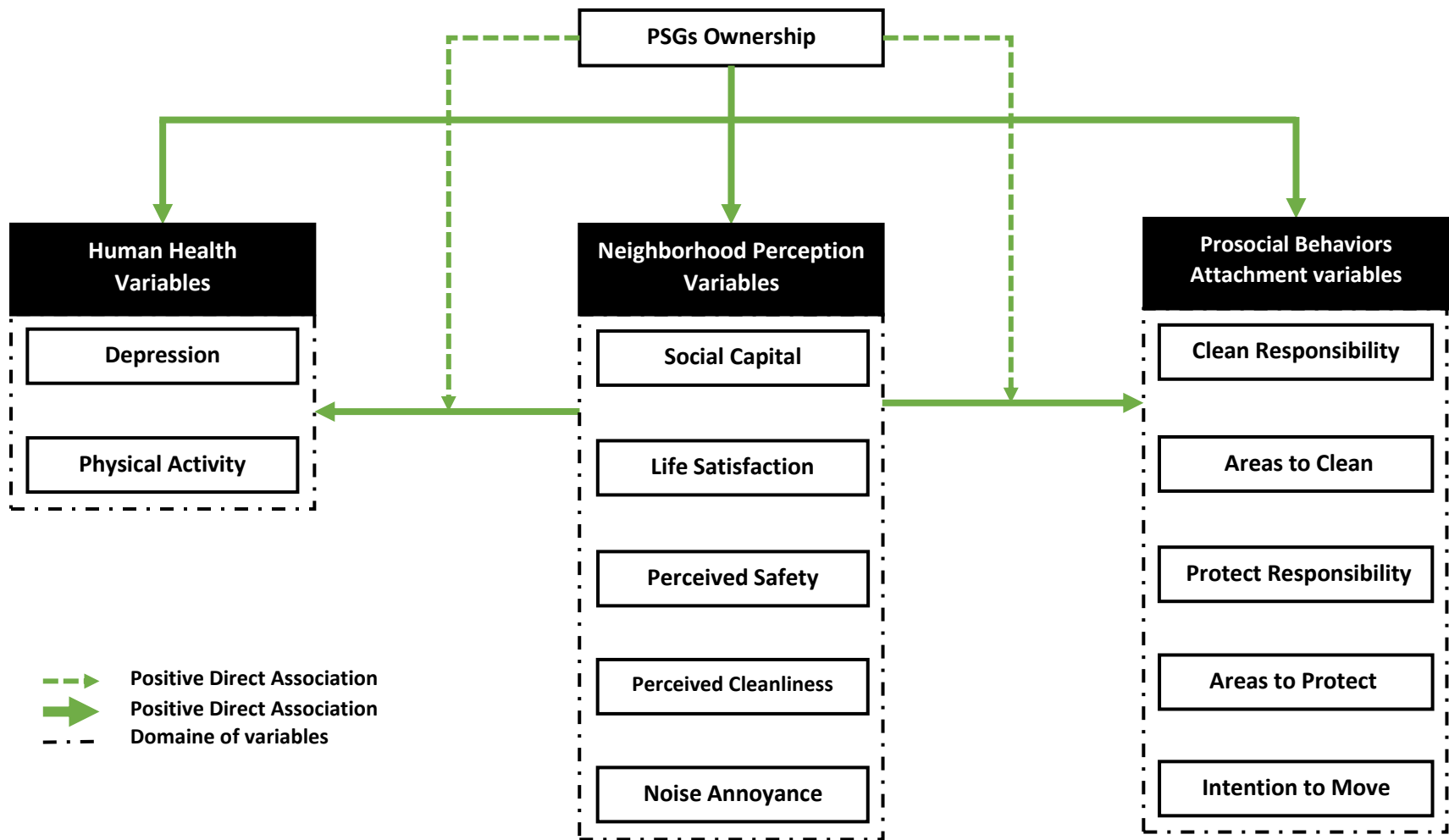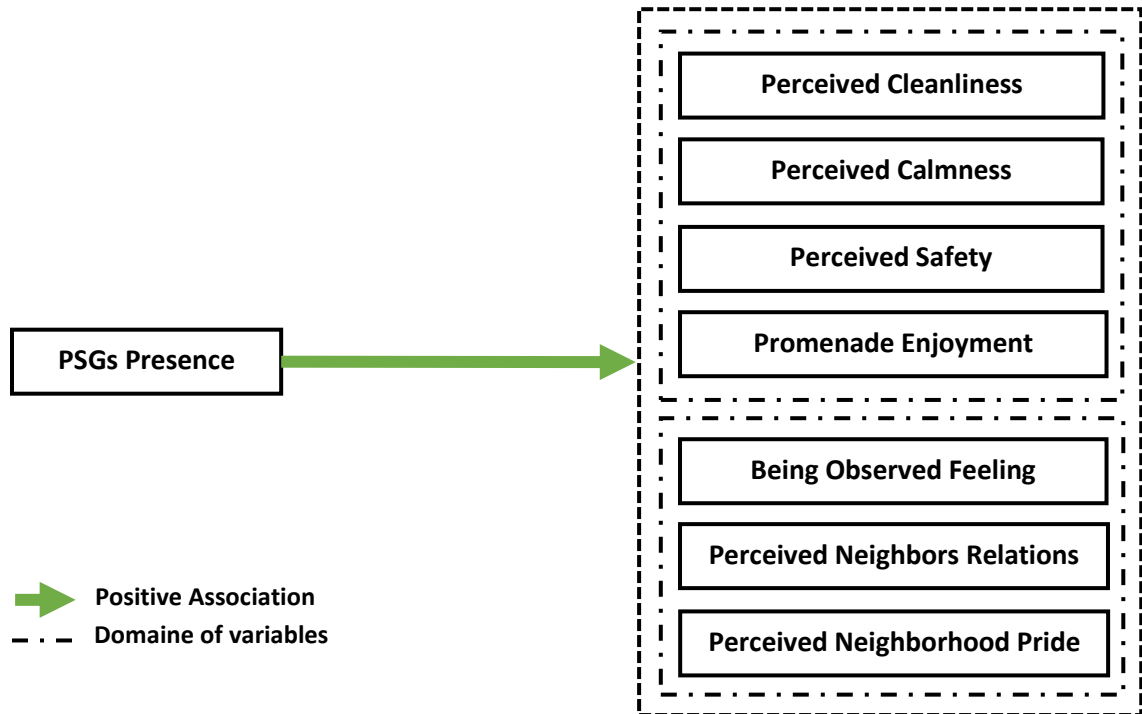
In chapter II, we present the main characteristics of our study area and the evolution of dwelling related green space in the Moroccan house.

In chapter III, we present the main aspects of our methodology, instruments, and measures used to assess our variables, data collection, and analysis plan.

In chapter IV, we present the survey analysis results, each variable apart categorized by our three main domains of variables. We first present results related to neighborhood perception domain, followed by those related to neighborhood attachment and prosocial behavior domain, and finally, those related to the health variables domain.

In chapter V, we present the promenade experiment analysis results, each variable apart.

In chapter VI, we present the conclusion of our study with the comparison of locals and outsiders neighborhood perception, limitations, and recommendations for future research.

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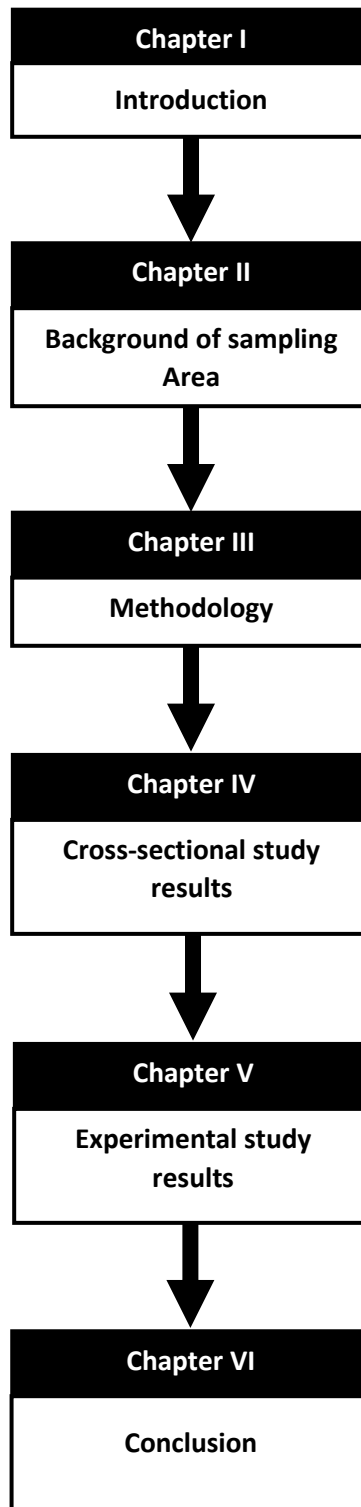
Figure 1-8. Research framework (made by author)

Chapter 2 : Background of study area

Figure 2-1 Situation of Tangier (Made by Author. Source. Google maps)

1. Tangier

Tangier is the northernmost port city in Morocco, and the second most important industrial center in the country, after Casablanca. It harbors the biggest port in the Mediterranean Sea and Africa. It occupies a very strategic position 14 kilometers from Spain across the Strait of Gibraltar, making it a gateway to Africa, Europe, and the Mediterranean Sea from the Atlantic Ocean. (Figure 2-1).

Throughout its history, the city has been coveted and occupied by many foreign countries. The Phoenicians probably founded Tangier in the 10th century BCE as a commercial platform with local Amazigh tribes. Subsequently, the area was occupied by Romans, Vandals, Byzantines, Visigoths, Arabs, Portuguese, Spanish and British. The city was finally liberated from occupation in 1684 by Moulay Ismail. The *medina* (walled city) was repopulated with local tribes. It later became the diplomatic capital of the country with foreign delegates taking seats in the city until 1912 when the Sultan signed the Treaty of Fez, starting the French-Spanish protectorate.

Figure 2-2 Aerial view of Tangier-Med, the largest port in Africa (source. www.sumitomocorp.com)

Northern Morocco became under Spanish administration, including Tangier, but again due to its strategic position, the status of the city was renegotiated. In 1924 Tangier became an international zone under the joint administration of France, Spain, Britain, and several other European countries, during that time the city knew a period of prosperity. However, after the Moroccan independence in 1956, Tangier knew a continuous period of decline that lasted until 2004 when the new port of the city, Tanger-Med, started construction (Figure 2-2).

Tanger-Med port became operational in 2007, and as of 2019 is considered to be the largest port in Africa and the Mediterranean Sea. The creation of new industrial logistic and free zones attracted more foreign investors and made Tangier the second most important industrial center in the country after Casablanca. This economic boom created a need for skilled and unskilled workers that produced a population boom, with newcomers from the region and other parts of the country. Consequently, Tangier's population almost doubled between 2004 and 2020 (Anon 2020) to become more than one million today.

Figure 2-3 Aerial view of Tangier with the situation of the study area (Source. www.acad.asso.

Delimitation of the study area
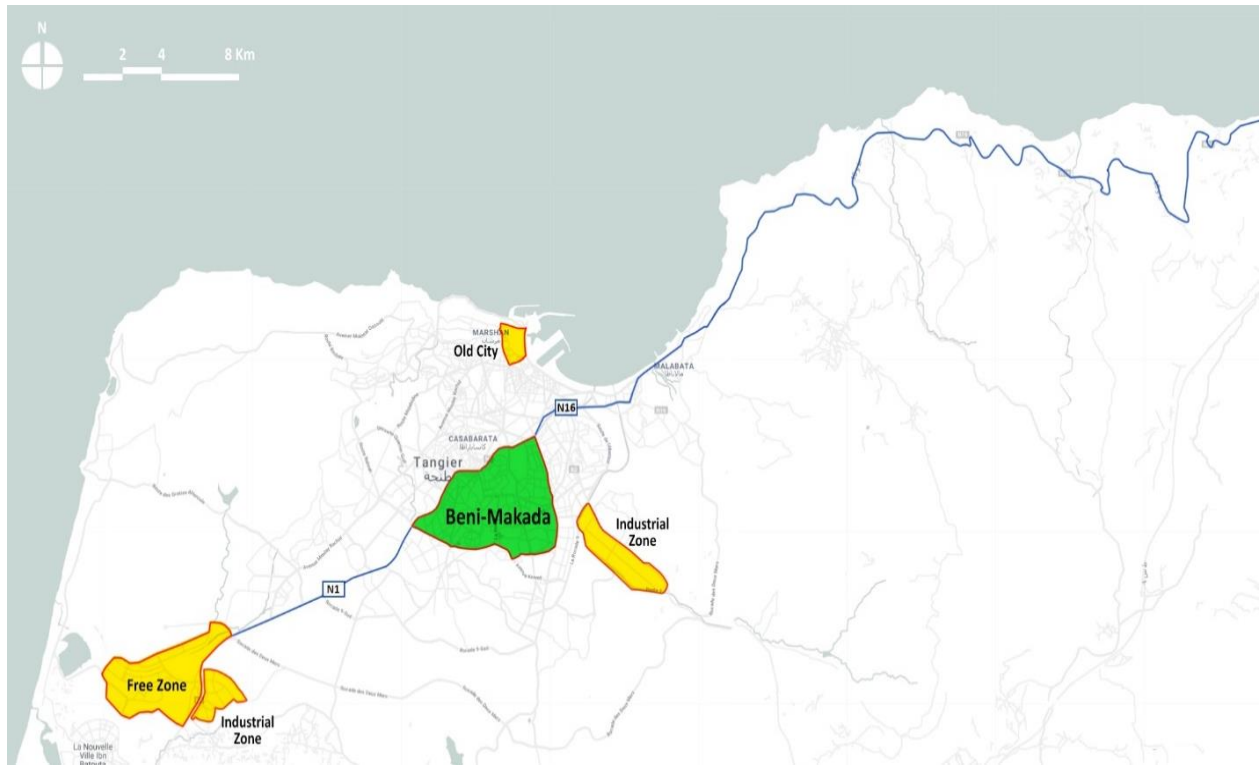Delimitation of Beni-Makada district

Figure 2-4 Situation of Beni-Makada (Made by author. Source. Google maps)

2. Beni-Makada

After the liberation of Tangier from British occupation in the 17th century, part of what is today the Beni-Makada district was settled by *Beni-Mkoud,* a *Houara* tribe (one of the biggest confederation of tribes in North Africa) that gave its name to the area. The newcomers established a small farming village that was still present in the area after Morocco's independence. Beni-Makda became gradually part of Tangier's urban fabric, attracting mainly its deprived immigrant population. The district was officially founded in 2002 with a royal decree and formally integrated into the urban area of Tangier.

Before 2016, Beni-Makada was famous mostly for being one of the strongholds of the 20- Février movement, the Moroccan version of the Arab spring (Desrues 2012), and for having some of the most dangerous neighborhoods in Tangier. Nevertheless, the district attracted significant media coverage and government attention during the 22nd conference of parties (COP22) organized in 2016, in part because of the unusual abundance of PSG, and the cleanliness of its residential streets compared to similar neighborhoods in Tangier and other cities in the kingdom.

Figure 2-5 Pictures of the study area (by author).

PSG were among the environmentally friendly initiatives highlighted and encouraged during the UN climate change conference. In Tangier, the local government tried to spread the use of PSG further, especially in dense and underprivileged neighborhoods to beautify these areas through a program called *madinati ajmal* or "My city more beautiful" in Arabic, started in February 2016. The local government organized competitions between neighborhoods and provided funds to local NGOs. Curiously most survey participants denied receiving any help from the government; some refused to be interviewed because they believed our study to be government-commissioned.

Figure 2-6 Street Potted Gardens in *Beni-Makada* (source: www.alaraby.co.uk)

However, according to our collected data, 77.3% of surveyed households started their PSG only after the governmental program was initiated.

Today Beni-Makada has the fastest growing population district in Tangier. The area's share of the city's population increase, between 2004 and 2014, was 56.8%, more than all the other districts combined (RGPH 2014). This is mainly due to the cheap rent and the abundance of low skilled job opportunities in its proximity, in the industrial and free zones situated south and east, and in the Tanger-Med port. According to the 2014 census (RGPH 2014), Beni-Makada is the most populated district of Tangier, housing more than 40% of the city's population, which amounts to 386.191 people living in 93.737 households, It is also its most disadvantaged area (La Cava et al. 2012; World Bank 2012), underequipped in social infrastructure, and suffering from the highest poverty rate (14 %) compared to the city's other districts (7 %) (Alvarez 2015). In 2016 the per capita green space in the area was 0.27m^2 (Anon 2016), by far the lowest compared to other Tangier' districts, and way lower than the 9m^2 per capita green within 15 minutes of walking distance from home advised by the world health organization (Pafi et al. 2016).
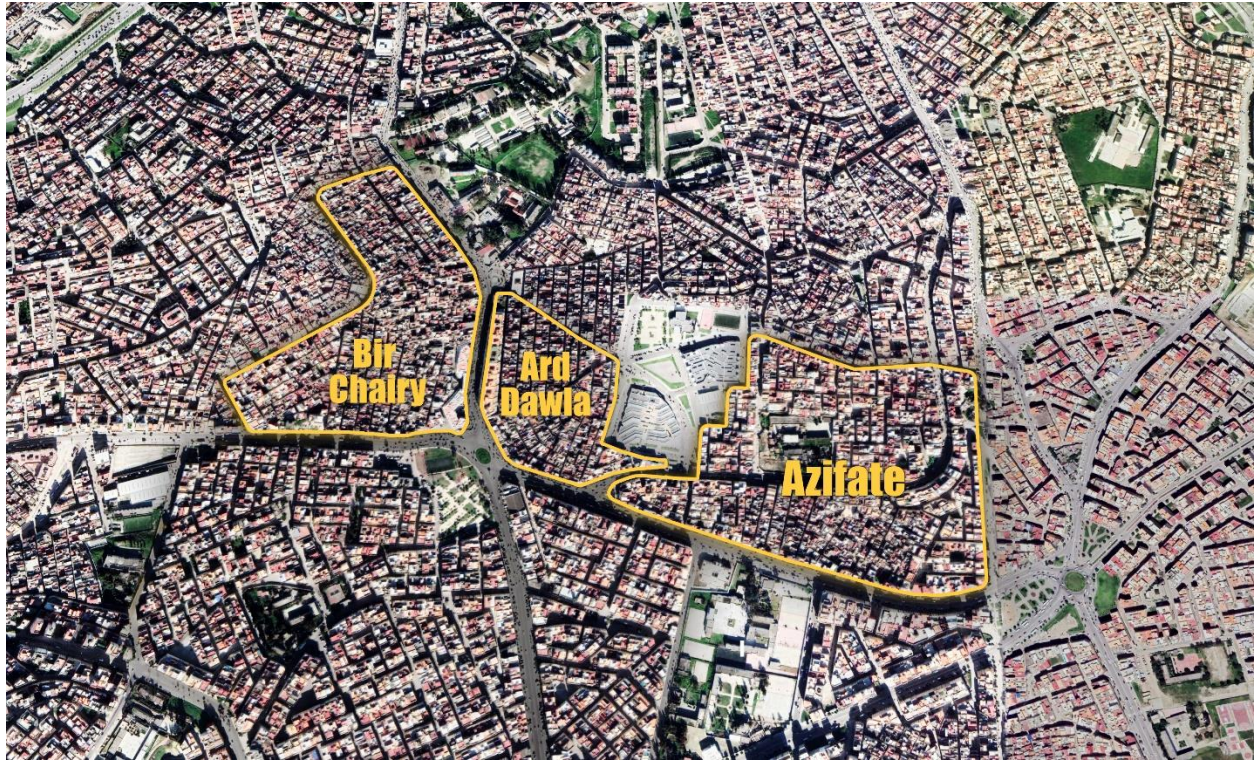
Figure 2-7 Situation of the study area (Made by author. Source. Google earth)

Beni-Makada's urban fabric is relatively homogenous, composed mostly of dense neighborhoods with few recent ones. According to the official census, 87 % of the area's households lived in Moroccan houses (Anon 2014), a housing typology that evolved from the traditional Moroccan house, as we will see later. Our study area's houses are occupied by one family or more and are characterized by the presence of a patio and accessible roof terraces. We focused our study on three dense neighborhoods (Figure 2-8); *Bir-Chairy, Ard dawla,* and *Azifate,* where PSG presence was the most mediatized in Moroccan outlets (Larbi Arbaoui 2016). The three neighborhoods are the result of multiple clandestine small subdivisions, with a significant disparity in street width, the presence of impasses, and streets accessible only by foot. In our first visit to the area, we noticed that the streets were dirty with a significant amount of litter, mainly sweets and biscuit wraps. According to locals, the government does not clean neighborhood streets regularly. Front yards with PSG were relatively cleaner and better maintained. As in all Moroccan cities, all first-floor apartment windows giving directly to the street are equipped with metallic security bars and are closed continuously to keep privacy. For safety reasons, only PSG, and heavy objects difficult to steel, like motorcycles and cars, are kept overnight in front of local houses.
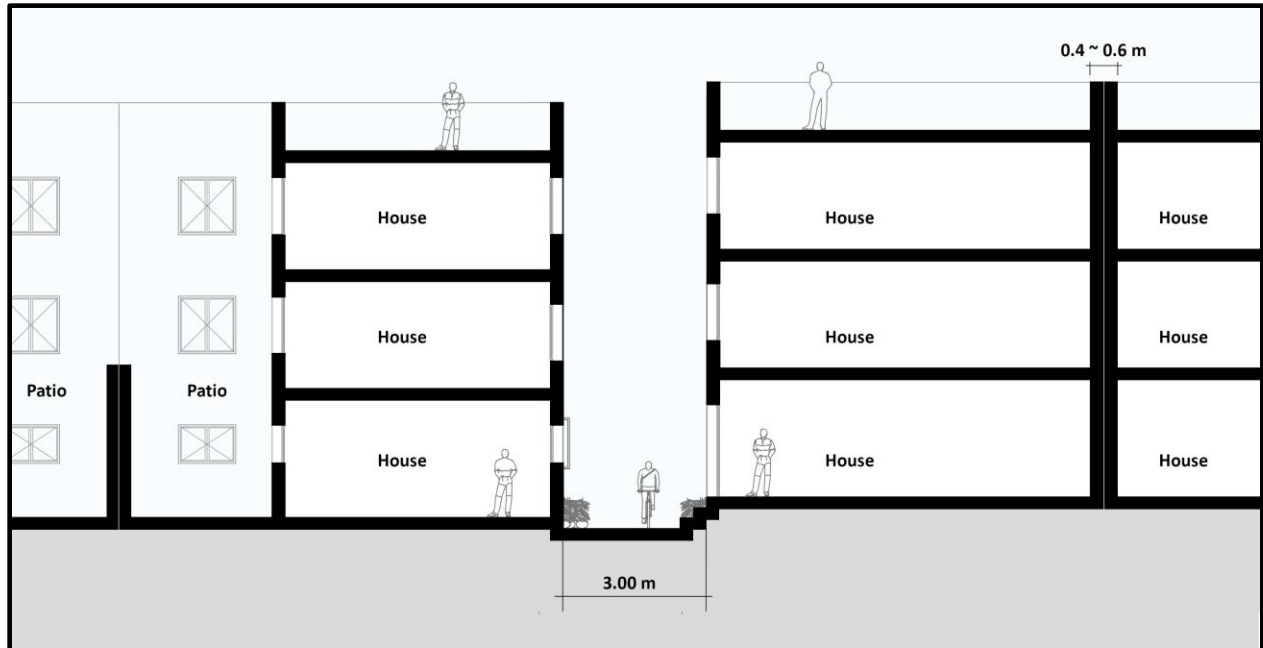
Figure 2-8 Section on survey area street, all surveyed households lived in houses with patios and accessible terraces.
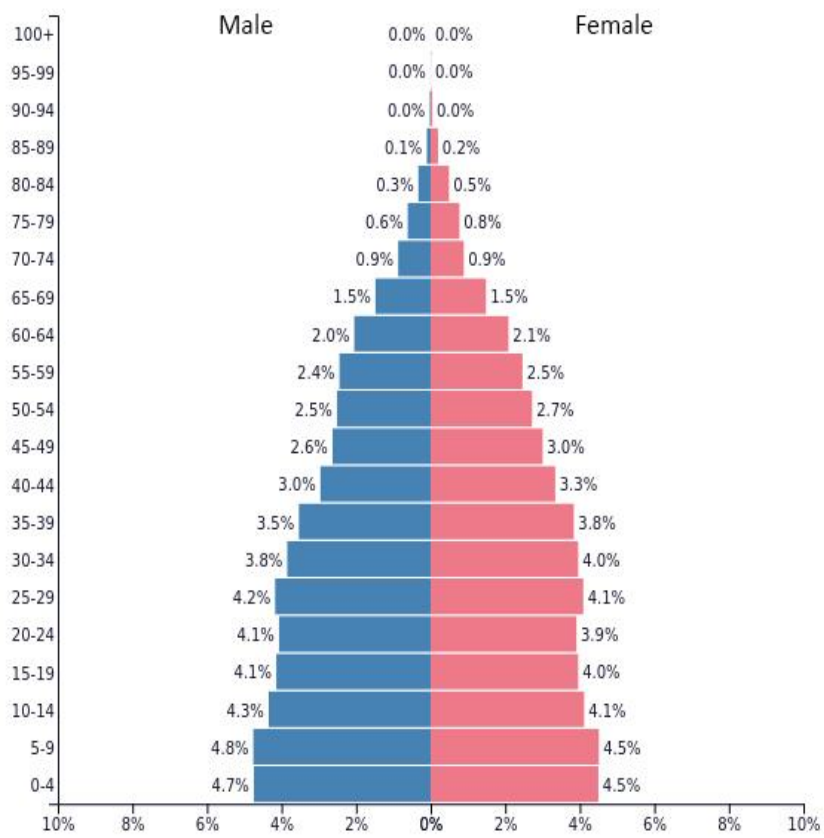

Figure 2-9. Moroccan population age pyramid 2019 (www.populationpyramid.net)

Locals were more troubled by street noises (45.1%), than with safety (7.6%), or with cleanliness (18.3%), mainly due to children's activity. As shown in Morocco's age pyramid (Figure 2-9), children represent almost a third of the local population, of which 38% are 19 years old or less plying mainly on the street, as Beni-makada has zero playgrounds, and Moroccan schools have no extracurricular clubs like in japan. The tick walls separating Moroccan houses help protect against neighbors' noises but are not enough against street' noises.

Half of the population (51.3%) reported owning their homes, with the vast majority of Beni-Makada dwellings (72.9%) being more than 16 years old (Anon 2014). We tried to homogenize our study area and our survey participants to the maximum by surveying only three stories high Moroccan houses, as all PSG observed were present in front of this housing typology.

All PSG observed in the study area are privately owned and cared for by locals, and were present directly on the streets back to back with owners' houses. All survey participants lived in the neighborhood's backstreets.
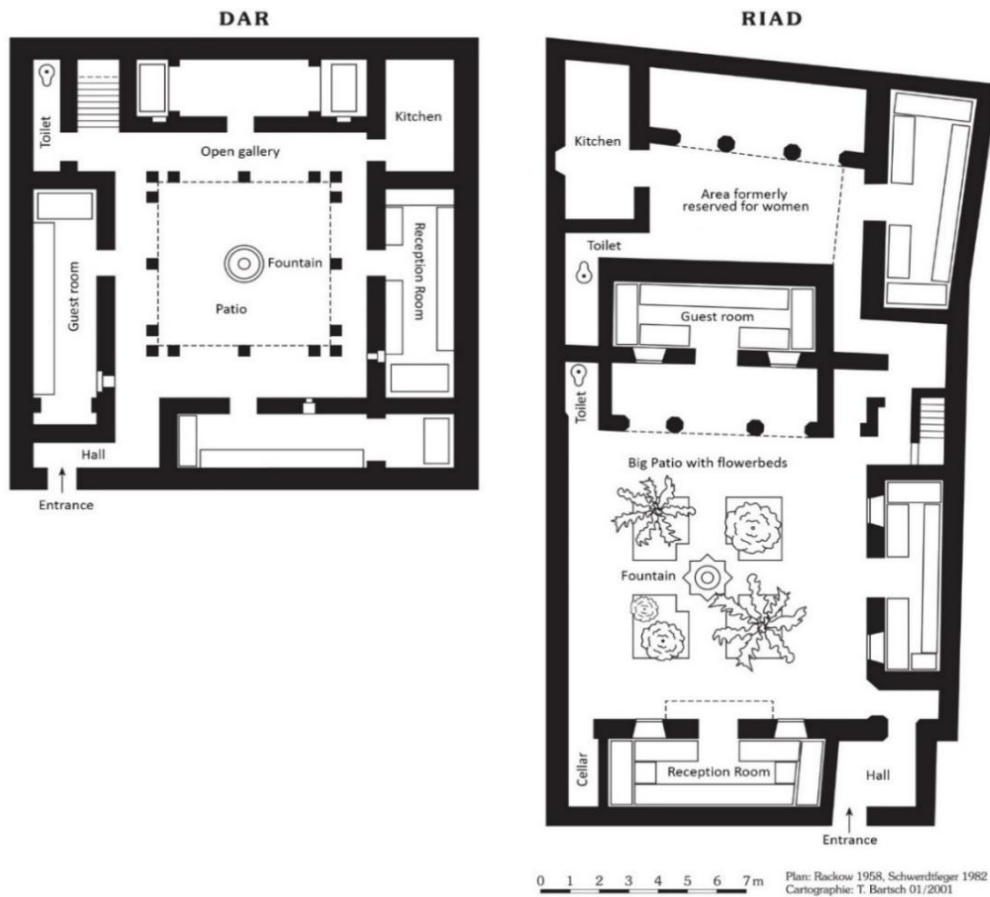
Figure 2-10 The two types of houses in the medina (Escher et al., 2000)

3. Evolution of the green element's presence in the Moroccan urban house

The contemporary Moroccan house is the result of a long process of evolution of the traditional urban house in Morocco. Before the Franco-Spanish occupation, Tangier's population, like in all other *medinas* in Morocco, lived in courtyard houses categorized into two principal types, as can be seen in figure 2-10, small ones called *dar* or house in Arabic, and big ones called *riad* meaning gardens (Escher, Petermann, and Clos 2000). Both types were inward focused with little to no windows to the street, and organized around a central patio, that provided light, sheltered occupant's privacy according to Islamic precepts, and protected from the hot weather in summer.
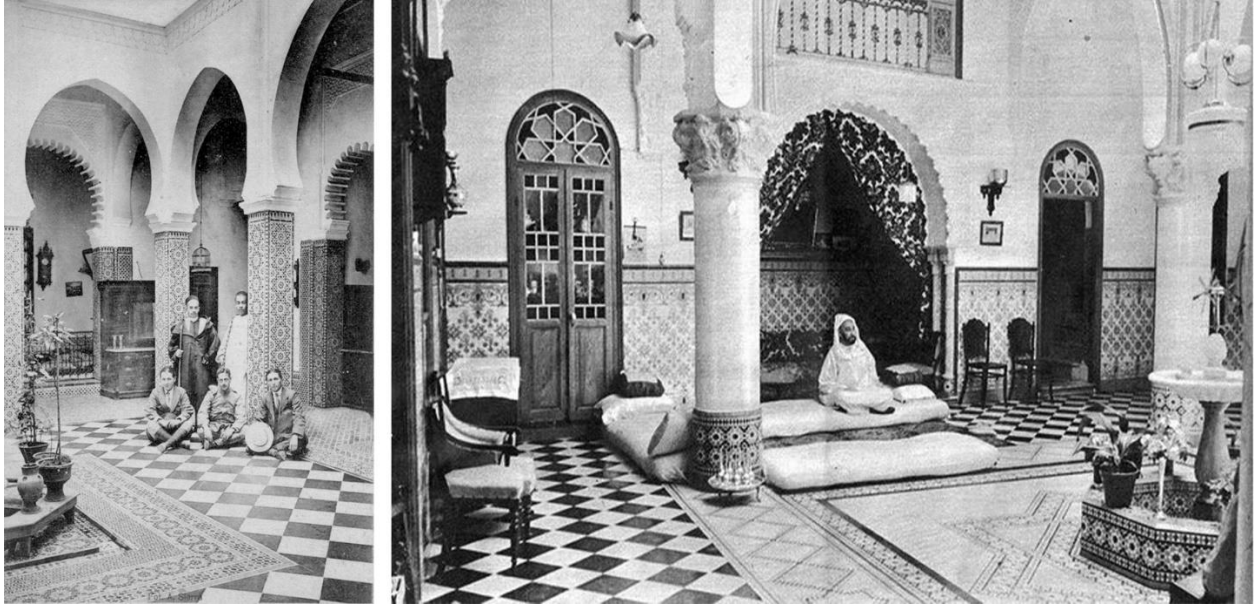
Figure 2-11 Pictures of Moroccan houses in Tangier and Tétouan (source. www.flicker.com)

Figure 2-12 A street in the city of Chefchaouen (source. www.planetjanettravels.com)

Apart from the size, one of the main differences between the *dar* and *riad* was the importance of green elements present in the patio. While the *riads* had bigger patios or multiple patios with larger gardens, often with trees planted directly on the soil, the *dar'*s patio was smaller and had most of the timeonly potted plants. The patio's green elements, were the only greenery, accessible to commoners inside the walls of the *medina*, as public green space was nonexistent. Pictures of patios in Moroccan houses show that potted plants decoration the central fountain, were very common, as can be seen in figure 2-11. To our knowledge, our research is the first to study UGS in Morocco; consequently, there are no academic studies or documentation on which to base to describe the origins of PSG or GS presence in the country's urban landscape. However, our interviews suggest that PSG predates the French occupation, some interviewees linked this practice to an old tradition in northern Moroccan cities, where every year, the residents of each neighborhood in the medina used to paint the streets with limestone powder mixed with blue dye, to protect the houses from humidity, and decorate their front houses with PSG. This tradition is still in practice in the city of Chefchaouen (figure 2-12), 110 kilometers south of Tangier, which means that PSG is an old phenomenon revived and adapted to the new contemporary urban structure.

During the French occupation, the protectorate built new neighborhoods close to the *medinas* called *ville nouvelle* intended to be occupied by Europeans, and separated from the walled city by no man's lands for "moral and hygienic reasons" (de Tarde 1919), and to preserve the cultural heritage of the natives (Abu-Lughod 2014). By the end of WWII. The vast majority of the urban indigenous population outside of the *medina* was composed of underpaid workers of rural backgrounds coming from all around the country, now living in dense *bidonvilles* or slums with adverse sanitary conditions. Fearing that these slums may become breeding grounds for revolution, the protectorate decided to completely remove these neighborhoods and relocate its occupants in new mass-produced housing units (Abu-Lughod 2014). The new housing typology followed the *trame sanitaire* of Ecochard later called *trame Ecochard* after the chief architect and urbanist of the protectorate Michel Ecochard. Each unit was designed to respond to the basic universal needs, and could be extended with the extension of the family (Maghraoui 2013) but not vertically.
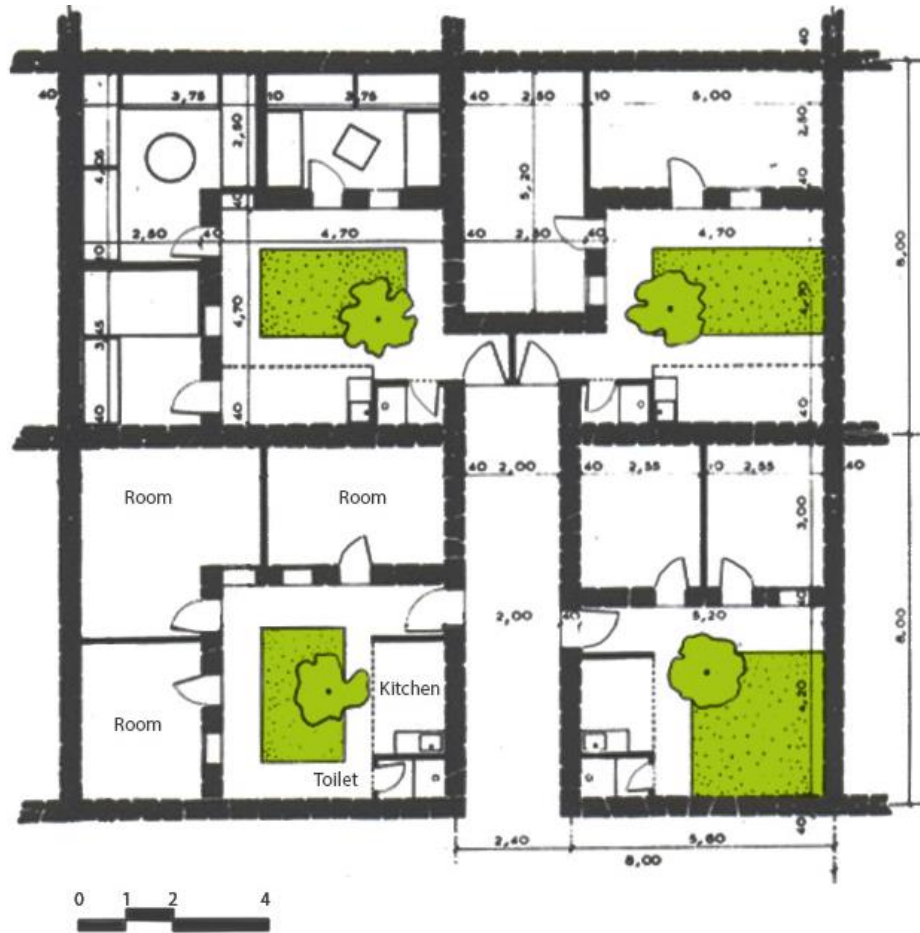
Figure 2-12 example of the trame sanitaire of Ecochard (Source. www.arquiscopio.com)

The *dar*, inspired Ecochard's new houses with rooms around an unpaved courtyard (figure 2-13), designed as a small garden that would assure the crucial sanitary role of keeping the workers healthy (Abu-Lughod 2014). The tram Ecochard will later evolve to become the modern Moroccan house but with some transformations initiated after the Moroccan independence.

Like its predecessors, the modern Moroccan houses are built directly to the property line, adjoined to each other, and have patios. The country's building code of 1964 (Moroccan 1966), allowed for the vertical extension of Echochard' units, now officially named "the economic house", and made it compulsory for all houses with only one façade to have an uncovered patio of at least 12m^2, and a bigger shared patio of 8x8 or 8x6 made of the addition of four patios as explained in figure 2-13, (for houses with more than one façade patios are optional). However, unlike in the *dar* where the patio was the central living space in the house, the patio's primary

role in the economic house is to provide light, as Moroccan families shrank, houses started to be occupied by more than one family. Consequently, the shared patio became a no man's land rarely used for social activities and relegated to a mere storage space for unwanted items, because of the loss of privacy (Pinson and Zakrani 1987). It is at this moment of the Moroccan house evolution that green elements until now typic of the patio, became very rare due to the change of its centrality and its social role.

The evolution of the Moroccan house does not only mirror the transformation of the Moroccan urban society and Moroccan families, in terms of size and social background, it also informs about the evolution of the green element's presence in the house. Formerly in the *medina,* most houses had gardens or green elements in their patios, the most central space in this type of housing, which shows the importance of greenery for the sophisticated urban population. With the massive emigration of the rural population to the city, the needs and modes of usage of the new urban houses and the Echochard units designed/imposed on them resulted in a new layout for the Moroccan urban house that relegated green elements presence gradually to the outside.
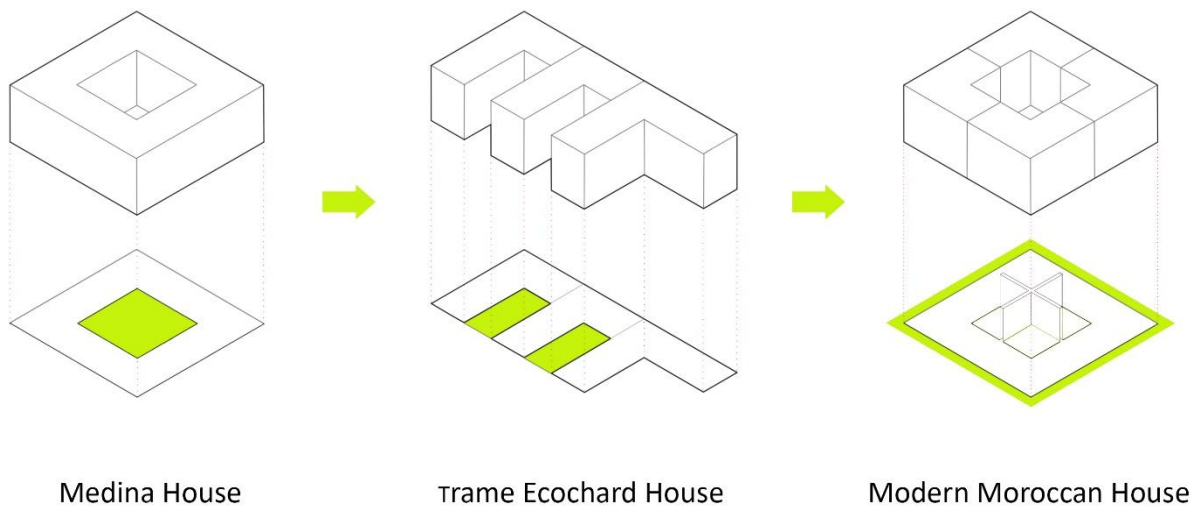

Medina House   Trame Ecochard House   Modern Moroccan House

Figure 2-13 Evolution of the green elements' presence in the Moroccan house (Made by author)

Chapter 3 : Methodology

1. Introduction

In this study, we used a mixed-method approach with quantitative and experimental data to investigate PSG association with neighborhood perception, health variables, and prosocial behaviors in a deprived residential area of Tangier, Morocco.

The use of a combined approach allowed us to enhance our comprehension of the PSG-human associations form different perspectives, using a broader range of variables and allowing a deeper understanding of these associations. In this research, the quantitative and experimental data have a complementary role, asking similar questions when the objective is to study the same variable from different perspectives, and complementary questions when the objective is to gain new insight. The quantitative data allowed us to uncover patterns of associations between PSG ownership and other variables form locals' perspective. In contrast, the experimental data allowed to assess the associations between PSG presence on neighborhood streets and neighborhood perception form outsiders' perception, and compare these perceptions with those of insiders.

Quantitative data were collected using a cross-sectional face-to-face survey of 388 residents of our study area. The experimental data were obtained from a field experiment with 51 participants.

We collected our data using a sequential method, which means that the quantitative survey was conducted first, in January 2019, followed by the field experiment in august 2019. This approach is typically followed when the data collected in the first step informs and guides the data collection of the next step (Onwuegbuzie and Collins 2007).

Figure 3-1 Pictures of the survey conductors with participants (by author)

2. The cross-sectional study

The data used in this study are derived from a face-to-face survey we conducted among the residents of the *Beni-Makda* district to assess the differences between PSG owners and non-owners.

We chose the face-to-face method of survey administration because it allowed us to directly meet our population and get more in-depth information directly on site. It also made it easier to get the minimum number of participants required for our statistical tests to be valid with a significance level α = 0.05, in less than a month thanks to the higher response rate. Using any other method would have taken too much time, energy, and unavailable financial resources.

A minimum sample size of 384 people was calculated to achieve a 95% confidence interval (CI). We used a systematic random sampling method for survey participants selection. We started our

survey in each street from the right row of houses knocking on the doors of every other house starting from our right then the second house on our left, when the potential participant refuses to participate, we ask the next house on the same row and so on. When more than one household lives in the house, we ask the one living on the first floor.

The survey was conducted in January 2019, directly on the streets of three of the *Beni-Makda* neighborhoods; *Bir-Chairi, Ard Dawla, and Azifate.*

The questionnaire (see Appendix. 1) was written in classic Arabic with the help of a professional translator fluent in the local dialect before being tested with focus groups in Morocco.

The final version of the questionnaire had 4 parts and 36 questions designed to measure respondents' neighborhood characteristics perception, physical and mental health, intentional prosocial behaviors, PSG characteristics, and their sociodemographic information.

Part 1 contains nine questions measuring PSG size, age, weekly care duration (watering and cleaning), publicness perception, in addition to recreational activities done next to plants, like eating, sitting, chatting, smoking. **Part 2** was composed of 18 questions measuring our key variables, neighborhood satisfaction, social capital, perceived safety, cleanliness, noise annoyance, cleaning, and protection responsibility, and neighborhood attachment. **Part 3** was composed of the Arabic version of the Patient Health Questionnaire (PHQ-9) developed by Kurt Kroenke, and colleagues and used to assess depression severity (Kroenke and Spitzer 2002). We chose depression because it is the most common mental health disorder in the world (Who 2017) and in Morocco (Moussaoui 2007). **Part 4** was composed of demographic questions.

The study was approved by the University of Tokyo ethics committee (appendix 3). The verbal informed consent for adults, and parental permission and verbal assent for minors were obtained before each interview. Adulthood was defined according to its legal definition in Morocco (≥18 years). Four male university students fluent in Tangier's local Arabic dialect (*Chamali*) conducted the interviews (the Beni-makada district has some of the most dangerous neighborhoods in Tangier; consequently, we could not risk and hire female interviewers). During each interview, potential participants receive extensive information about the survey, its objectives, anonymity, and exclusive use of collected data for scientific research only. The interviews were conducted in private on the street. After four weeks, and with a participation rate of 80%, we obtained 388 valid questionnaires.

2.1. Measures

The vast majority of the first survey variables were measured using straightforward questions except for three variables; life satisfaction and social capital, each measured using the index of two questions, and depression score measured using the PHQ-9 depression score questionnaire. The reliability of our items was tested using Cronbach's α reliability coefficient. Cronbach's alpha measures internal consistency, or how closely related a set of items are as a group. Cronbach's α values range from 0 – 1.0, with a value of 0.7 or higher, indicating acceptable internal consistency (Streiner 2003).

2.1.1. Neighborhood perception measures

Life satisfaction. Neighborhood life quality satisfaction was measured as a continuous variable using a life quality satisfaction index, summing participant's answers to two questions: "How satisfied or dissatisfied are you with life quality in your neighborhood" (satisfaction) measuring overall neighborhood satisfaction, with responses (1) "not satisfied at all," (2) "not satisfied," (3) "average," (4) "satisfied ," and "very satisfied", and "how proud are you to live in this neighborhood" (pride) measuring belonging pride, with responses (1) "not proud at all," (2) "not proud," (3) "average," (4) "proud," and (5) "very proud", The summed score ranged from 1 to 10. Similar questions were used in previous research to measure life satisfaction (Lee et al. 2008). The internal consistency of the items was good (Cronbach's α = .881).

Social capital. Neighborhood perceived social capital was measured as a continuous variable using an individual social capital index to conceptualize social capital (Stone 2001), summing participant's answers to two questions "How would you describe relationships between neighbors in this neighborhood" (quality) measuring the quality of neighbor's relationship, with responses (1) "very bad," (2) "bad," (3) "neutral," (4) "good," and "very good," and "how many of your neighbors do you know" (quantity) measuring the proportion of known neighbors, with responses (1) "none of them," (2) "few of them," (3) "half of them," (4) "most of them," and "all of them". The summed score ranged from 1 to 10. Similar questions were used in previous research to measure social capital (Beenackers et al. 2013). The internal consistency of the items was good (Cronbach's α = .795).

Perceived safety. Neighborhood perceived safety was measured as an ordinal variable using the question: "how safe do you feel in this neighborhood?" with responses (1) "very unsafe," (2) "unsafe," (3) "neutral," (4) "safe," and "very safe" (5).

Perceived cleanliness. Neighborhood perceived cleanliness was measured as an ordinal variable using the question "How clean is this neighborhood?" with responses (1) "not clean at all," (2) "not clean," (3) "neutral," (4) "clean," and "very clean" (5).

Noise annoyance. Neighborhood Noise annoyance was measured as an ordinal variable using the question "to what extent are you annoyed by the noise coming from your neighborhood streets?" with responses (1) "not annoyed at all," (2) "not annoyed," (3) "neutral," (4) "annoyed," and "very annoyed" (5). Scores for this question were reverse-recoded so that higher values indicated less noise annoyance form neighborhood' streets, and lower values indicated higher noise annoyance.

2.1.2. Prosocial behavior and neighborhood attachment measures

Intention to move. Intention to move was used to measure neighborhood attachment as a dichotomous variable, using the question "would you like to move out of the neighborhood if it was possible?", with responses, (0) "No), and (1) "Yes" and (3) "other". The "other" option was dropped from the analysis to obtain dichotomous data.

Protection responsibility. Protection responsibility reflected participants' responsibility towards protecting their neighborhoods and was measured as a dichotomous variable using the question, "do you believe that it is your responsibility to keep your neighborhood safe?", with responses, (0) "No), and (1) "Yes".

Areas to protect. Areas to protect measured the diffusion of participants' responsibility, as an ordinal variable reflecting the diffusion of neighborhood areas respondents felt responsible to protect, using the question *"*If you answered by (yes) in question 26, which area do you think (or areas) is YOUR responsibility?", with responses (1) "only my in front house", (2) "only mine and my closest neighbors front house", (3) "all my street", (4) "all my neighborhood".

Cleaning responsibility. Cleaning responsibility reflected participants' responsibility towards cleaning their neighborhoods and was measured as a dichotomous variable using the question, "do you believe that it is your responsibility to keep your neighborhood clean?", with responses, (0) "No), and (1) "Yes".

Areas to clean. Areas to clean was measured as an ordinal variable reflecting the diffusion of neighborhood' areas respondents felt responsible for cleaning as an ordinal variable using the question *"*If you answered by yes in 23, which area you think (or areas) is YOUR responsibility?", with responses (1) "only my in front house", (2) "only mine and my closest neighbors front house", (3) "all my street", (4) "all my neighborhood".

2.1.3. Health variables

Depression score. Depression score was measured using the PHQ-9 questionnaire, a user-friendly survey tool with nine items assessing different aspects of depression. The PHQ-9 is in the public domain, no permission or fees are required to use it. The Arabic version has been validated and used in previous research in Morocco (Wafki et al. 2012) and other Arab speaking countries (AlHadi et al. 2017; Belhadj et al. 2017; Sawaya et al. 2016).

Survey participants rated the frequency of 9 symptoms over the past two weeks. Response options are (0) "not at all", (1) "several days", (2) "more than half the days," and (3) "nearly every day". Items were summed to create a score where higher values indicate more severe depression. The summed score ranged from 0 to 27. The PHQ-9 also contains a question at the end of the diagnostic portion, asking patients who checked off any problem: "How difficult have these problems made it for you to do your work, take care of things at home, or get along with other people?." with responses (1) "Not difficult at all," (2) "Somewhat difficult," (3) "Very difficult," and (4) "Extremely difficult." However, this question is generally not included in the PHQ-9 depression score. The internal consistency of the items was acceptable (Cronbach's α = .73).

Moderate physical activity. Physical activity in the neighborhood was assessed using weekly walking duration measured in minutes, with the product of two questions; "How many times a week do you have a walk in your neighborhood?", measuring promenade frequency, with

responses ranging from "(0) Never" to "7 times a week", and "How much time does every walk last?" measuring promenade duration in minutes.

2.1.4. PSG characteristics variables

Seven PSG related variables were utilized for this study. The variables reflected PSG characteristics and perception, necessary activities related to PSG maintenance, and optional recreational activities. The objective was to identify the PSG characteristics and typology of daily routines that had the most significant association with our dependent variables.

- **PSG characteristics and perception**

PSG ownership. PSG ownership was deduced by interviewers first hand during the survey, with two possible answers, no PSG coded as (0), and PSG ownership coded as (1)

PSG age. PSG age was measured in months using the question, "Since when do you have potted plants in front of your house," answers were converted in months when given in years.

PSG size. PSG size was measured in plant pots number using the question "how many plant pots are there in your garden."

PSG publicness. PSG publicness here does not refer to ownership, as all PSG are privately owned, but refers to the extent to which owners were ready to share their PSG with other neighbors or outsiders as an altruistic gesture. The variable was measured using the question "Do you think that your potted garden is public or private" with responses (1) "private", (2) "both private and public", and (3) "Public".

- **PSG necessary activities (maintenance)**

Weekly care duration. Weekly care duration was measured using the product of two questions, "how much time do you spend caring for your plant pots daily?", measuring care duration in minutes, and "how many times a week do you take care of your plant (by watering or cleaning)?" measuring care frequency, with responses ranging from "(0) Never" to "7 times a week".

- **Optional activities**

Diversity of recreational activities. Diversity of recreational activities done next to PSG was assessed using the question "What kind of activities do you do next to your pots" a check-All-

That-Apply question. Responses included the most common activities conducted next to PSG according to our observations, (0) "nothing", (1) "sitting or standing," (1) "eating", (1) "chatting," (1) "smoking," and (1) "other," the outcome was the sum of all checked activities. The summed score ranged from 0 to 5.

Frequency of recreational activities. Weekly frequency of recreational activities done next to PSG was measured using the question "On average, how many times a week do you have activities next to your pots," with responses ranging from "(0) Never" to "7 times a week".

2.1.5. Demographic variables

Nine demographic *control* variables were utilized in this study, including:

Gender. Gender as a dichotomous variable with responses (0) "male," and (1) "female."

Age category. Age category was measured as an ordinal variable, with responses ranging from (1) "less than 18", (2) "18-35", (3) "36-50", (4) "51-65", and (5) "more than 65".

Marital status. Marital status was measured as a categorical variable with responses, "married," "single," "divorced," "widowed," and "other." Each category was dummy coded as a dichotomous variable in order to be included in the regression analysis.

Household size. Household size measured as a continuous variable reflecting the number of family members living in the same household.

Education level. Education level measured as an ordinal variable reflecting the highest degree obtained, with responses, (1) "Less than high school," (2) "Vocational training," (3) "High school graduate," (4) "Bachelor's degree," (5) "Master's degree," (6) "Doctorate," and "other." the "other" option was dropped from the analysis to obtain ordinal data.

Occupation. Occupation as a categorical variable with responses "Student," "University student," "self-employed," "employed," "retired," "housewife," "unemployed," and "other" were dummy coded as dichotomous variables.

Residence duration as a continuous variable measured the years lived at the current address.

Homeownership, as a dichotomous variable with responses (0) "rent," and (1) "own."

Car ownership, as a dichotomous variable with responses, (0) "No" and (1) "Yes".

2.2. Analysis Plan

We analyzed 12 dependent variables (DV) of different nature (continuous, ordinal, dichotomous, categorical). Each type of data requires several assumptions for the analysis results to be valid. We verified all of these assumptions for each of these variables before the analysis. The data was cleaned from outliers, identified using Cook's distance (Cook 1979). All tests were conducted in SPSS version 25. The individual analysis of each DV is described in detail in the appropriate section.

2.2.1. Bivariate analysis

To measure the variance in our variables, between respondents with and without PSG, we divided our survey participants into two groups. PSG owners and non-owners.

We used t-tests or U tests for continuous variables (Independent samples t-test for normally distributed data and Mann-Whitney U test for non-normally distributed data), and chi-square tests for categorical and ordinal variables to identify association patterns and significant differences ($p < .05$) between our two groups.

We also calculated Spearman's Rank correlation coefficient (r_s) for the whole sample and our two groups in order to identify the strength, significance, and direction (negative or positive) of the relationship between our variables, two at a time. This step was crucial in order to identify association patterns and detect the presence of PSG ownership' moderation effect, that can be detected when a variable acts differently in each of our two groups.

2.2.2. Multivariate analysis

In order to define the significance of the associations between our DVs and IVs, adjusting for control variables, we opted to analyze our data using regression analyses. The objective of the analysis is not to study whole models but to assess the associations between our DVs and our central IVs adjusting for control variables, potentially related to the DVs. This procedure is necessary in order to remove the control variables' effect from the equation and avoid type I (the

rejection of a true null hypothesis or false positive) and type II (the non-rejection of a false null hypothesis or false negative) errors.

2.2.2.1. Type of regression analysis

The regression analysis type used to analyze our IVs depends on the nature of the outcome data and how well it meets regression assumptions.

Linear regression. Continuous DVs were analyzed using linear regression. Linear regression assumptions (normality, linearity, homoscedasticity, and absence of multicollinearity) were tested before the analysis. We checked normality and linearity graphically, homoscedasticity using the Breusch-Pagan test (Breusch and Pagan 1979), and multicollinearity using the variance inflation factor (VIF), according to Hair et al. (Hair et al. 1998) the VIF value should not typically exceed 10, with some exceptions (Anon n.d.).

Ordinal logistic regression. Ordinal DVs were tested using ordinal logistic regression. Ordinal regression assumptions (ordered DV, one or more of the DVs is either continuous, categorical or ordinal, no multicollinearity, and proportional odds) were tested before the analysis. The proportional odds assumption was tested using the test of parallel lines in SPSS V25, while multicollinearity was tested using the variance inflation factor (VIF) (Anon n.d.). In case ordinal regression assumptions were not met, we use either multinomial or binary logistic regression.

Binary logistic regression. Dichotomous DVs were analyzed using binary logistic regression. Logistic regression assumptions (binary DV, the linearity of continuous IVs with the logit of the DV, a large sample size, no multicollinearity, independent observations) were tested before the analysis. Multicollinearity was measured for each regression analysis using the variance inflation factor (VIF). The linearity of continuous IVs with the logit of the DV was evaluated using the Box-Tidwell procedure (Box and Tidwell 1962). The adequacy of our sample size was measured using the formula $50+8*p$ where p is the number of IVs in the regression analysis (Sileshi 2015), the highest number of IVs used in a binary logistic regression was 18, (while analyzing the group of PSG owners alone), which makes the minimum sample size required 194. Since we have a sample size of 388, this assumption is also met.

Multinomial logistic regression. We initially did not design our questionnaire to include a categorical DV. Unfortunately, one of our ordinal variables violated the proportional odds assumption, and we could not analyze the variable as dichotomous data because we loose valuable information by collapsing the ordinal variable to a dichotomous one. Multinomial regression assumptions (multinomial DV, one or more of the DVs is either continuous, categorical or ordinal, independence of observations, no multicollinearity, the linearity of continuous IVs with the logit of the DV, a large sample size, no outliers) were tested before the analysis. Multicollinearity was measured for each regression analysis using the variance inflation factor (VIF), the linearity of continuous IVs with the logit of the DV was evaluated using the Box-Tidwell procedure (Box and Tidwell 1962).

2.2.2.2. Regression models

Each of our DVs was analyzed using three models.

Model 1. In model 1, we perform the regression analysis for our two groups of PSG owners and nonowners separately in order to identify the association patterns between the DV and the IVs for each group. The results of this first analysis allow us to identify the difference between our two groups adjusting for control variables.

Model 2. In Model 2, we perform a hierarchical regression, adding the interaction terms between our central IVs and the PSG ownership variable to test for moderation.

According to Baron and Kenny, a moderator is a variable that affects the direction or strength of the relationship between an IV and a DV (Baron and Kenny 1986). Moderation occurs when the interaction term between the moderator variable and the IV is significant, this means that PSG ownership significantly changes the direction (positive or negative) or strength of the relationship between the DV and the IV.

A moderator variable can have three types of effects; an ***enhancing effect***, where an increase in the moderator would increase the effect of the IV on the DV; a ***buffering effect,*** where an increase in the moderator would decrease the effect of the IV on the DV, or an ***antagonistic effect,*** where an increase in the moderator would reverse the effect of the IV on the DV.
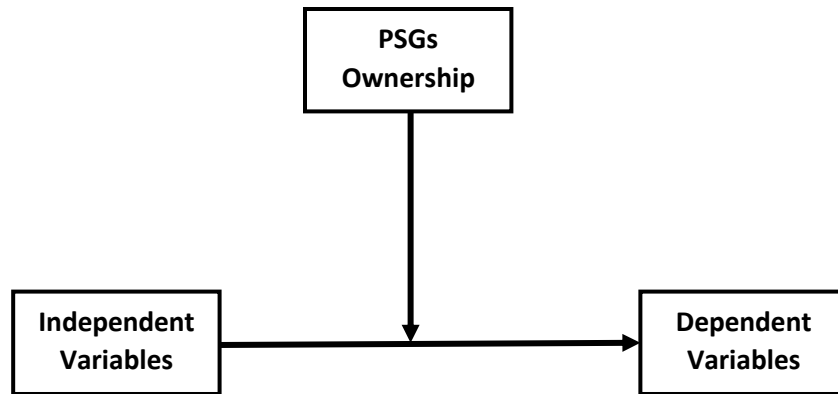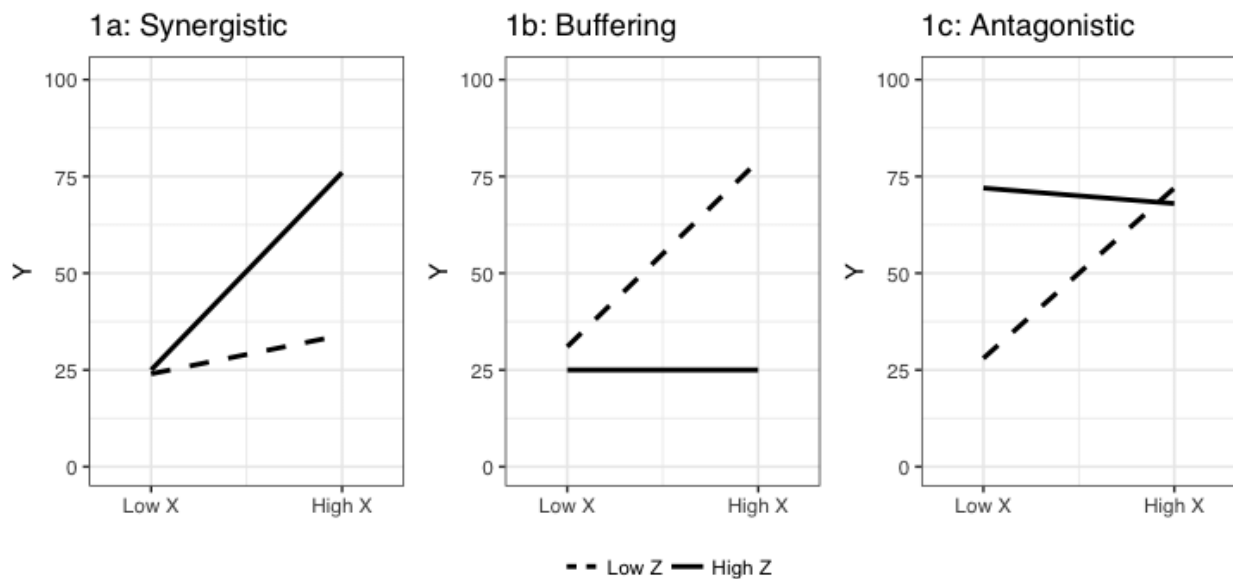
Figure 3-2 Moderation effect

Figure 3-3 Types of moderation effects (McCabe et al., 2018)

Model 3. Finally, in model 3, we test the associations between our DVs and PSG related variables, perceived publicness, PSG size, age, weekly care duration, and weekly frequency and diversity of recreational activities for the group of PSG owners only. This model will allow us to verify if these PSG related variables do explain the direct association between PSG ownership and the DV, revealed in Model 2.

3. The field experiment study

The field experiment was conducted in August 2019, in two similar streets situated next to each other, the Saad Zaghloul street, with PSG, and an unnamed street, without PSG. The experiment subjects received an incentive of 1500 yen and were transported by car to the site in groups of four. Between each promenade, a pause of five minutes was taken to fill a questionnaire (see appendix 2). The experiment required participants to have two promenades in the Beni-Makada district following two different itineraries. The first promenade in streets with PSG and the second one with streets without PSG. Participants read the questionnaire before the start of the experiment and filled the first and second parts of the instrument after the end of the first and second promenades, respectively. All promenades were conducted in the afternoon between 5:00 pm and 7:00 pm (in August, the sunset time is between 7:56 pm and 8:27 pm).

We adopted a double-blind experimental design; the objective of the experiment was communicated neither to the experiment conductors, nor to the subjects, in order to avoid observer and participant' biases, where conductors influence participants observations (McCambridge, Kypri, and Elbourne 2014), and participants social desirability compromises their perception of the observed phenomena (Furnham, 1986). All participants were living in Tangier but not in the Beni-Makada district at the time of the experiment.

The questionnaire was written in classic Arabic and tested with focus groups and a professional translator fluent in the local dialect before being conducted. The final version had 3 parts and 21 questions.

Part 1 and Part 2 had the same questions, answered separately after each promenade. The questions assessed neighborhood cleanliness, noise annoyance, safety, promenade enjoyment, participants feeling of being observed, locals' perceived relationship quality and local's neighborhood belonging pride. Part 3 was composed of demographic questions.

Figure 3-4 Pathway of the promenade in Azifate neighborhood (source Agence Urbaine de Tanger. by author)

● Saad Zaghloul street (with PSGs)   ● Unamed street (without PSGs)

Figure 3-5 Situation of the two streets (source www.googlemaps.com, by author)

3.1. Measures

Perceived cleanliness. Neighborhood perceived cleanliness was measured as an ordinal variable using the question "How clean are the streets in this neighborhood?" with responses (1) "not clean at all," (2) "not clean," (3) "neutral," (4) "clean," and (5) "very clean."

Perceived calmness. Neighborhood perceived calmness was measured as an ordinal variable using the question "How calm is this neighborhood?" with responses (1) "not calm at all," (2) "not calm," (3) "neutral," (4) "calm," and (5) "very calm."

Perceived safety. Neighborhood perceived neighborhood safety was measured as an ordinal variable using the question: "how safe did you feel in this neighborhood?" with responses (1) "very unsafe," (2) "unsafe," (3) "neutral," (4) "safe," and (5) "very safe."

Feeling of being observed. Feeling of being observed by local's was measured using the question "Did you feel observed in this neighborhood?", with responses (1) "not at all," (2) "Not really," (3) "Neutral," (4) "I felt observed," and (5) " I was surely observed."

Promenade enjoyment. Promenade enjoyment was measured using the question, "How enjoyable was your promenade in this neighborhood?", with responses (1) "not enjoyable at all," (2) "Not enjoyable", (3) "Neutral," (4) "enjoyable," and (5) "very enjoyable."

Perceived locals' pride. Locals' neighborhood belonging pride was measured using the question, "How proud do you think residents in this neighborhood are of their neighborhood?", with responses (1) "not proud at all," (2) "Not proud," (3) "Neutral," (4) "proud," and (5) "very proud."

Perceived locals' relationship quality. Participants' perception of locals' relationship quality was measured with the question, "How do you think neighbors' relationship quality is in this neighborhood?", with responses (1) "very bad," (2) "bad," (3) "Neutral," (4) "good," and (5) "very good."

Demographic variables included gender, age, occupation, marital status, education level, and car ownership.

3.2. Analysis plan

To measure the variance in our variables, between streets with and without PSG, we divided our observations into two groups. Streets with PSG and streets with no PSG, the experiment data was then tested using binary and multivariate analysis.

3.2.1. Binary analysis

The binary analysis will follow the same pattern as for the first survey, using t-tests or U-tests for continuous variables, (depending on the distribution of the data; Independent samples t-test for normally distributed data and Mann-Whitney U test for non-normally distributed data), and chi-square tests for categorical and ordinal variables to identify association patterns and significant differences between our two groups. We then calculated Spearman's Rank correlation coefficient (r_s) for the whole sample, and our two groups apart, in order to identify the strength, significance, and direction (negative or positive), of the relationship between our variables, two at a time.

3.2.2. Multivariate analysis

In the multivariate analyses, we tested for the direct correlations between PSG presence on neighborhood streets and neighborhood perception using regression. Because of the significantly smaller sample size of the experiment (N=102 observations), we included a lower number of variables than in the survey data analysis. We also did not test for moderation or DVs relation to PSG characteristics as the experiment data was mainly intended to investigate the direct correlations between our variables.

Chapter 4 : Cross-sectional study results

1. Introduction

We will present in this chapter the results of the first survey data analysis. Each domain of variables will be presented separately. We will start by presenting the demographic characteristics of our sample, followed by PSG characteristics. We will then present the analysis results concerning the neighborhood perception, intentional prosocial behaviors and neighborhood attachment, and finally, the health variables.

1.1. Demographic characteristics

As indicated in Table 4-1, more than two-thirds of the sample was male (69.8%). We had very few opportunities to interview females for various reasons (the interviewers were all male, we could not hire female interviewers due to the reputation of the neighborhood as an unsafe area, we were also asked to delete photos and data obtained with the consent of female participants by their sons and brothers). The average age of the survey participants was 2.54 (SD=0.82), which is between 18 and 35 years old; all the population adult age categories were represented in the sample. The average maximum level of education was 2.68 (range 0–6; SD=1.68), which is between vocational training and high school graduate, with 56.9% having at least a high school degree. The average household size was 4.92 (SD=1.70), while the average duration lived at the current address at the moment of the interview was 23 years (SD=10.83). Half of our sample (49.7%) identified as single, while 40.6% were married, 4.9% were widowed, and 2.3% were divorced. More than half of the survey participants (56.1%) owned their houses, while 66.8 % reported having a car in their household. Nearly half of our respondents (43.9%) were either employed or self-employed, with a significant number of students (23.5%).

We run bivariate tests to compare PSG owners to nonowners, on all demographic variables, t-tests for continuous variables and chi-square (χ^2) tests for categorical variables. The results of all the tests were all insignificant ($p > .05$), which means that our sample is homogenous with no significant differences between participants with and without PSG in terms of gender, age, education level, marital status, occupation, Homeownership, car ownership, Residence duration at the current address or household size. Besides, we tested multicollinearity between our variables using two methods. First, using a Spearman correlation matrix (table 4-2), and then using the Variance inflation factor (VIF). According to Tabachnick & Fidell (Tabachnick and Fidell

2014), independent variables with a bivariate correlation exceeding 0.70 should not be included in multiple regression analyses, while according to Hair et al. (Hair et al. 1998), the VIF value should not exceed 10. As shown in table 4-2, recreational activities frequency and diversity correlation coefficient was equal to 0.7. While in all our regression models, the VIF value for both variables never exceeded 10, we, therefore, selected to keep both IV in our analysis.

Table 4-1 Demographic characteristics of the Sample (N = 388)

Response	Whole sample	No PSG	With PSG
Gender			
Male	271 (69.8%)	92(74.2%)	179(67.8%)
Female	117(30.2%)	32(25.8%)	85(32.2%)
Age category			
less than 18	10 (2.6%)	3 (2.4%)	7 (2.7%)
18-35	219 (56.4%)	76 (61.3%)	143 (54.2%)
36-50	110 (28.4%)	30 (24.2%)	80 (30.3%)
51-65	37 (9.5%)	13 (10.5%)	24 (9.1%)
More than 65	12 (3.1%)	2 (1.6%)	10 (3.8%)
Education level			
Less than high school	82 (21.1%)	29 (23.4%)	53 (20.1%)
Vocational training	32 (8.2%)	10 (8.1%)	22 (8.3%)
High school graduate	78 (20.1%)	20 (16.1%)	58 (22.0%)
Bachelor's degree	77 (19.8%)	31 (25.0%)	46 (17.4%)
Master's degree	64 (16.5%)	19 (15.3%)	45 (17.0%)
Doctorate degree	2 (.5%)	1 (.8%)	1 (.4%)
Marital status			
Single	49.7%	(65) 52.8%	(126) 47.7%
Married	40.6%	(47) 38.2%	(109) 41.3%
Widowed	4.9%	(6) 4.9%	(13) 4.9%
Divorced	2.3%	(4) 3.3%	(5) 1.9%
Other	2.3%	(1) 0.8%	(8) 3.1%
Occupation			
Student	16 (4.1%)	6 (4.8%)	10 (3.8%)
University student	75 (19.4%)	25 (20.2%)	50 (19.0%)
Self employed	118 (30.5%)	39 (31.5%)	79 (30.0%)
Employee	52 (13.4%)	18 (14.5%)	34 (12.9%)
Retired	15 (3.9%)	1 (.8%)	14 (5.3%)
Housewife	56 (14.5%)	14 (11.3%)	42 (16.0%)
Unemployed	47 (12.1%)	20 (16.1%)	27 (10.3%)
Other	8 (2.1%)	1 (.8%)	7 (2.7%)
Homeownership			
Yes	56.1%	56.5%	55.7%
No	43.9%	42.7%	44.3%
Car ownership			
Yes	257 (66.8%)	87 (70.2%)	170 (65.1%)
No	128 (33.2%)	37 (29.8%)	91 (34.5%)
Residence duration	M=23; SD=10.83.	M=23.75; SD=11.45	M=23.25; SD=10.55
Household size	M=4.92; SD=1.70	M=4.86; SD=1.79	M=4.95; SD=1.64

Boldface indicates *p* < .05 for PSG owners versus nonowners.

Table 4-2 Spearman correlation matrix for ordinal and continuous variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1 PSG Publicness																	
2 PSG age	-0.01																
3 PSG size	0.06	**0.25**															
4 Care duration	0.11	**0.22**	**0.54**														
5 Activities diversity	0.12	0.03	**0.29**	**0.46**													
6 Freq. activities	**0.13**	0.09	**0.39**	**0.56**	**0.70**												
7 Walking duration	0.05	-0.09	**0.19**	**0.31**	**0.36**	**0.40**											
8 PHQ-9	**-0.23**	**0.15**	-0.10	-0.02	-0.04	-0.04	0.04										
9 Life satisfaction	**-0.18**	0.03	**0.25**	**0.19**	**0.21**	**0.27**	**0.23**	-0.01									
10 Social Capital	-0.03	0.05	**0.25**	0.13	0.09	**0.13**	**0.16**	0.01	**0.40**								
11 Safety	-0.01	**0.15**	**0.13**	**0.22**	0.02	0.10	0.04	0.03	**0.27**	**0.20**							
12 Noise Annoyance	-0.01	0.04	0.12	**0.15**	**0.18**	**0.13**	0.04	**-0.10**	**0.18**	**0.18**	**0.13**						
13 Cleanliness	0.00	-0.12	**0.33**	**0.16**	**0.22**	**0.32**	**0.39**	-0.06	**0.35**	**0.22**	**0.14**	0.07					
14 Areas to clean	-0.03	**-0.14**	-0.01	0.01	0.05	0.06	**0.33**	0.05	0.03	-0.06	**0.11**	0.02	**0.30**				
15 Areas to protect	0.02	**-0.13**	**-0.17**	-0.07	-0.03	-0.03	**0.23**	0.05	0.05	0.00	**0.10**	0.02	**0.16**	**0.64**			
16 Age group	-0.05	-0.03	0.05	0.10	0.06	0.06	0.06	**0.13**	0.02	**-0.15**	-0.01	-0.01	0.06	**0.17**	**0.16**		
17 Household size	-0.07	**0.17**	0.08	0.00	0.01	0.00	0.00	0.06	0.01	0.06	0.03	0.03	0.00	-0.07	-0.08	-0.05	
18 Residence duration	-0.02	-0.09	-0.04	-0.10	-0.06	-0.02	-0.02	-0.03	-0.01	**-0.13**	0.08	-0.05	**0.22**	**0.16**	0.03	**-0.21**	-0.08

1.2. PSG characteristics

More than two-thirds of our sample (68%) had PSG in front of their houses, PSG size reflected the number of plant pots composing it, the minimum was one while the maximum was 40. At the time of the survey in January 2019, 77.3% of reviewed PSG were 36 months old or younger, which suggests PSG presence in the neighborhood might be related to the program *Madinaty Ajmal* started by the government in February 2016 to encourage PSG ownership and other similar neighborhood beautifying initiatives. Curiously survey participants denied any association between their PSG and the government; some even refused to participate in the survey because they suspected the government commissioned our study. A small proportion of participants (22.8%) perceived their PSG as exclusively private. PSG owners spent, on average, 47 minutes watering and cleaning their plants, while recreational activities were done next to PSG, 2 to 3 times a week.

Table 4-3 PSG characteristics and perception

Response	N (%)
PSG ownership	
Yes	264 (68%)
No	124 (32%)
PSG age	M=30.34; SD=32.168
Less than 3 years	204 (77.3%)
More than 3 years	60 (22.7%)
PSG size (range 1-40)	M=7.65; SD=4.621
PSG publicness	M=2.14; SD=0.76
Private	60 (22.8%)
Both	107 (40.7%)
Public	96 (36.5%)
Daily care duration (min)	M=17.26; SD=13.63
Weekly care frequency (0-7)	M=2.40; SD=1.44
Weekly care duration (min)	M=47.26; SD=48.41
Recreational activities frequency (0-7)	M=2.27; SD=1.77
Diversity of recreational activities (0-5) nonexclusive	M=1.17; SD=.96
None	79 (20.4%)
Eating	8 (2.1%)
Standing/Sitting	151 (38.9%)
Smoking	31 (8.0%)
Talking	103 (26.5%)
Other	17 (4.4%)

2. Neighborhood perception

2.1. Introduction

Perceived neighborhood characteristics were measured using five variables.

Life satisfaction measuring participants perceived neighborhood life quality satisfaction, social capital measuring neighbors' relationships, perceived safety as a measure for participants' safety feeling, perceived cleanliness representing participants' ratings of their neighborhood cleanliness, and noise annoyance measuring street noise pollution.

As indicated in Table 4-4, only life satisfaction scores, neighborhood perceived cleanliness, and neighborhood perceived safety were significantly different between PSG owners and nonowners. PSG owners had significantly higher life satisfaction scores and perceived their neighborhoods as being cleaner but less safe compared to those with no PSG.

Table 4-4 Neighborhood perception variables

	Whole sample	No PSG	With PSG
Life satisfaction score (range 1-10)	M=8.04; *SD*=1.14	**M=7.7; SD=1.08**	**M=8.20; SD=1.13**
Social capital score (range 1-10)	M=7.98; SD=1.41	M=7.91; SD=1.67	M=8.01; SD=1.26
Perceived Safety	3.91 (0.771)	3.90 (0.712)	3.91 (0.798)
Not safe at all	2	**0.8%**	**0.4%**
Not safe	27	**6.6%**	**7.2%**
Neutral	40	**5.8%**	**12.5%**
Safe	250	**75.2%**	**60.5%**
Very safe	65	**11.6%**	**19.4%**
Perceived cleanliness	M= 3.92; SD=1.09	M=3.89; SD=1.21	M=3.93; SD=1.027
Not clean at all	3 (0.8%)	**2 (1.6%)**	**1 (0.4%)**
Not clean	68 (17.5%)	**26 (21.0%)**	**42 (15.9%)**
Neutral	24 (6.2%)	**7 (5.6%)**	**17 (6.4%)**
clean	155 (35.3%)	**36 (29.0%)**	**119 (45.1%)**
Very clean	137 (35.3)	**52 (41.9)**	**85 (32.2%)**
Noise annoyance	M=2.85; SD=1.04	M=2.88; SD=1.06	M=2.83; SD=1.03
Very Annoyed	31 (8.0%)	11 (8.6%)	20 (7.6%)
Annoyed	144 (37.1%)	44 (35.5%)	100 (37.9%)
Neutral	74 (19.1%)	19 (15.3%)	55 (20.8%)
Not annoyed	132 (34.0%)	49 (39.5%)	83 (31.4%)
Not annoyed at all	7 (1.8%)	1 (0.8%)	6 (2.3%)

Boldface indicates p < .05 for PSG owners versus nonowners.

2.2. Neighborhood Life Quality Satisfaction

As explained in Figure 4-1 and 4-2, this analysis objective was to investigate the potential association between PSG ownership and characteristics, and neighborhood life quality satisfaction, in order to validate or refute two hypotheses:

H1: PSG ownership is positively associated with life satisfaction score.

H2: PSG ownership enhanced life satisfaction score association with social capital, and neighborhood safety and cleanliness.

H3: PSG characteristics are directly positively associated with neighborhood satisfaction.
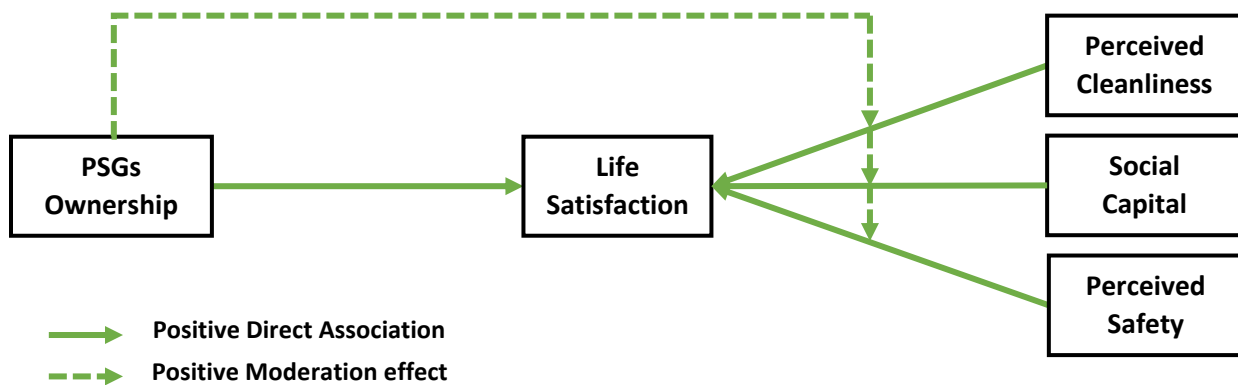
Figure 4-1 Conceptual model of PSG ownership hypothesized relationship with life satisfaction.
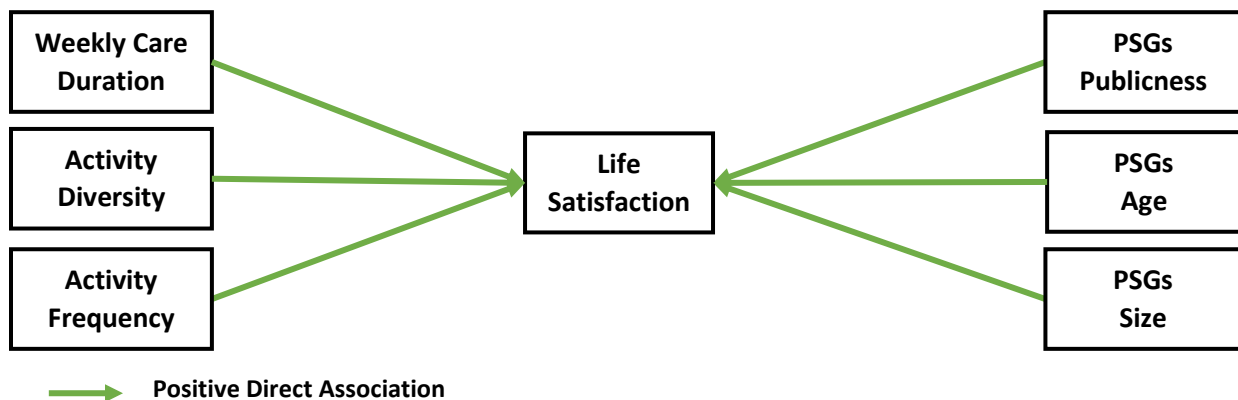
Figure 4-2 Conceptual model of PSG variables hypothesized relationship with life satisfaction.

2.2.1. Bivariate Analysis

We first used bivariate analyses (t-tests and χ^2 tests) to identify significant differences between our two groups (see Table 1). PSG owners had significantly higher life quality satisfaction scores than those without PSG (8.20 vs. 7.70).

Table 4-5 Life satisfaction and principal covariates characteristics

	Whole sample	No PSG	With PSG
Life satisfaction score (range 1-10)	M=8.04; *SD*=1.14	**M=7.7; SD=1.08**	**M=8.20; SD=1.13**

Boldface indicates p<.05 for PSG owners compared to those with no PSG.

Spearman's correlations were also calculated among our five key variables, neighborhood life quality satisfaction, neighborhood safety, social capital, and cleanliness for respondents with and without PSG. Results showed that for those without PSG, life satisfaction was significantly correlated social capital (*r* = .328; *p* < .001) and perceived cleanliness (*r* = .310; *p* < .001) only. There were no significant associations between neighborhood safety and any other variables.

Table 4-6 Spearman's Correlation Matrix for Participants without PSG

	1	2	3	4
1 Life Satisfaction	1			
2 Social Capital	**.328***	1		
3 Perceived Safety	-.056	-.003	1	
4 Perceived Cleanliness	**.310***	-.031	-.101	1

*p < .05; **p < .01; ***p < .001.

For those with PSG, life quality satisfaction was significantly associated with perceived safety, social capital, and cleanliness (*p* < .001).

Table 4-7 Spearman's Correlation Matrix for PSG owners

	1	2	3	4
1 Life Satisfaction	1			
2 Social Capital	**.443***	1		
3 Perceived Safety	**.359***	**.279***	1	
4 Perceived Cleanliness	**.387***	**.359***	**.241***	1

*p < .05; **p < .01; ***p < .001.

For the whole sample, neighborhood satisfaction was significantly associated with all other variables, while PSG ownership was significantly correlated only with Life satisfaction.

Table 4-8 Spearman's Correlation Matrix for the whole sample

	1	2	3	4	5
1 Life Satisfaction	1				
2 PSG ownership	**.182***	1			
3 Social Capital	**.400***	-.008	1		
4 Perceived Safety	**.268***	.011	**.199**	1	
5 Perceived cleanliness	**.345***	-.027	**.222***	**.137**	1

***p* < .05; ***p < .01; ****p < .001.**

2.2.2. Multivariate Analysis

The Breusch-Pagan test (Breusch and Pagan 1979) was used to verify our data homoscedasticity. The test was significant for all our regression Models (p < .001), revealing the presence of heteroscedasticity. Consequently, we opted to perform weighted linear regressions (WLS) using standard deviation function (Mike Crowson 2019) to reweight the observations.

In Model 1, we tested the relationship between neighborhood life quality satisfaction and our independent variables. In Model 2, we conducted a hierarchical WLS by adding the interaction terms between PSG ownership on one side and perceived safety, cleanliness, and social capital on the other side. Finally, In Model 3, we conducted a WLS regression for PSG owners' group only, adding variables related to PSG ownership; perceived publicness, size, age, daily care duration, weekly care frequency, types of recreational activities and their frequency, this last test aims to identify the PSG variables that affected our outcome variables the most. Table 4-9 shows the results of the WLS predicting neighborhood satisfaction score, stratified by PSG ownership.

Table 4-9 WLS Regression Models of life satisfaction by PSG ownership (N=388)

	Model1		Model2		Model3	
	With PSG	**No PSG**	**Step1**	**Step2**	**Step2**	
	b(CI)	**b(CI)**	**b(CI)**		**b(CI)**	**b(CI)**
PSG ownership Yes			**.36*** .19/.53	**.41*** .25/.58	**.470*** .275/.665	
Social capital	**.18** .07/.28	**.25*** .14/.35	**.41*** .33/.49	**.40*** .32/.48	**.352*** .256/.449	**.19*** .08/.302
Perceived safety	**.28*** .16/.40	.06 -.04/.16	.04 -.02/.11	**.20*** .09/.30	**.209*** .103/.315	**.27*** .15/.3
Perceived cleanliness	**.34*** .21/.47	**.21** .07/.35	**.27*** .18/.37	**.26*** .17/.36	**.279*** .152/.406	**.34*** .20/.47
Social capital x PSG ownership					-.16 -.32/.001	

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Perceived safety x PSG ownership				.31*** .15/.47	.35*** .18/.51	
Cleanliness x PSG ownership					-.01 -.20/.18	
PSG publicness						-.06 -.20/.07
PSG size						-.01 -.04/.02
PSG age						.004 -.002/.01
Weekly care duration						-.001 -.005/.002
Activity diversity						.05 -.12/23
Activity frequency						.13** .04/.22
Gender (Female)	.005 -.24/.25	-.12 -.34/.09	-.09 -.24/.05	-.08 -.23/.07	-.05 -.20/.09	.06 -.18/.31
Age category	-.10 -.27/.07	.51*** .32/.71	.344*** .2/.45	.34*** .24/.44	.32*** .22/.43	-.21* -.39/-.04
Marital status						
Married	.43 -.002/.87	-.23 -.61/.16	-.18 -.75/.39	-.15 -.71/.41	-.18 -.74/.37	.30 -.19/.80
Widow	.50 -.65/1.66	-.49 -1.43/.45	-.28 -1.42/.85	-.21 -1.32/.90	-.17 -1.28/.94	.47 -1.03/1.97
Divorced	.68 -.75/2.11	-.49 -1.23/.24	-.48 -1.49/.52	-.35 -1.34/.64	-.30 -1.30/.68	.96 -.54/2.46
Single	.42 -.03/.87	-.146 -.5/.26	.01 -.55/.57	.03 -.51/.5	-.006 -.56/.54	.195 -.32/.71
Education	-.01 -.09/.06	-.012 -.08/.06	-.03 -.08/.012	-.01 -.06/.03	-.008 -.05/.04	-.0 -.11/.04
Household size	.08* .006/.16	-.02 -.11/.06	.02 -.03/.08	.03 -.03/.08	.02 -.03/.08	.09* .02/.16
Residence duration	-.01 -.02/.005	.02** .01/.0	.022*** .011/.033	.02*** .01/.03	.020*** .009/.031	-.01 -.03/.00
Homeownership (yes)	.02 -.22/.25	.39*** .18/.60	.306*** .147/.464	.37*** .214.53	.350*** .186/.514	-.05 -.28/.18
Car ownership (yes)	.13 -.08/35	-.04 -.36/.28	.062 -.126/.250	.06 -.12/.24	.077 -.108/.261	.09 -.12/.31
Constant	24.680	-39.73**	-41.47***	-39.63***	-38.01***	28.848
F test	10.599***	10.846***	9.070***	9.320***	8.276***	8.505***

b: Unstandardized Regression Coefficient; *Cl*: Confidence Interval; *p* < .05; **p* < .01; ***p* < .001.

As can be seen in model 1, among PSG owners, social capital score, and neighborhood perceived safety and cleanliness were significantly correlated with neighborhood life quality satisfaction score. With one-point increase in social capital score correlated with 0.18 increase in neighborhood life satisfaction index score (*b* = .18, *CI* = .07/.28), one level increase in

neighborhood perceived safety correlated with a 0.30 increase in life satisfaction score (b = .28, CI = .16/.40), and one level increase in neighborhood perceived cleanliness correlated with a 0.34 increase in life satisfaction score (b = .34, CI = .21/.47).

However, for participants without PSG, only social capital score and neighborhood perceived cleanliness were significantly correlated with life satisfaction score, with a 1-point increase in social capital score index associated with a 0.25 increase in life satisfaction index score (b = .25, CI = .14/.35), and one level increase in neighborhood perceived cleanliness correlated with a 0.21 increase in life satisfaction score (b = .21, CI = **.**07/.35).

Homeownership was associated with a 0.39 increase in neighborhood life satisfaction score (b=.39, CI= **.**18/.60).

Model 2 shows the results of the hierarchical regression; step 1 with the main effect variables only (PSG ownership, perceived safety, social capital, and perceived cleanliness), and step 2 and 3 with the introduction of the interaction terms.

In step 1, among our key variables, only PSG ownership, social capital, and perceived cleanliness were significantly associated with life satisfaction index score. PSG ownership was associated with 0.36 increase in life satisfaction index score (b = .36, CI = .19/.53), one-point increase in social capital index score was associated with 0.41 increase in life satisfaction index score (b = .41, CI = .33/.49), while one level increase in neighborhood perceived cleanliness was correlated with a 0.27 increase in life satisfaction score (b = .27, CI = **.**18/.37). This result supports hypothesis 1, suggesting that PSG ownership, social capital, and perceived cleanliness are positively associated with life quality satisfaction.

In steps 2 and 3, we verified if PSG's ownership moderated the relationship between life satisfaction score on one side and social capital, perceived safety, and perceived cleanliness on the other side. Only the interaction term between PSG' ownership and perceived safety was significant in step 2. The additional variation explained between step 1 and step 2 was 1.8% (F(1, 344) = 14.154, p < .001. R^2 change = .018), which means that, in support of hypothesis 2, PSG's ownership does have an antagonizing moderation effect on the neighborhood satisfaction-perceived safety relationship. The simple slope explaining this moderation (figure 4-3), shows

that for PSG owners, an increase in perceived safety levels was associated with a significant increase in life satisfaction index score. While for nonowners, perceived safety increase had no significant association with life satisfaction scores.
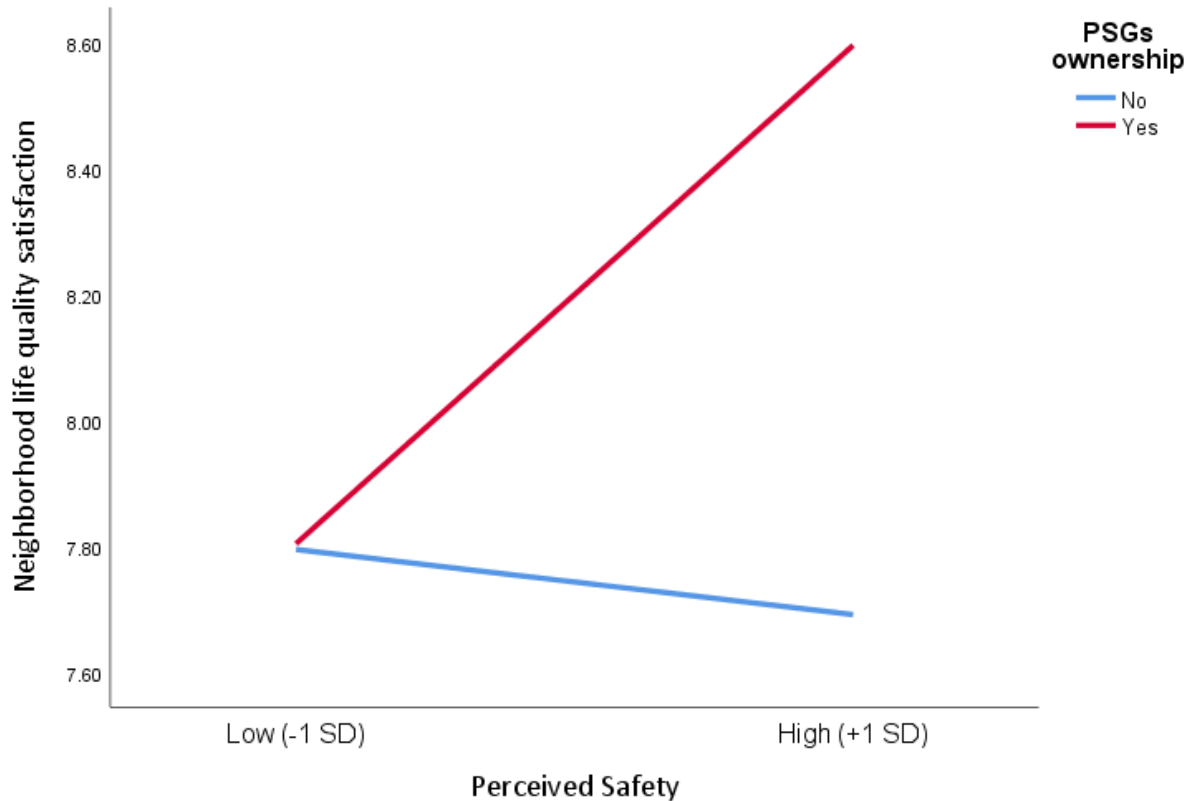
Figure 4-3 Simple slope for PSG ownership moderation of the life satisfaction – perceived safety relationship. The low value for life quality satisfaction is plotted at 1 SD below the mean, and the high value is plotted at 1 SD above the mean.

Model 3 shows that a one-unit increase in the weekly frequency of recreational activities done next to PSG was associated with a 0.13 increase in life satisfaction index score (b = .13, CI = .04/.22). This result supports hypothesis 3, stipulating that more interaction with PSG is associated with higher life satisfaction.

2.2.3. Discussion

The results of this study suggest that in our sample, PSG ownership was a sign of higher life quality satisfaction levels. PSG ownership was also found to have an enhancing moderation effect on the relationship between neighborhood perceived safety and life quality satisfaction, which means

that for participants with PSG, an increase in neighborhood perceived safety was significantly associated with a higher life quality satisfaction compared to those with no PSG, where an increase in perceived safety was negatively associated with life quality satisfaction.

Furthermore, increased weekly frequency of recreational activities undergone next to PSG was significantly associated with increased life quality satisfaction. This result suggests that although PSG is not a formal green space, it does provide a venue or a reason for recreational routines that, in turn, might have a significant positive association with an essential aspect of neighborhood life.

These results are congruent with previous research that associated interaction with and availability of formal UGS with increased life satisfaction (Houlden et al. 2018; Kiani et al. 2014) and associated neighborhood safety, community relations, and physical environment characteristics with neighborhood satisfaction (Grogan-Kaylor et al. 2006). However, to our best knowledge, this study is the first to investigate the potential direct and moderation effects of PSG ownership and related variables and neighborhood life quality satisfaction.

These findings show that PSG ownership and the recreational activities conducted next to it are a strong sign of higher neighborhood life satisfaction, and might be a potential way to improve wellbeing in dense disadvantaged neighborhoods. The findings show also the importance of neighborhood safety in defining life satisfaction level for PSG owners only. In the case of life satisfaction variable, hypotheses 1, 2, and 3 were all validated. Figures 4-4 and 4-5 illustrate the found correlations.
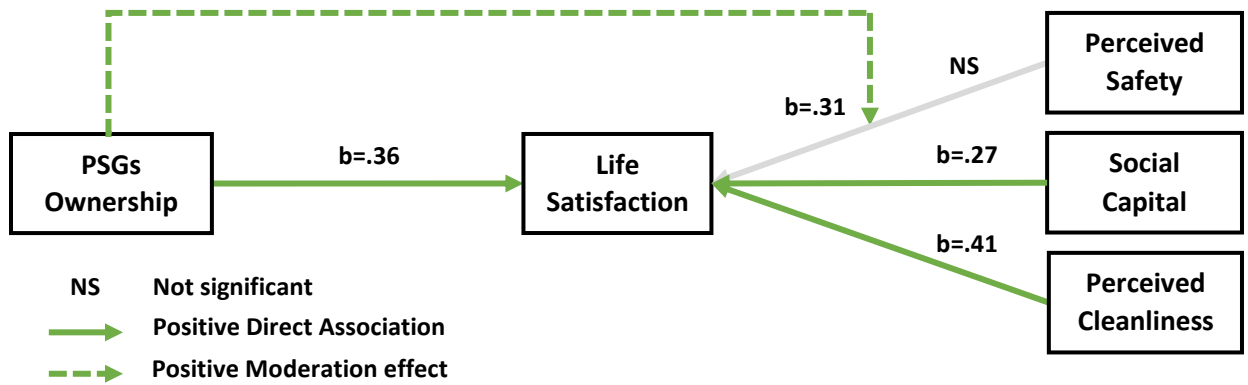
Figure 4-4 Diagram of PSG ownership association with Life satisfaction score.
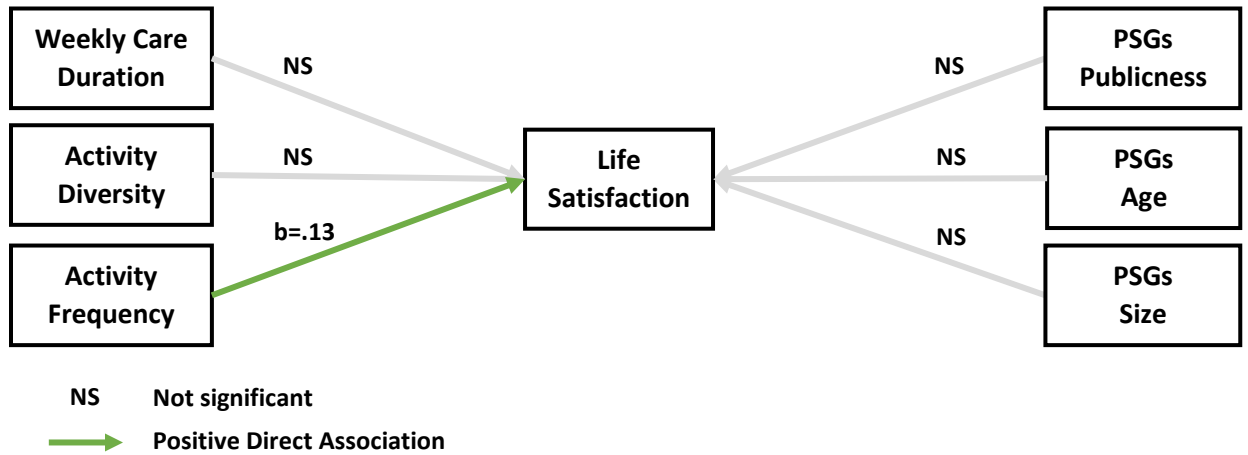
Figure 4-5 Diagram of PSG variables association with Life satisfaction score.

2.3. Neighborhood Social capital

As explained in figures 4-6 and 4-7, this analysis objective was to investigate the potential association between PSG ownership and characteristics, and social capital, in order to validate or refute three hypotheses:

H1: PSG ownership is positively associated with social capital score.

H2: PSG ownership enhanced social capital' association with neighborhood safety and life satisfaction.

H3: PSG characteristics are positively associated with social capital score.
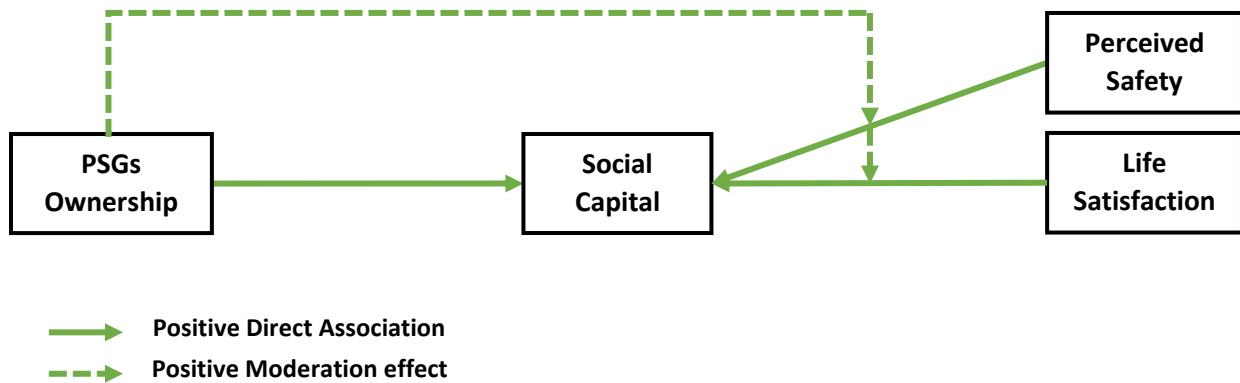
Figure 4-6 Conceptual model of PSG ownership hypothesized relationship with social capital.
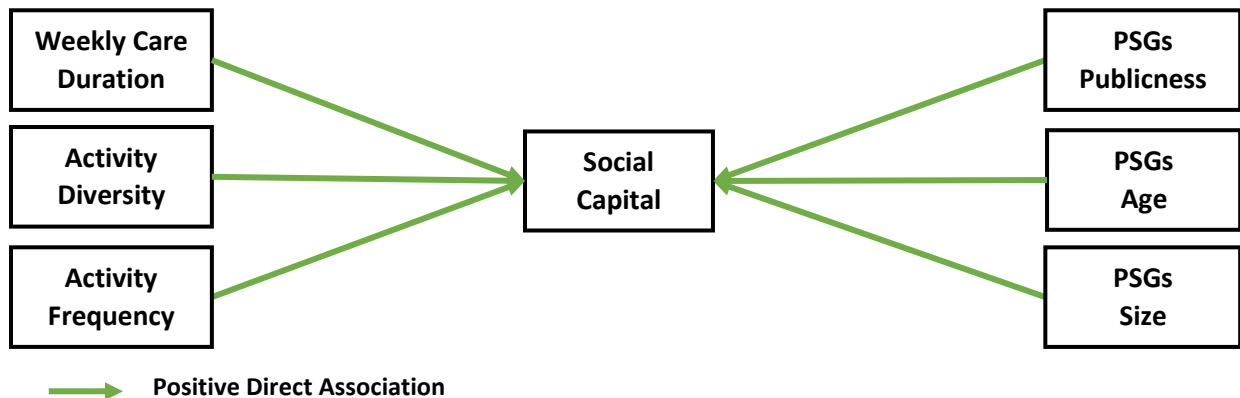
Figure 4-7 Conceptual model of PSG variables hypothesized relationship with social capital.

2.3.1. Bivariate Analysis

We used bivariate analyses (t-tests and χ^2 tests) to identify significant differences between our two groups (see Table 4-10). Neighborhood perceived social capital was higher among PSG owners, but this difference was not significant (8.01 vs. 7.91).

Table 4-10 Social capital and principal covariates characteristics

Whole sample	No PSG	With PSG	Whole sample
Social capital score (range 1-10)	M=7.98; SD=1.41	M=7.91; SD=1.67	M=8.01; SD=1.26

Boldface indicates p<.05 for PSG owners compared to those with no PSG.

Spearman's correlations were also calculated among our four key variables, social capital neighborhood life quality satisfaction, and neighborhood safety, for respondents with and without PSG. Results showed that for those without PSG, social capital was significantly correlated with life satisfaction (r=.377; p < .001) only.

Table 4-11 Spearman's Correlation Matrix for Participants without PSG

	1	2	3
1 Social Capital	1		
2 Life Satisfaction	**.328***	1	
3 Perceived Safety	-.003	-.056	1

***p* < .05; ***p* < .01; ****p* < .001.**

While for PSG owners, social capital was significantly associated with life satisfaction and perceived safety (p < .001).

Table 4-12 Spearman's Correlation Matrix for PSG owners

	1	2	3
1 Social Capital	1		
2 Life Satisfaction	**.443***	1	
3 Perceived Safety	**.279***	**.359***	1

***p* < .05; ***p* < .01; ****p* < .001.**

For the whole sample social capital was significantly associated with life satisfaction and perceived safety, but not with PSG ownership.

Table 4-13 Spearman's Correlation Matrix for the whole sample

	1	2	3	4
1 Social Capital	1			
2 PSG ownership	-.008	1		
3 Life Satisfaction	**.400*****	**.182*****	1	
4 Perceived Safety	**.199*****	.011	**.268*****	1

*p < .05; **p < .01; ***p < .001.

2.3.2. Multivariate Analysis

The Breusch-Pagan test (Breusch and Pagan 1979) used to verify our data homoscedasticity was significant for all our regression Models (p < .001), revealing the presence of heteroscedasticity for both variables. Consequently, we opted to perform weighted linear regressions (WLS) using standard deviation function (Mike Crowson 2019) to reweight the observations.

In model 1, we tested the relationship between social capital and our independent variables. In model 2, we conducted a hierarchical WLS by adding the interaction terms between PSG ownership on one side and perceived safety and life satisfaction on the other side. Finally, In model 3, we conducted a WLS regression for PSG owners' group only, adding variables related to PSG ownership, perceived publicness, size, age, daily care duration, weekly care frequency, types of recreational activities, and their frequency. This last test aims to identify the PSG variables that affected our outcome variables the most. Table 4-14 shows the results of the WLS predicting social capital score, stratified by PSG ownership.

As can be seen in model 1, among PSG owners, both neighborhood life quality satisfaction and perceived safety were significantly correlated with social capital index score. With one-point increase in life satisfaction score correlated with a 0.39 increase in social capital score (*b*=.39, *CI*=29/.49), and one level increase in neighborhood perceived safety correlated with a 0.11 increase in social capital score (*b*=.118, *CI*=.001/.234). Except for education, household size, and divorced, all other variables were negatively associated with social capital.

However, for participants without PSG, only life satisfaction was significantly correlated with social capital, with a 1-point increase in life satisfaction score associated with a 0.91 increase in

social capital index score (*b*=.91, *CI*= .69/1.13). Except for years lived in the neighborhood and car ownership all other variables were positively associated with social capital score.

Table 4-14 WLS Regression Models Explaining social capital by PSG ownership (N=388)

	Model1		Model2		Model3
	With PSG	**No PSG**	**Step1**	**Step2**	
	b(CI)	**b(CI)**	**b(CI)**	**b(CI)**	**b(CI)**
PSG ownership (Yes)			-.045 -.289/.198	-.045 -.292/.201	
Life satisfaction	**.394*** .295/.493**	**.916*** .698/1.134**	**.401*** .321/.482**	**.506*** .370/.643**	**.351*** .250/.452**
Perceived safety	**.118* .001/.234**	.072 -.187/.331	.056 -.029/.141	.047 -.065/.160	.078 -.021/.178
Life satisfaction x PSG ownership				-.383 -.775/.009	
Perceived safety x PSG ownership				.068 -.239/.376	
PSG publicness					-.065 -.194/.065
PSG size					**.056*** .033/.079**
PSG age					-.004 -.010/.002
Weekly care duration					-.002 -.005/.001
Activity diversity					-.066 -.206/.074
Activity frequency					.038 -.040/.116
Gender (Female)	-.020 -.213/.174	.033 -.171/.237	**.189*** .089/.290**	**.185*** .084/.286**	.078 -.130/.285
Age category	**-.204* -.390/-.018**	.039 -.302/.380	**-.839*** -.941/-.736**	**-.843*** -.946/-.739**	-.112 -.274/.050
Marital status					
Married	-.033 -.789/.723	**1.199*** .655/1.743**	.449 -.310/1.208	.470 -.287/1.227	.279 -.402/.961
Widow	-.363 -1.468/.742	.789 .152/1.426	1.000 -.046/2.046	**1.077* .032/2.123**	-.467 -1.386/.453
Divorced	1.171 -.741/3.084	**1.042*** .522/1.562**	**1.217* .039/2.394**	**1.268* .091/2.444**	1.437 -.177/3.050
Single	-.165 -.932/.602	**1.224*** .633/1.814**	-.227 -.987/.533	-.210 -.969/.548	.267 -.415/.949
Education	**.151*** .070/.232**	.004 -.113/.122	**.108** .046/.170**	**.106 .044/.168**	**.084* .013/.155**
Household size	.046 -.019/.110	.078 -.052/.209	.001 -.033/.032	.001 -.031/.033	.051 -.013/.114

Residence duration	**-.029*****	**-.011***	**-.023*****	**-.023*****	**-.026*****
	-.042/-.016	**-.022/.000**	**-.034/-.012**	**-.034/-.012**	**-.037/-.016**
Homeownership	-.045	.252	-.039	-.048	-.128
(yes)	-.269/.178	-.180/.683	-.263/.184	-.271/.176	-.320/.063
Car ownership (yes)	-.154	-.304	-.044	-.032	**-.233***
	-.380/.073	-.676/.069	-.265/.178	-.254/.190	**-.420/-.046**
Constant	**61.839*****	21.497	**51.271*****	**50.483*****	**57.061*****
F test	**12.480*****	**5669.849*****	**111.821*****	**105.424*****	**24.019*****

b: Unstandardized Regression Coefficient; CI: Confidence Interval; *p < .05; **p < .01; ***p < .001.

Model 2 shows the results of the hierarchical regression; step 1 with the main effect variables only (PSG ownership, perceived safety, social capital, and neighborhood safety), and step 2 with the introduction of the interaction terms.

In step 1, only life satisfaction was significantly associated with social capital, with a 1-point increase in life satisfaction index score associated with a 0.40 increase in social capital index score (b=.40, CI= .32/.48). PSG ownership was negatively associated with social capital, although this association was not significant.

This result does not support hypothesis 1, that PSG ownership was significantly positively associated with social capital.

In step 2, we verified if PSG ownership moderated the relationship between social capital score on one side and life quality satisfaction score and perceived safety on the other side. No interaction term was significant; this result does not support hypothesis 2, stipulating that PSG ownership is a moderator to the relationship between social capital and our two other IVs.

Model 3 shows that, among the PSG perception and routines variables, only PSG size was significant, with one plant pot increase in PSG size associated with a 0.05 increase in social capital index score (b=.05, CI=-.033/.07). Apart from PSG size and frequency of recreational activities, all other PSG related variables were negatively associated with social capital score. These results support hypothesis 3 that stipulates PSG characteristics are positively associated with social capital.

2.3.3. Discussion

The results of our analysis suggest that, overall, PSG ownership had no significant association with social capital, neither in bivariate nor in multivariate analysis. However, the associations between social capital and other variables for our two groups with and without PSG were significantly different.

PSG size was the only PSG related variable to be significantly positively associated with social capital score. Nevertheless, this positive association does not explain PSG ownership negative correlation with social capital in model 2, which may be explained when observing the association of all other PSG related variables with social capital in model 3, where out of six variables, four were negatively correlated with social capital.

It is possible that bigger PSG require more care time and presence outside owner's houses, which might be providing more opportunities to meet and possibly socialize with next-door neighbors. However, in that case, weekly care duration should also be positively correlated with social capital. It is also possible that participants with higher social capital have bigger PSG for altruistic reasons, which is consistent with previous research that associated social capital with altruistic behaviors (Theurer and Wister 2010).

The results of this study showed that the higher the number of plant pots, the higher the social capital among PSG owners, which suggests that encouraging bigger PSG might be an effective way to boost social capital in dense neighborhoods.
In the case of social capital score, hypotheses 1, 2 were rejected, while hypothesis 3 was validated. Figures 3 and 4 illustrate the found correlations.
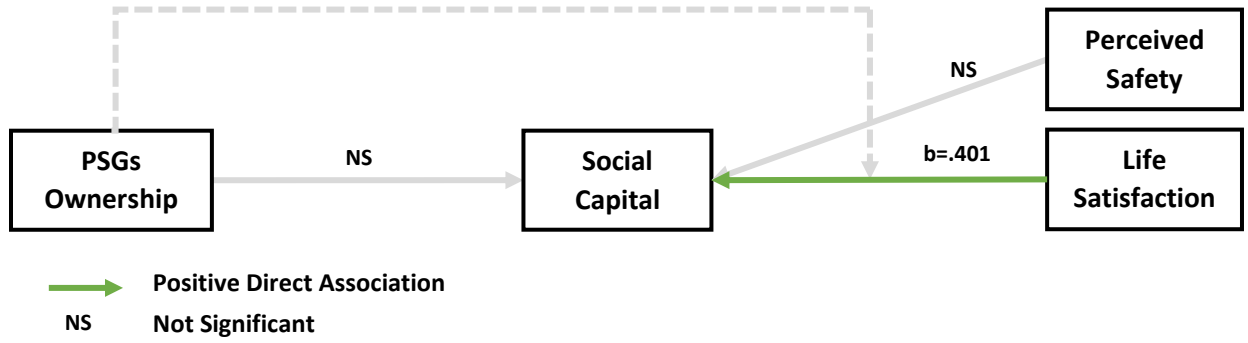
Figure 4-8 Diagram of PSG ownership association with social capital score.
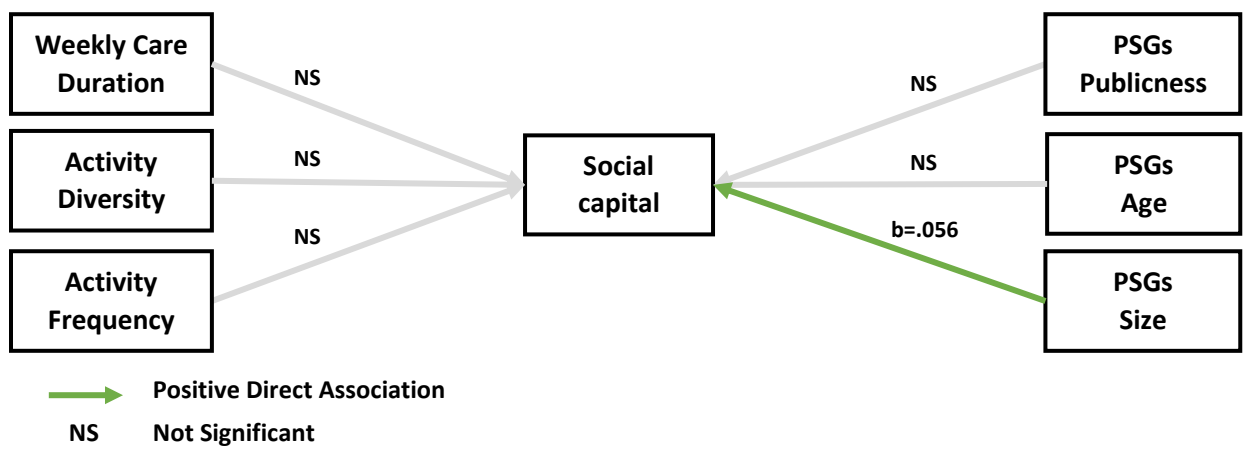
Figure 4-9 Diagram of PSG variables association with social capital score.

2.4. Neighborhood perceived safety

As explained in figures 4-10 and 4-11, this analysis objective is to investigate the potential association between PSG ownership and characteristics, and neighborhood perceived safety, in order to validate or refute three hypotheses:

H1: PSG ownership is positively associated with neighborhood perceived safety.

H2: PSG ownership enhanced neighborhood perceived safety association with social capital and life satisfaction.

H3: PSG characteristics are positively associated with neighborhood perceived safety.
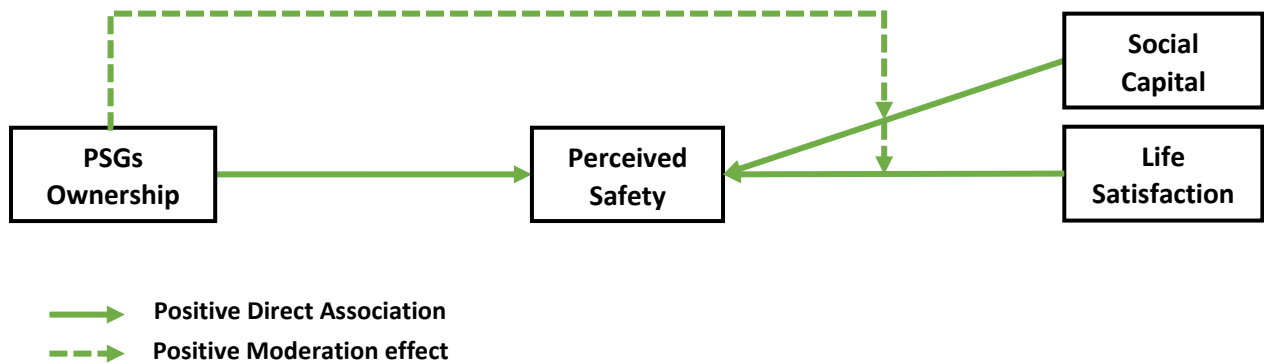
Figure 4-10 Conceptual model of PSG ownership hypothesized relationship with perceived safety
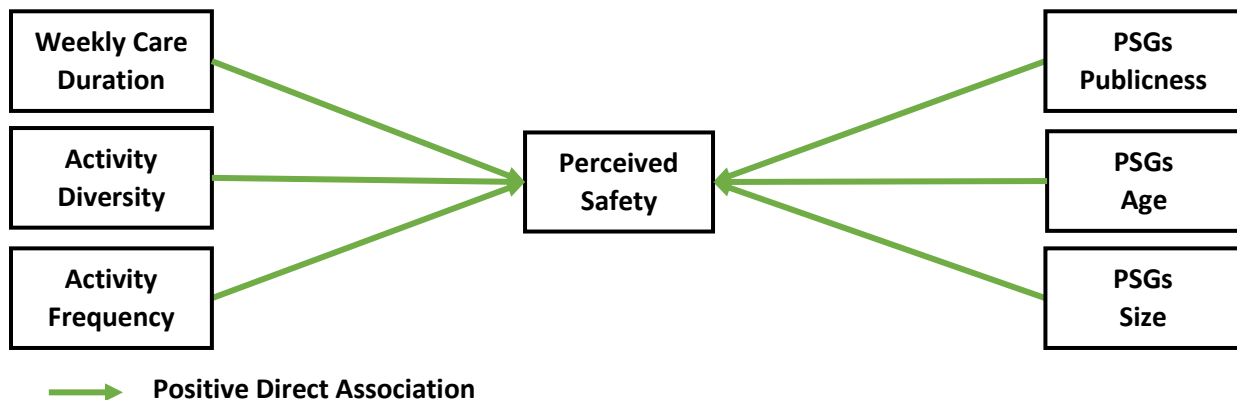
Figure 4-11 Conceptual model of PSG variables hypothesized relationship with perceived safety

2.4.1. Bivariate Analysis

Neighborhood perceived safety cannot be analyzed using ordinal regression as the data violated the proportional odds assumption. Usually, when this occurs, the usual alternative analysis would be a multinomial regression. However, we opted to analyze the data using a binary regression because less than 8% of our sample felt "not safe/not safe at all" in their neighborhoods. We, therefore, collapsed our five categories to two, (0) "Not safe at all/ Not safe / Neutral" and "Safe/Very safe" (1), and analyzed the dichotomous variable in this section.

As can be seen in Table 4-15, the vast majority of our sample (81%) perceived their neighborhoods as being "safe / very safe". Although PSG owners were more likely to report feeling Not safe at all/ Not safe / Neutral in their neighborhoods, this difference was not significant.

Table 4-15 Ordinal and dichotomous perceived safety.

Whole sample	Whole sample	No PSG	With PSG
Perceived Safety (ordinal)	3.91 (0.771)	3.90 (0.712)	3.91 (0.798)
Not safe at all	2 (0.5%)	**1 (0.8%)**	**1 (0.4%)**
Not safe	27 (7.0%)	**8 (6.6%)**	**19 (7.2%)**
Neutral	40 (10.4%)	**7 (5.8%)**	**33 (12.5%)**
Safe	250 (65.1%)	**91 (75.2%)**	**159 (60.5%)**
Very safe	65 (16.9%)	**14 (11.6%)**	**51 (19.4%)**
Perceived safety (dichotomous)			
Not safe at all/ Not safe / Neutral	69 (17.8%)	16 (12.9%)	53 (20.1%)
Safe/Very safe	315 (81.2%)	105 (84.7%)	210 (79.5%)

Boldface indicates p<.05 for PSG owners compared to those with no PSG.

Spearman's correlations were also calculated for our key variables, neighborhood safety, PSG ownership, life satisfaction, and social capital. Results showed that for participants without PSG, neighborhood safety was not significantly correlated with any variable. Neighborhood satisfaction and social capital were significantly associated.

Table 4-16 Spearman's Correlation Matrix for PSG owners

	1	2	3
1 Perceived Safety	1		
2 Life Satisfaction	-.056	1	
3 Social capital	-.003	**.328***	1

*$p < .05$; **$p < .01$; ***$p < .001$.

For PSG owners, all variables were significantly associated with each other with a significance of p < .001 at least (Table 4-17).

Table 4-17 Spearman's Correlation Matrix for PSG owners

	1	2	3
1 Perceived Safety	1		
2 Life Satisfaction	**.359***	1	
3 social capital	**.279***	**.443***	1

*p < .05; **p < .01; ***p < .001.

For the whole sample, perceived safety was significantly associated with all other variables except for PSG ownership, while PSG ownership was significantly correlated only with Life satisfaction (Table 4-18).

Table 4-18 Spearman's Correlation Matrix for the whole sample

	1	2	3	4
1 Perceived Safety	1			
2 PSG ownership	.011	1		
3 Life Satisfaction	**.268***	**.182***	1	
4 social capital	**.199***	-.008	**.400***	1

*p < .05; **p < .01; ***p < .001.

2.4.2. Multivariate Analysis

The linearity of our continuous independent variables with the logit of the dependent variable was evaluated using the Box-Tidwell procedure (Box and Tidwell 1962) in SPSS 25. All our continuous independent variables were found to be linearly correlated with the logit of the dependent variable. In order to avoid sparse data bias (Greenland, Mansournia, and Altman 2016), we dropped the variables "single," "widow" and "divorced," this procedure did not affect the significance of critical variables.

Table 4-19 shows the results of the binary logistic regression predicting perceived safety, stratified by PSG ownership.

Table 4-19 Binary Logistic Regression explaining perceived safety (N = 388)

	Model1		Model2		Model3
	With PSG	**No PSG**	**Step1**	**Step2**	
	OR(CI)	OR(CI)	OR(CI)	OR(CI)	OR(CI)
PSG ownership (yes)			**.44*** **.22/.87**	.63 .31/1.26	
Life satisfaction	**1.42*** **1.08/1.86**	.824 .434/1.566	**1.41*** **1.08/1.84**	**1.40*** **1.04/1.86**	**1.78**** **1.19/2.67**
Social capital	**1.71**** **1.20/2.44**	1.100 .783/1.545	**1.26*** **1.04/1.54**	**1.32**** **1.07/1.63**	**1.42*** **1.04/1.95**
Life satisfaction x PSG ownership				**2.00*** **1.04/3.85**	
Social capital x PSG ownership				1.27 .85/1.90	
PSG publicness					.92 .57/1.49
PSG size					.99 .89/1.09
PSG age					1.00 .99/1.02
Weekly care duration					**1.02*** **1.00/1.035**
Activity diversity					.70 .38/1.28
Activity frequency					.93 .66/1.31
Gender (Female)	1.99 .86/4.61	2.21 .370/13.25	**2.17*** **1.06/4.46**	**2.17*** **1.03/4.56**	1.67 .66/4.21
Age category	1.09 .67/1.77	.88 .390/2.01	1.004 .670/1.505	1.01 .67/1.52	1.06 .62/1.81
Marital status					
Married	1.13 .19/6.47	.52 .14/1.95	.89 .47/1.71	.85 .44/1.65	1.34 .55/3.24
Education	1.098 .871/1.384	.90 .554/.475	1.04 .86/1.27	1.03 .84/1.26	1.12 .86/1.46
Household size	.937 .76/1.15	.75 .50/1.11	.95 .80/1.13	.89 .74/1.07	.97 .77/1.24
Residence duration	1.018 .97/1.06	1.02 .96/1.09	1.00 .97/1.04	1.02 .98/1.05	1.03 .98/1.07
Homeownership	.56 .25/1.25	1.27 .28/5.66	.67 .34/1.32	.66 .33/1.32	.66 .28/1.57
Car ownership	1.29 .62/2.69	1.67 .44/6.34	1.14 .61/2.12	1.35 .71/2.53	1.55 .71/3.40
Constant	.001	.001	.001	.001	.011
χ^2 test	8.166	**33.086****	**30.92****	**39.268*****	**14.039****
Nagelkerke R^2	.128	.196	.134	.169	.256

OR: Odds ratio; *CI*: 95% Confidence Interval; *p <.05; **p <.01; ***p <.001.

As can be seen in model 1, In the PSG owners' group, an increase of one point in life satisfaction index was associated with an increased likelihood of rating the neighborhood as being safe or very safe by 1.42 times (42%) (*OR* = 1.42, *CI* = 1.08/2.34). An increase of one point in social capital index was associated with an increased likelihood of rating the neighborhood as being safe or very safe by 1.71 times (71%) (*OR* = 1.71, *CI* = 1.20/2.44).

Among participants with no PSG, no variable was significantly associated with neighborhood perceived safety. Model 1 shows that there is indeed a difference between the two groups.

Model 2 shows the results of the hierarchical regression, step 1 with the main effect variables only (including PSG ownership), and step 2 with the addition of the interaction terms.

Step 1 shows that PSG owners were 56% less likely to rate the neighborhood as being safe/very safe compared to participants with no PSG (*OR* = .44, *CI* = .22/.87). An increase of one level in neighborhood perceived safety was associated with 1.41 times (41%) increased likelihood of rating the neighborhood as being safe/very safe (*OR* = 1.41, *CI* = 1.08/1.84). While one-point increase in social capital index was associated with 1.26 (26%) increased likelihood of rating the neighborhood as being safe/very safe (*OR* = 1.26, *CI* = 1.04/1.54). This result does not support hypothesis 1 that stipulates that PSG ownership is positively associated with neighborhood perceived safety. Curiously these results revealed the opposite of expected results.

Step 2 tests the effects of PSG ownership as a moderator on the relationship between neighborhood perceived safety, life quality satisfaction, and social capital. Only the interaction term between life satisfaction and PSG ownership was found significant (OR=2.00, CI=1.04/3.85). The simple slope explaining this moderation effect shows that for PSG owners only, an increase in life satisfaction score was associated with a significant increase in perceived safety. For nonowners, perceived safety increase and life satisfaction score were not significantly associated.

This result partially supports hypothesis 2, stipulating that PSG ownership enhances the relationship between neighborhood safety and neighborhood life quality satisfaction (Figure 4-12).
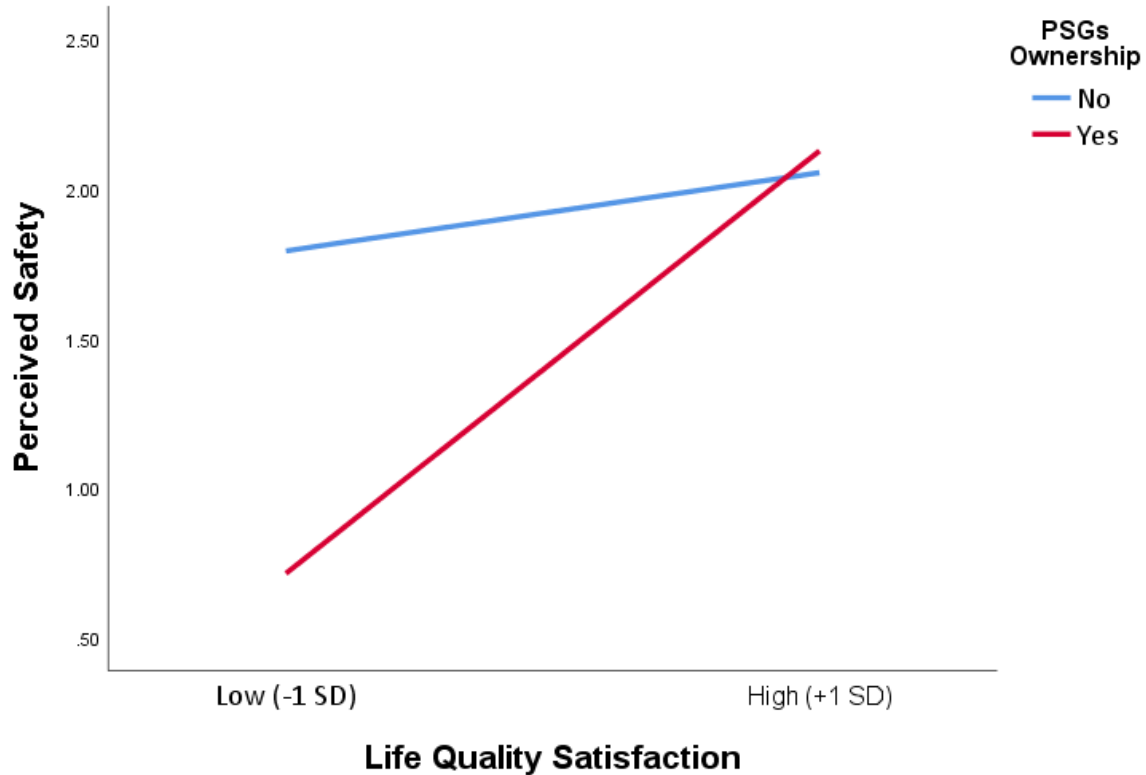
Figure 4-12 Simple slope for PSG ownership moderation of perceived safety – Neighborhood satisfaction relationship. The low value for life quality satisfaction is plotted at 1 SD below the mean, and the high value is plotted at 1 SD above the mean

In model 3, we test the association between PSG characteristics, perception and related routines on one side, and neighborhood perceived safety. Results indicate that only weekly care duration was significant, where a 1-minute increase in weekly care duration is associated with a 2% increased likelihood of rating the neighborhood as being safe/very safe (*OR* = 1.02, *CI* = 1.00/1.035). This result supports our hypothesis that PSG induced daily routines are associated with neighborhood perceived safety, but does not explain the negative association between PSG ownership and perceived safety.

Figure 4-13 Neighborhood safety by weekly care duration in Minutes.

2.4.3. Discussion

Greener neighborhoods were linked to an increase in perceived safety and a decrease in crime rates (Kuo et al. 1998; Kuo and Sullivan 2001). However, most of these studies focused on formal UGS like grass and trees. In this research, we investigated the potential relationship between PSG ownership and neighborhood perceived safety. Results showed that PSG owners were 56% less likely to perceive their neighborhoods as safe or very safe compared to those without PSG (Figure 4-14). Furthermore, PSG ownership moderated the association between life satisfaction and perceived safety.

More time spent watering and cleaning PSG was significantly associated with a higher likelihood of reporting the neighborhood being safe/very safe. Nevertheless, all other variables introduced in model 3, although not significant, were negatively related to safety perception.
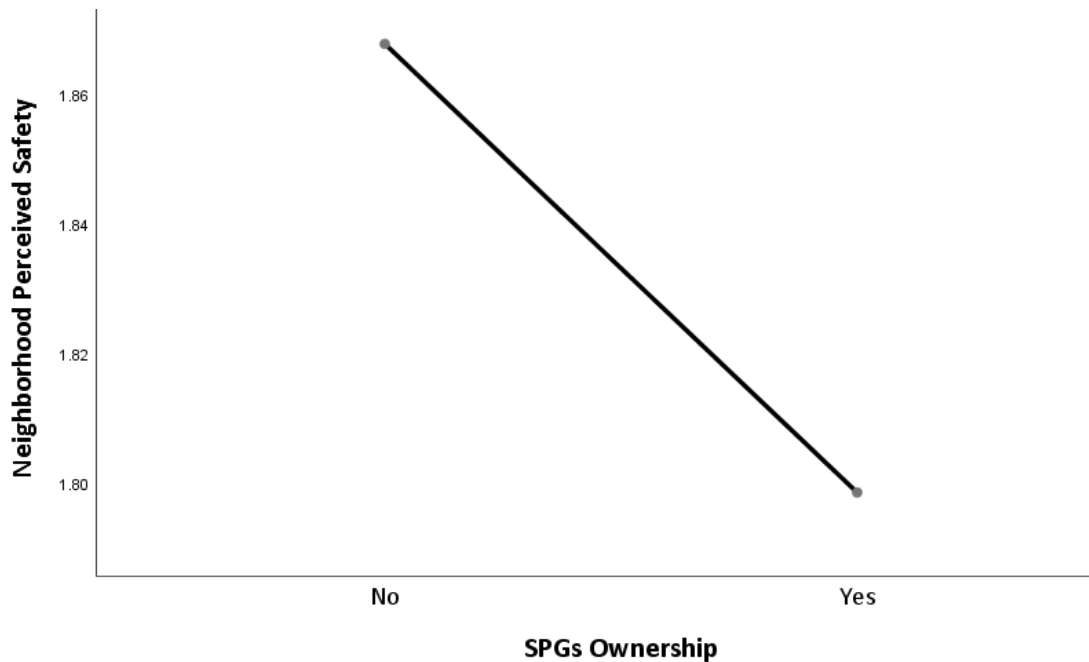
Figure 4-14 Neighborhood safety by PSG ownership

Overall, these results do not support previous findings in our literature review, that suggest greener neighborhoods are correlated with increased perceived safety. The association between PSG ownership and decreased levels perceived safety found in this research might be related to PSG nature as private property, especially that PSG publicness was found to be positively associated with perceived safety (figure 4-15). This means that the more public PSG were perceived, the safer PSG owners felt in their neighborhoods. This association was not significant, but it is very interesting.

We suggest two possible explanatory hypotheses to these findings:

a) PSG perception as a private property present outside of owners' area of control, in one of Tangier's most disadvantaged neighborhoods (La Cava et al. 2012), might be the cause for the increased perception of unsafety. Neighborhood safety, social capital, and life satisfaction were all significantly correlated only for PSG owners' group, which might imply that PSG owners are more sensitive to their neighborhood's characteristics than others.

Figure 4-15 Neighborhood safety by PSG publicness

b) People feeling unsafe are more likely to have a PSG than others: PSG might be a territorial defense mechanism as PSG connection with territoriality was already established in previous research. According to Golant's theoretical model of residential normalcy, and the P-E fit theory, PSG ownership might represent an assimilative strategy or a coping mechanism, improvised by locals to adapt with their feeling of unsafety in their neighborhoods, as a first line of defense against intruders into what they perceive as their territory. Previous research reported the use of PSG for such purposes but did not report a negative association between PSG ownership and perceived safety.

To our knowledge, this study is the first to measure PSG ownership direct and moderated association with neighborhood perceived safety. Therefore, there are no comparable data to compare to ours. Also, given our study design, our findings cannot verify the directionality of the association between PSG ownership and perceived safety. Furthermore, it is recommended to use bigger sample sizes, experimental designs, and longitudinal data in order to explore causal relationships between PSG ownership and perceived neighborhood safety.

To conclude, PSG ownership may be amplifying the feeling of insecurity in unsafe neighborhoods, while more time spent cleaning and watering collectively owned PSG may help dissipate the

feeling of insecurity. In the case of perceived neighborhood safety, the analysis results were mixed. Hypotheses 1 was rejected, while hypotheses 2 and 3 were validated. Figures 4-16 and 4-17 illustrate the found correlations.
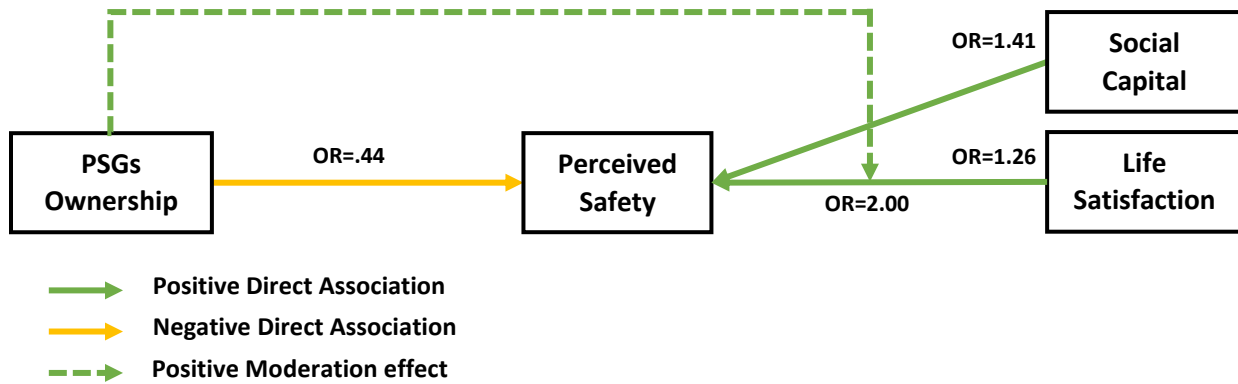
Figure 4-16 Diagram of PSG ownership association with Perceived safety.
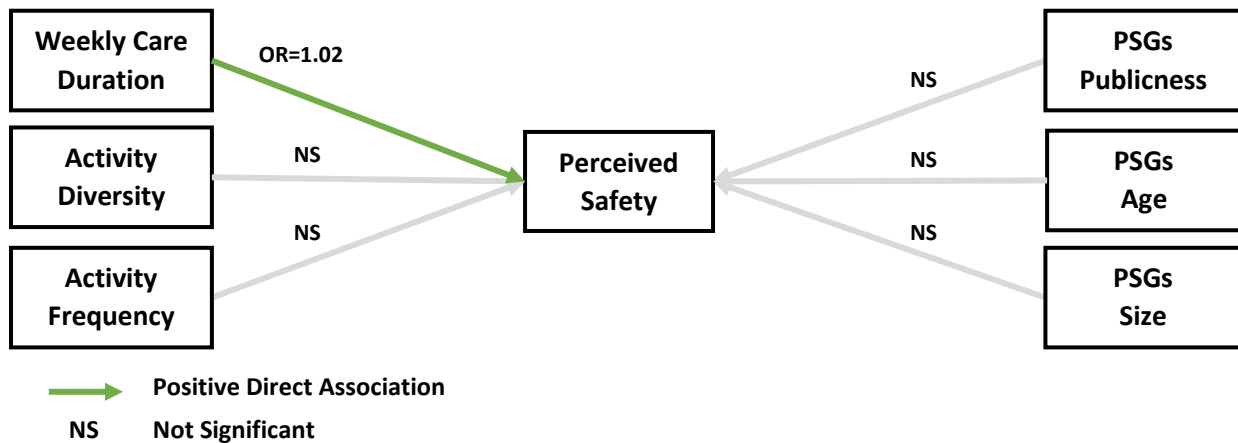
Figure 4-17 Diagram of PSG variables association with Perceived safety.

2.5. Neighborhood perceived cleanliness

As explained in Figures 4-18 and 4-19, this analysis objective is to investigate the potential association between PSG ownership and characteristics, and neighborhood perceived cleanliness, in order to validate or refute three hypotheses:

H1: PSG ownership is positively associated with neighborhood perceived cleanliness.

H2: PSG ownership enhanced neighborhood perceived cleanliness association with neighborhood safety, life satisfaction, and social capital.

H3: PSG characteristics are positively associated with neighborhood perceived cleanliness.
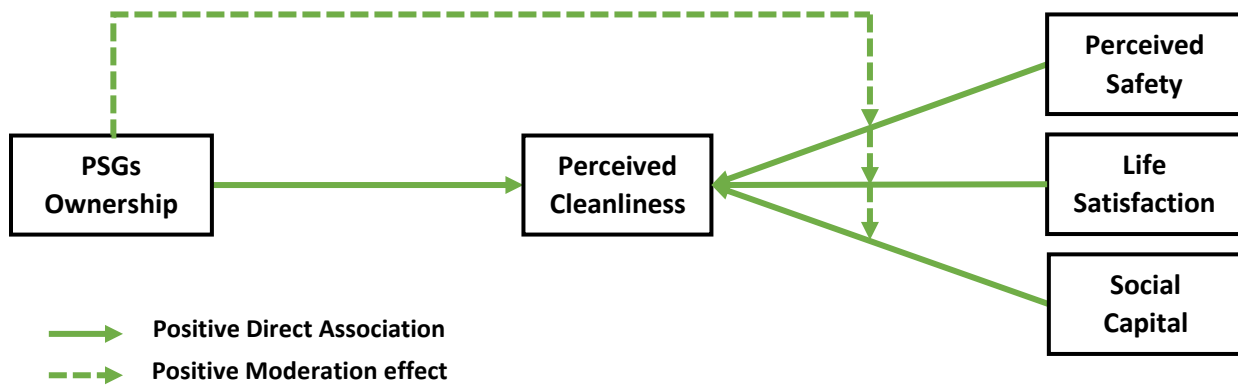
Figure 4-18 Conceptual model of PSG ownership hypothesized association to perceived cleanliness.
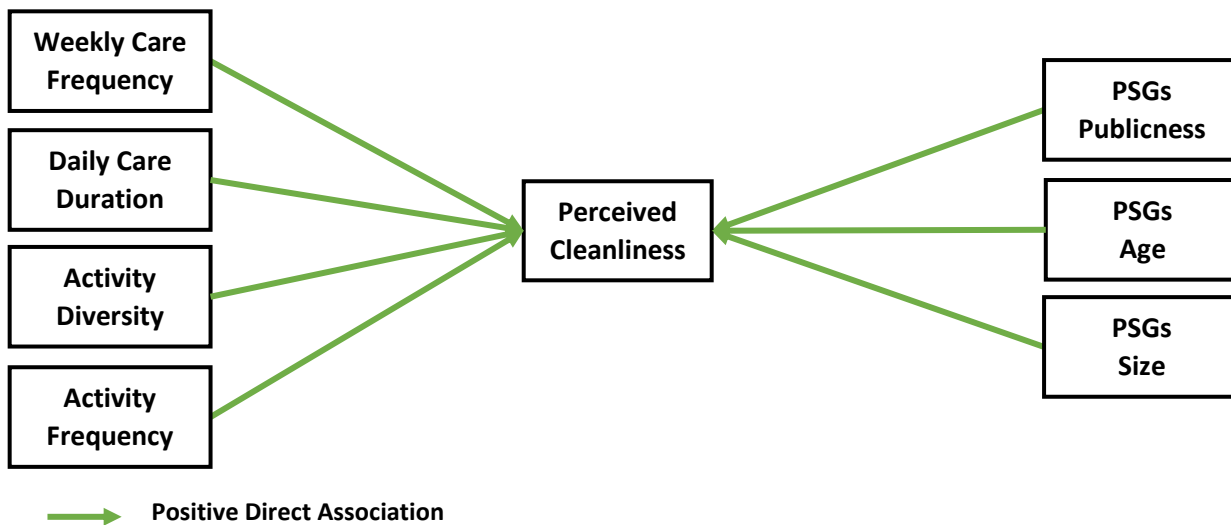
Figure 4-19 Conceptual model of PSG variables hypothesized association to perceived cleanliness.

2.5.1. Bivariate Analysis

We performed bivariate analyses (t-tests and χ^2 tests) to identify significant differences between groups with and without PSG (Table 4-20). There was a significant difference between the two groups in neighborhood perceived cleanliness. PSG Owners were more likely to perceive their neighborhoods as being cleaner than others.

Table 4-20 Perceived cleanliness

Whole sample	Whole sample	No PSG	With PSG
Perceived cleanliness	M= 3.92; SD=1.09	M=3.89; SD=1.21	M=3.93; SD=1.027
Not clean at all	3 (0.8%)	**2 (1.6%)**	**1 (0.4%)**
Not clean	68 (17.5%)	**26 (21.0%)**	**42 (15.9%)**
Neutral	24 (6.2%)	**7 (5.6%)**	**17 (6.4%)**
clean	155 (35.3%)	**36 (29.0%)**	**119 (45.1%)**
Very clean	137 (35.3)	**52 (41.9)**	**85 (32.2%)**

Boldface indicates p<.05 for PSG owners compared to those with no PSG.

We calculated Spearman's correlations, neighborhood cleanliness, neighborhood safety, life satisfaction, and social capital, stratified by PSG ownership. For the group with no PSG, perceived cleanliness was significantly associated only with life satisfaction (r=.310, p < .001).

Table 4-21 Spearman's Correlation Matrix for Participants without PSG

	1	2	3	4
1 Perceived cleanliness	1			
2 Perceived Safety	-.101	1		
3 Life Satisfaction	**.310***	-.056	1	
4 Social Capital	-.031	-.003	**.328***	1

*p < .05; **p < .01; ***p < .001.

For PSG owners, all variables were significantly associated with neighborhood perceived cleanliness and with each other with p < .001.

Table 4-22 Spearman's Correlation Matrix for PSG Owners

	1	2	3	4
1 Perceived cleanliness	1			
2 Perceived Safety	**.241***	1		
3 Life Satisfaction	**.387***	**.359***	1	
4 Social Capital	**.359***	**.279***	**.443***	1

*p < .05; **p < .01; ***p < .001.

For the whole sample, perceived cleanliness was significantly associated only with life satisfaction, social capital, and perceived safety but not with PSG ownership. In contrast, PSG ownership was significantly correlated only with Life satisfaction. Social capital, perceived safety, and life satisfaction were all significantly associated with each other.

Table 4-23 Spearman's Correlation Matrix for the whole sample

	1	2	3	4	5
1 Perceived cleanliness	1				
2 PSG Ownership	-.027	1			
3 Perceived Safety	.137**	.011	1		
4 Life Satisfaction	.345***	.182***	.268***	1	
5 Social Capital	.222***	-.008	.199***	.400***	1

$p < .05$; **$p < .01$; ***$p < .001$.

2.5.2. Multivariate Analysis

In order to meet the proportional odds assumption in our regression models, we added the categorical variable "occupation." This modification did not change the significance of the key variables. However, it allowed us to analyze the data using ordinal logistic regression tests, which is the fittest analysis type for ordinal data. Table 4-24 shows the results of the ordinal logistic regression predicting neighborhood perceived cleanliness, stratified by PSG ownership.

Table 4-24 Ordinal Logistic Regression explaining neighborhood perceived cleanliness (N = 388)

	Model1		Model2		Model3	
	With PSG	No PSG	Step 1	Step 2	Step2	
	OR(CI)	OR(CI)	OR(CI)	OR(CI)	OR(CI)	OR(CI)
PSG ownership			.67 .42/1.07	.70 .43/1.12	.72 .45/1.18	
Life satisfaction	**1.77*** 1.33/2.35**	**1.70* 1.04/2.78**	**1.65*** 1.32/2.07**	**1.62*** 1.28/2.04**	**1.59*** 1.27/2.00**	**1.77*** 1.29/2.43**
Perceived safety	1.03 .72/1.47	.80 .41/1.55	.98 .74/1.31	.95 .71/1.29	.92 .68/1.24	1.01 .68/1.51
Social capital	**1.85*** 1.44/2.37**	1.16 .90/1.50	**1.48*** 1.25/1.75**	**1.54*** 1.28/1.86**	**1.54*** 1.29/1.85**	**1.75*** 1.32/2.32**
Social capital x PSG ownership				**1.39* 1.01/1.93**	1.33 .96/1.83	
Life satisfaction x PSG ownership					1.12 .68/1.85	
Perceived Safety x PSG ownership					1.42 .72/2.81	

PSG publicness						.78 .54/1.13
PSG size						**1.09*** **1.01/1.18**
PSG age						.99 .98/1.00
Weekly care frequency						**1.33*** **1.00/1.75**
Daily care duration						**.96*** **.94/.99**
Activity diversity						1.01 .64/1.59
Activity frequency						1.14 .88/1.48
Gender (Female)	.97 .43/2.21	1.8 .44/7.27	.960 .50/1.84	.94 .48/1.84	.91 .47/1.77	1.29 .53/3.12
Age category	**2.34*** 1.48/3.71	.95 .39/2.35	**1.836** 1.25/2.69	**1.85** 1.27/2.69	**1.84** 1.25/2.71	**2.33** 1.40/3.85
Marital status						
Single	**10.85** 2.14/55.02	7.31 .12/421.92	**9.87** 2.35/41.32	**9.73** 2.45/38.68	**9.62** 2.28/40.59	**9.68** 1.82/51.27
Married	**6.52*** 1.31/32.34	7.791 .1/460.77	**7.47** 1.80/30.99	**7.08** 1.77/28.24	**6.89** 1.64/28.89	**6.72*** 1.31/34.32
Divorced	11.92 .89/158.54	6.247 .07/569.18	**7.51*** **1.04/54.37**	6.44 .96/43.00	6.59 .89/48.76	8.91 .62/127.88
widowed	2.29 .26/19.99	9.77 .1/908.2	2.992 .48/18.60	2.74 .45/16.73	2.69 .43/16.94	2.58 .26/25.36
Occupation						
H. student	**16.30*** 1.82/145.38	.52 .00/101.86	5.55 .90/4.26	4.85 .74/31.54	4.98 .81/30.57	**12.05*** 1.21/119.46
Uni. student	**9.58*** 1.59/57.60	.55 .004/86.15	**5.25*** 1.09/25.16	4.55 .90/22.83	4.55 .95/21.80	**9.50*** 1.47/61.44
Self employed	**16.957** 2.80/102.67	6.49 .04/903.21	**13.63** 2.91/63.73	**11.94** 2.45/58.15	**12.07** 2.58/56.37	**10.64*** 1.60/70.61
Employee	**13.61** 2.01/92.20	3.67 .02/599.23	**11.81** 2.30/60.61	**10.29** 1.93/54.68	**10.41** 2.03/53.36	**8.23*** 1.09/61.96
Retired	**12.370*** 1.13/135.41	.43 .001/110.34	**8.49*** 1.07/67.45	6.76 .85/53.80	6.74 .83/54.38	6.75 .53/84.71
Housewife	**22.657** 2.89/177.54	5.36 .05/544.22	**16.88** 3.11/91.45	**15.21** 2.68/86.29	**15.74** 2.91/85.24	**9.30*** 1.03/83.60
Unemployed	**19.08** 2.86/127.28	3.65 .03/421.34	**11.78** 2.38/58.22	**10.29** 1.99/53.25	**10.71** 2.17/52.87	**10.19*** 1.37/75.79
Education	**1.71*** 1.35/2.17	**2.64*** 1.61/4.33	**1.73*** 1.427/2.11	**1.72*** 1.41/2.10	**1.73*** 1.42/2.11	**1.46** 1.12/1.89
Household size	.98 .82/1.17	1.33 .98/1.82	1.05 .91/1.20	1.03 .89/1.18	1.02 .89/1.18	.96 .80/1.16
Residence duration	**1.07*** 1.03/1.10	.98 .93/1.03	**1.04** 1.012/1.06	**1.04** 1.01/1.06	**1.04** 1.01/1.07	**1.06** 1.03/1.11
Homeownership	1.14 .62/2.08	**.31*** **.11/.89**	.78 .48/1.27	.76 .47/1.23	.77 .47/1.26	1.31 .68/2.50
Car ownership	.74	.81	.818	.85	.87	.55

	.41/1.32	.29/2.23	.51/1.31	.53/1.37	.54/1.40	.28/1.06
Model fitting χ²	**153.24***	**71.42***	**188.97***	**193.07***	**194.31***	**160.14***
Nagelkerke *R²*	**.505**	**.511**	**.445**	**.452**	**.454**	**.547**

<div align="center">OR: Odds ratio; CI: 95% Confidence Interval; *p <.05; **p <.01; ***p <.001.</div>

As can be seen in Model 1, for PSG owners' group, an increase of one unit in life quality satisfaction index was associated with an increase of 77% in the likelihood of rating neighborhood cleanliness higher (*OR* = 1.77, *CI* = 1.33/2.35), and an increase of one unit in social capital index was associated with an increase of 85% in likelihood of rating neighborhood cleanliness higher (*OR* = 1.85, *CI*= 1.44/2.37).

An increase in one-level in age category was associated with a 134% likelihood increase in neighborhood cleanliness rating (OR=2.34, CI= 1.48/3.71). An increase of one education level was associated with a 71% likelihood increase in neighborhood cleanliness rating (*OR* = 1.71, *CI* = 1.35/2.17). While an increase of one year in time lived in the neighborhood was associated with a 7% likelihood increase in neighborhood cleanliness rating (*OR* = 1.07, *CI* = 1.03/1.10). Perceived safety was not significant.

Among participants with no PSG, an increase of one unit in life quality satisfaction index was associated with a 70% likelihood increase in neighborhood cleanliness rating (*OR* = 1.70, *CI*=1.04/2.78). An increase of one education level was associated with a 164% likelihood increase in neighborhood cleanliness rating (*OR* = 2.64, *CI* = 1.61/4.33). Homeownership was associated with a 69% increased likelihood of rating neighborhood cleanliness higher (*OR* = .31, *CI* = .11/.89). Perceived safety and social capital were not significant.

Model 2 shows the results of the hierarchical regression, step 1 with the main effect variables only (including PSG ownership this time), and steps 2 and 3 with the addition of the interaction terms.

Step 1 shows that for the whole sample, PSG ownership had a negative association with perceived cleanliness. However, this correlation was not significant; an increase of one unit in life quality satisfaction index was associated with a 65% likelihood increase in neighborhood cleanliness rating (*OR* = 1.65, *CI* = 1.32/2.07). Moreover, an increase of one unit in social capital index was associated with an increase of a 48% likelihood increase in cleanliness rating (*OR* = 1.48,

CI = 1.25/1.75). An increase of one age category was associated with an 83% likelihood increase in neighborhood cleanliness rating (*OR* = 1.83, *CI* = 1.25/2.69). An increase of one education level was associated with an increase of 73% likelihood increase in cleanliness rating (*OR* = 1.73, *CI* = 1.42/2.11). While an increase of one year in time lived in the neighborhood was associated with a 4% likelihood increase in cleanliness rating (OR=1.04, CI= 1.01/1.06). Perceived safety was not significant.

This result does not support hypothesis 1, stipulating that PSG ownership is significantly associated with higher neighborhood perceived cleanliness.

Step 2 tests the effects of PSG ownership as a moderator on the relationship between cleanliness rating and social capital. The PSG ownership-social capital interaction term was found significant (OR=1.39, CI= 1.01/1.93). While in step 3, no interaction term was found to be significant. The simple slope explaining this moderation effect (Figure 4-20) shows that for PSG owners only, an increase in social capital score was associated with a significant increase in perceived cleanliness. For nonowners perceived cleanliness and social capital score were not significantly associated.

This result partially supports hypothesis 2 that PSG ownership enhances the cleanliness-social capital interaction.

In model 3, we test the association between PSG characteristics, perception, and related routines on one side and cleanliness rating. Only PSG size and daily care duration and weekly care frequency were significantly associated with perceived cleanliness. With one plant pot increase in PSG size associated with a 9% likelihood increase in cleanliness rating (*OR* = 1.09, *CI*= 1.01/1.18), one time increase in weekly care frequency associated with 33% likelihood increase in cleanliness rating (*OR* = 1.33, *CI* = 1.00/1.75). And one-minute increase in daily care duration was associated with 4% decrease in neighborhood cleanliness rating (*OR* = .96, *CI*= .94/.99).

These results are mixed with 2 out of 3 PSG related variables positively associated with higher cleanliness rating, which partially supports our hypothesis that PSG characteristics and induced daily routines are associated with higher neighborhood perceived cleanliness rating.
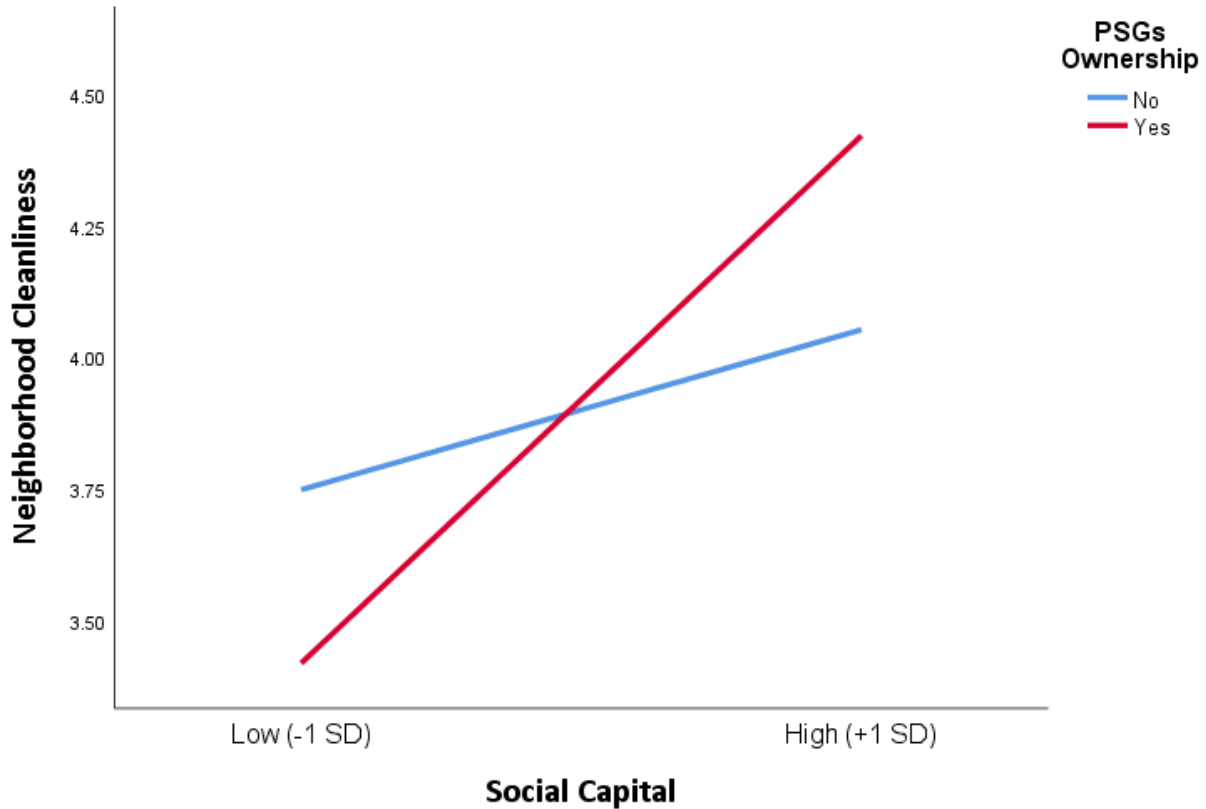
Figure 4-20 Simple slope for PSG ownership moderation of the neighborhood perceived cleanliness – social capital relationship. The low value for social capital plotted at 1 SD below the mean, and the high value is plotted at 1 SD above the mean.

2.5.3. Discussion

A consistent body of research associated exposure to UGS with prosocial behaviors. While territoriality was linked with the increased implication in neighborhood area maintenance (O'Brien 2016). PSG being both an informal green space that increases neighborhood greenery perception in residential neighborhoods, and a manifestation of increased territoriality, might consequently be positively associated with more street cleaning and thus increased perceived cleanliness.

However, to our best knowledge, no research has investigated the correlation between PSG ownership and neighborhood perceived cleanliness. Understanding this potential association is of great importance in order to create better living environments, especially in disadvantaged neighborhoods.

Our results showed that PSG ownership had an enhancing moderation effect on the perceived cleanliness-social capital association, which means that PSG owners with higher social capital scores, perceived their neighborhoods cleaner compared to those with no PSG. This finding might be explained by the perceived cleanliness positive association with PSG size and weekly frequency (Figure. 4-21 and 4-22).
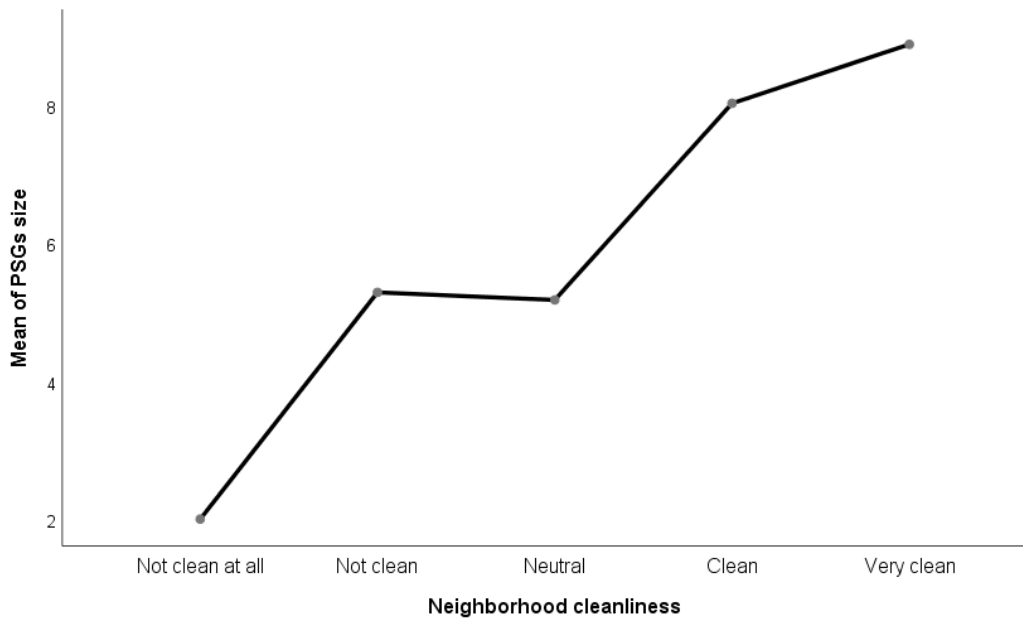
Figure 4-21 Neighborhood perceived cleanliness by PSG size
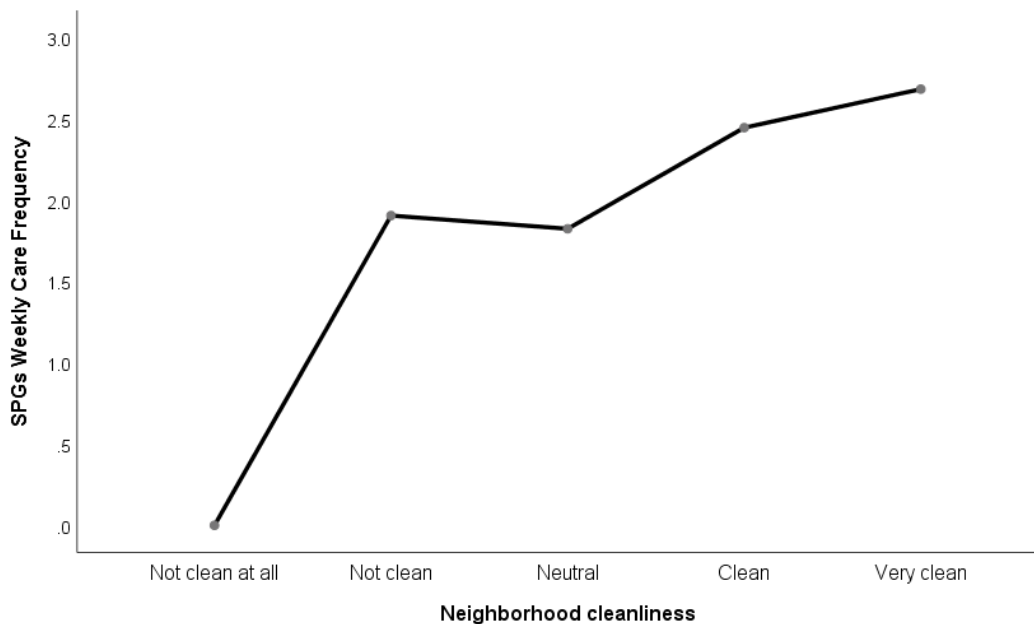
Figure 4-22 Neighborhood perceived cleanliness by weekly care frequency

Curiously daily care duration was negatively associated with cleanliness rating in the adjusted model. In a simple model with no control variables the association was positive although not significant (Figure 4-23)
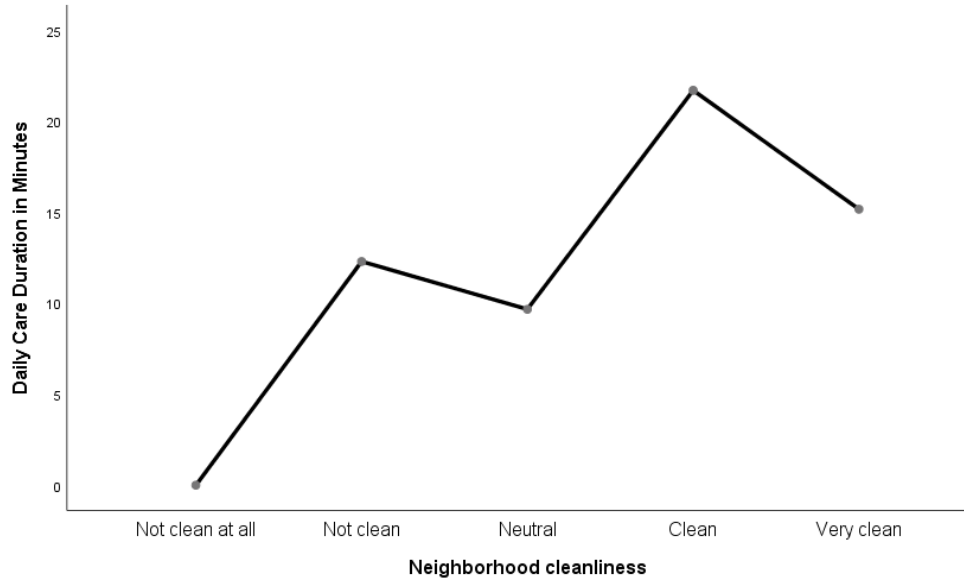
Figure 4-23 Neighborhood perceived cleanliness by weekly care frequency

Our findings suggest that PSG ownership would be a strategic and cost-efficient way to increase perceived cleanliness in dense disadvantaged neighborhoods. However, experimental data is required in order to verify if PSG ownership is associated with cleaner neighborhoods or just the perception of cleanliness. In the case of perceived neighborhood cleanliness, the analysis results were mixed; hypotheses one was rejected, while hypotheses 2 and 3 were partially validated. Figures 4-24 and 4-25 illustrate the found correlations.
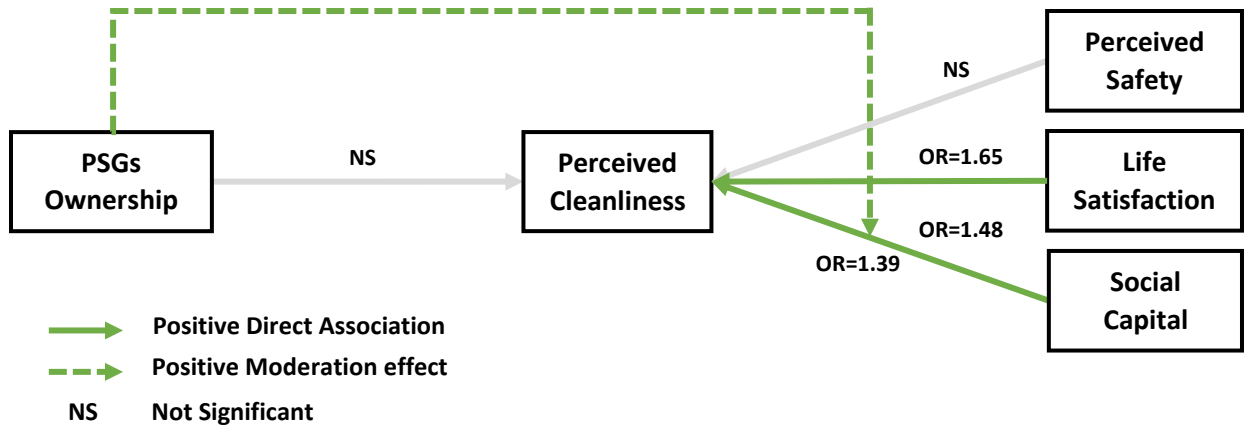
Figure 4-24 Diagram of PSG ownership association with perceived cleanliness.
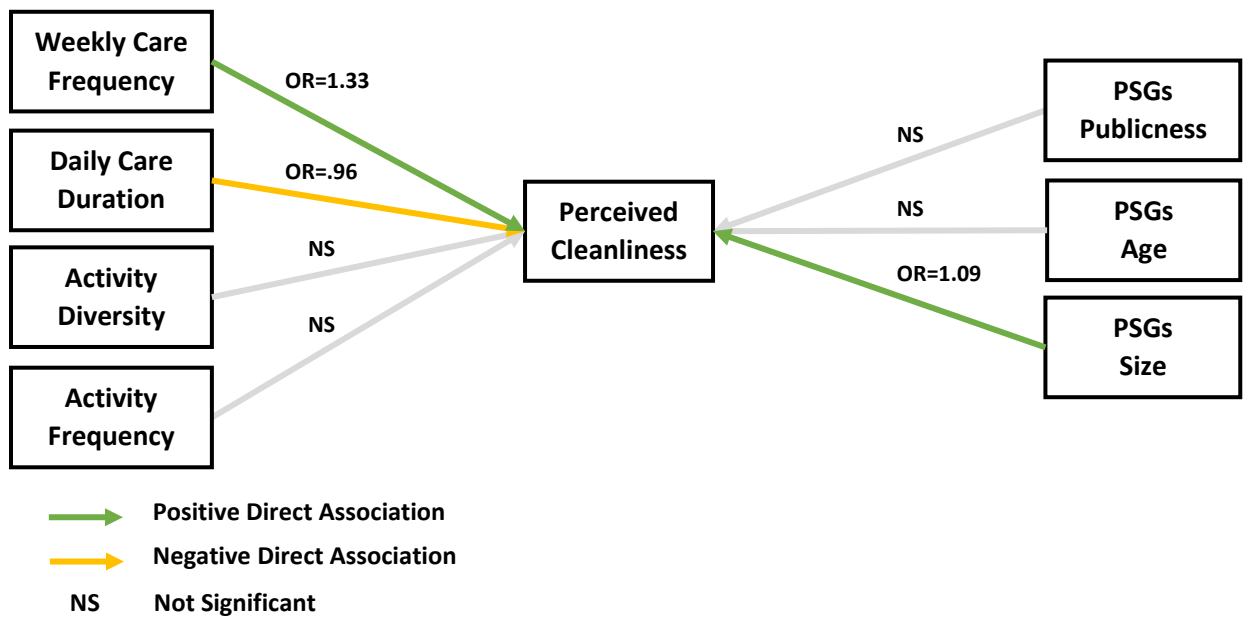
Figure 4-25 Diagram of PSG variables association with perceived cleanliness.

2.6. Perceived noise annoyance

As explained in Figures 4-26 and 4-27, this analysis aimed to study PSG ownership and related variables' correlation with noise annoyance, we assumed that PSG presence would dissuade outsiders from engaging in noisy activities in front of owners' houses, like talking out loud, playing soccer. The bivariate and multivariate analyses objective was therefore, to investigate the veracity of three hypotheses:

H1: PSG ownership is negatively associated with high levels of noise annoyance.

H2: PSG ownership buffers noise annoyance association with life satisfaction, perceived safety, and social capital.

H3: PSG characteristics are negatively associated with high levels of noise annoyance.
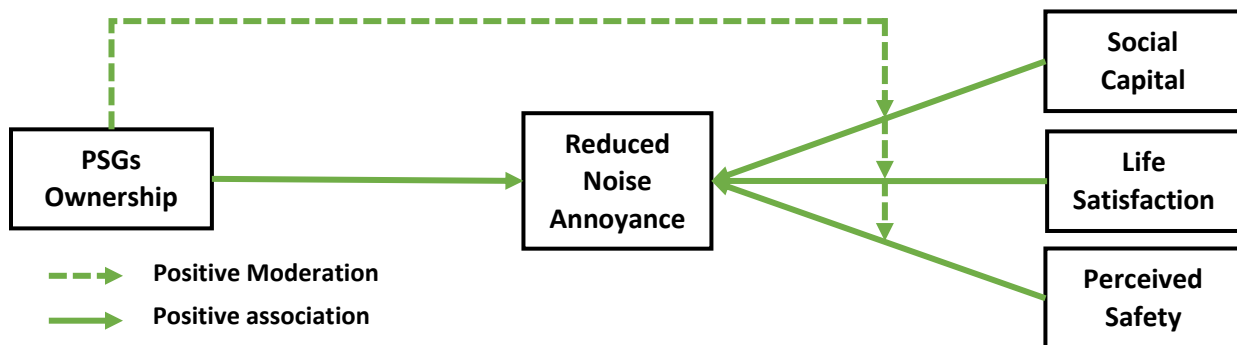
Figure 4-26 Conceptual model of PSG ownership hypothesized relationship with noise annoyance.
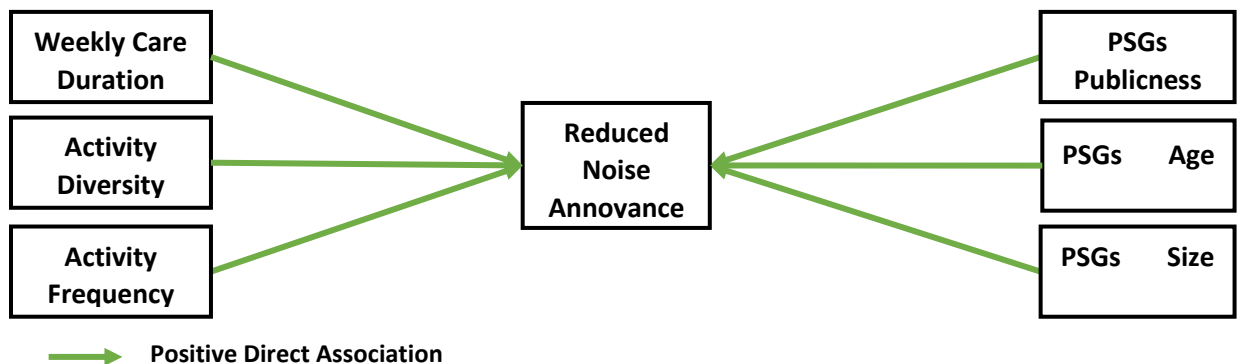
Figure 4-27 Conceptual model of PSG variables hypothesized association with noise annoyance.

Neighborhood noise annoyance cannot be analyzed using ordinal regression because it violated the proportional odds assumption. We opted to analyze the data using a dichotomous regression. We decided to omit the category "Neutral" because allowing it to either side would change the sense of the association. We were also more interested in identifying PSG association with the extremes of noise annoyance. Therefore, we collapsed our five categories to two, (0) "Very annoyed/Annoyed" and "Not annoyed/Not annoyed at all" (1). We will, therefore, analyze the dichotomous variable in this section.

2.6.1. Bivariate Analysis

We performed bivariate analyses (t-tests and χ^2 tests) to identify significant differences between groups with and without PSG (Table 4-25). There were no significant differences between our two groups in terms of neighborhood noise annoyance, 55.7 % of survey participants reported being very annoyed/annoyed, while 44% reported being not annoyed/not annoyed at all.

Table 4-25 Noise annoyance ordinal and dichotomous

Whole sample	No PSG	With PSG	Whole sample
Noise annoyance (ordinal)	M=2.85; SD=1.04	M=2.88; SD=1.06	M=2.83; SD=1.03
Very Annoyed	31 (8.0%)	11 (8.6%)	20 (7.6%)
Annoyed	144 (37.1%)	44 (35.5%)	100 (37.9%)
Neutral	74 (19.1%)	19 (15.3%)	55 (20.8%)
Not annoyed	132 (34.0%)	49 (39.5%)	83 (31.4%)
Not annoyed at all	7 (1.8%)	1 (0.8%)	6 (2.3%)
Noise annoyance (dichotomous)			
Very annoyed /annoyed	175 (55.7%)	55 (52.4%)	120 (57.4%)
Not annoyed/not annoyed at all	139 (44.3%)	50 (47.6%)	89 (42.6%)

Boldface indicates *p* < .05 for PSG owners versus nonowners.

Spearman's correlations were also calculated for our key variables, neighborhood noise annoyance, PSG ownership, life satisfaction, and social capital. Results showed that for participants without PSG, neighborhood noise annoyance was not significantly correlated with any variable. Neighborhood satisfaction and social capital were significantly associated (Table 4-26).

Table 4-26 Spearman's Correlation Matrix for participants with no PSG

	1	2	3	4
1 Noise annoyance	1			
2 Perceived Safety	-.035	1		
3 Life Satisfaction	.001	-.056	1	
4 social capital	.138	-.003	.328***	1

*p < .05; **p < .01; ***p < .001.*

For PSG owners, noise annoyance was significantly correlated with all other variables; all variables were significantly associated with each other with *p* < .01 at least (Table 4-27).

Table 4-27 Spearman's Correlation Matrix for PSG owners

	1	2	3	4
1 Noise annoyance	1			
2 Perceived Safety	.187**	1		
3 Life Satisfaction	.218**	.359***	1	
4 social capital	.210**	.279***	.443***	1

*p < .05; **p < .01; ***p < .001.*

For the whole sample, neighborhood noise annoyance was significantly associated with all other variables except for PSG ownership.

Table 4-28 Spearman's Correlation Matrix for the whole sample

	1	2	3	4	5
1 Noise annoyance	1				
2 PSG ownership	-.048	1			
3 Perceived Safety	.117*	.011	1		
4 Life Satisfaction	.144*	.182***	.268***	1	
5 social capital	.184**	-.008	.199**	.400***	1

*p < .05; **p < .01; ***p < .001.*

2.6.2. Multivariate Analysis

The linearity of continuous independent variables with the logit of the dependent variable was evaluated using the Box-Tidwell procedure (Box and Tidwell 1962) in SPSS 25. All our continuous independent variables were found to be linearly correlated with the logit of the dependent variable. In order to avoid sparse data bias (Greenland et al. 2016), we dropped the variables "single," "widow" and "divorced," this procedure did not affect the significance of key variables.

Table 4-29 shows the results of the binary logistic regression predicting neighborhood noise annoyance, stratified by PSG ownership.

Table 4-29 Binary Logistic Regression explaining neighborhood noise annoyance (N = 388)

	Model1		Model2		Model3	
	With PSG	No PSG	Step1	Step2	Step3	
	OR(CI)	OR(CI)	OR(CI)	OR(CI)	OR(CI)	OR(CI)
PSG ownership (yes)			.76 .44/1.28	.80 .47/1.36	.924 .53/1.60	
Life satisfaction	1.38 .97/1.96	.72 .43/1.19	1.152 .89/1.48	1.09 .84/1.42	1.12 .86/1.47	**1.50* 1.01/2.22**
Social capital	1.09 .82/1.45	.97 .73/1.28	.994 .82/1.19	.99 .82/1.20	1.04 .84/1.28	.94 .69/1.28
Perceived safety	1.36 .87/2.12	.62 .31/1.21	1.217 .87/1.69	1.24 .87/1.75	1.11 .78/1.59	1.31 .80/2.16
Perceived safety x PSG ownership				**2.13* 1.01/4.46**	2.04 .95/4.39	
Life satisfaction x PSG ownership					**1.85* 1.04/3.29**	
Social capital x PSG ownership					1.15 .79/1.68	
PSG publicness						**.58* .37/.90**
PSG size						1.02 .94/1.11
PSG age						1.00 .99/1.01
Weekly care duration						.99 .99/1.00
Activity diversity						1.65 .94/2.88
Activity frequency						.85 .63/1.15
Gender (Female)	.77 .38/1.56	.32 .10/1.05	.673 .37/1.19	1.01 .71/1.42	.64 .36/1.16	.66 .29/1.47
Age category	1.16 .75/1.79	.83 .43/1.58	1.045 .74/1.47	.661 .37/1.18	1.01 .71/1.44	1.09 .67/.78
Marital status						
Married	.91 .45/1.82	. 2.34 .84/6.50	1.283 .74/2.21	1.24 .72/2.15	1.19 .68/2.08	1.14 .50/2.62
Education	1.20 .97/1.49	.87 .62/1.22	1.111 .93/1.31	1.09 .92/1.299	1.10 .93/1.31	**1.30* 1.01/1.67**
Household size	.96 .79/1.170	.85 .62/1.16	1.030 .88/1.19	1.02 .87/1.1	.97 .83/1.13	.98 .79/1.22
Residence duration	.98 .94/1.02	1.00 .95/1.06	.981 .95/1.01	.98 .95/1.01	.98 .95/1.01	.99 .95/1.02

Homeownership (yes)	.91 .46/1.78	1.59 .52/4.84	.918 .53/1.58	.97 .56/1.68	1.01 .57/1.77	.93 .44/1.96
Car ownership (yes)	1.24 .64/2.39	.90 .33/2.46	.983 .58/1.65	1.00 .59/1.70	1.09 .64/1.88	1.45 .69/3.05
Constant	.0001	.017	.0001	.0001	.0001	.011
χ^2 test	17.612	9.832	10.691	14.891	21.594	27.569
Nagelkerke R^2	.116	.133	.049	.067	.097	.191

OR: Odds ratio; *CI*: 95% Confidence Interval; *p <.05; **p <.01; ***p <.001.

As can be seen in model 1, no variable was significantly correlated with noise annoyance in either of our two groups. Model 1 failed to uncover any significant difference between PSG owners and non-owners.

Model 2 shows the results of the hierarchical regression, step 1 with the main effect variables only (including PSG ownership this time), and step 2 with the addition of the interaction terms.

Step 1 shows that PSG ownership was associated with an increase in noise annoyance likelihood, but this association was not significant. No variable was significantly associated with noise annoyance in that model. This result does not support hypothesis 1, stipulating that PSG ownership was negatively associated with noise annoyance.

Steps 2 and 3 test the effects of PSG ownership as a moderator on the relationship between noise annoyance and perceived safety, life satisfaction, and social capital. The interaction term between PSG ownership and perceived safety (*OR* = 2.13, *CI* = 1.01/4.46) in step 2, and life satisfaction (*OR* = 1.85, *CI* = 1.04/3.29) in step 3 were both significant. This result supports hypothesis 2, stipulating that PSG ownership antagonized the relationship between noise annoyance in one side and neighborhood safety and life quality satisfaction on the other side. The simple slope explaining PSG ownership moderation effect on the noise annoyance –life satisfaction association (Figures 4-28) shows that for PSG owners only, an increase in life satisfaction score is associated with a decrease in noise annoyance levels. For nonowners, the relationship was inversed, an increase in life satisfaction level was associated with an increase in noise annoyance. While for the noise annoyance –perceived safety association (Figures 4-29) shows that for PSG owners, an increase in perceived safety levels was associated with a significant decrease in noise annoyance. For nonowners, the relationship was inversed, an increase in perceived safety was associated with an increase in noise annoyance.
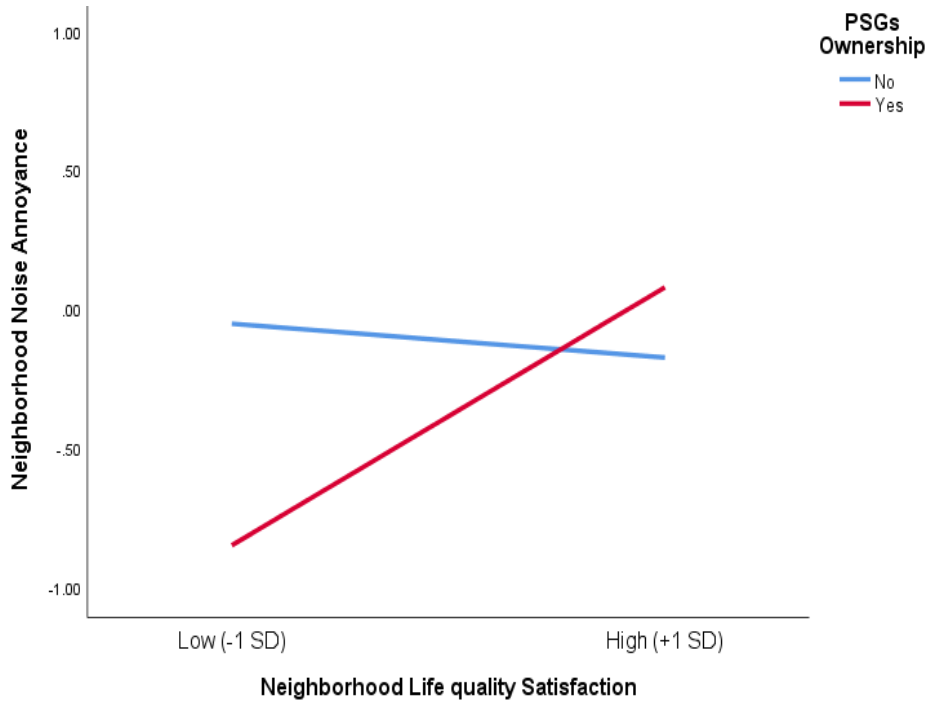
Figure 4-28 Simple slope for PSG ownership moderation of the Noise annoyance- life quality relationship. The low value for life quality satisfaction is plotted at 1 SD below the mean, and the high value is plotted at 1 SD above the mean.

Figure 4-29 Simple slope for PSG ownership moderation of the Noise annoyance - perceived safety relationship. The low value for perceived safety is plotted at 1 SD below the mean, and the high value is plotted at 1 SD above the mean.

In model 3, we tested the association between PSG characteristics, perception, and related routines on one side and Noise annoyance. Results indicate that only PSG publicness was significant, perceiving PSG as public was associated with 42% decreased likelihood of not being annoyed or very annoyed with noises in neighborhood streets (*OR* = .58, *CI* = .37/.90). This result does not support our hypothesis that PSG related variables are associated with decreased neighborhood noise annoyance.

Figure 4-30 Noise annoyance by PSG publicness

2.6.3. Discussion

Noise annoyance in urban environments is associated with higher risks for mental health (Dzhambov, Markevych, B. G. Tilov, et al. 2018). increasing GS presence in residential neighborhoods may play an active role in reducing noise pollution and noise annoyance (Aylor 1977; Dzhambov, Markevych, B. Tilov, et al. 2018; Yang, Bao, and Zhu 2011), partially thanks of its capacity to disrupt noise propagation (Van Renterghem and Botteldooren 2016). Nonetheless, the vast majority of the consulted research focused on noise annoyance association with formal UGS like trees and grass, even though UGS is not equitably distributed through the urban landscape and is challenging to create and introduce to dense neighborhoods. Informal GS like PSG might have a significant impact on reducing noise annoyance in residential neighborhoods.

The results of this study suggest that in our sample, PSG ownership was not directly associated with neighborhood perceived noise annoyance. Nevertheless, PSG ownership antagonized noise annoyance association with neighborhood perceived safety and life quality satisfaction, which means that increased social capital and life satisfaction score was significantly associated with an increased likelihood of not being annoyed with street noises only for PSG owners. At the same time, this relationship was inversed for those without PSG.

Curiously increased PSG publicness was associated with increased noise annoyance likelihood. This result was unexpected, especially that PSG publicness was also associated with increased care duration, frequency, and diversity of activities done next to PSG. The increased presence of PSG owners next to their plant pots is supposed to dissuade outsiders from occupying this space and making undesirable noises. Instead, perceiving PSG as public seems to reduce owners' willingness to chase away noisemakers from their territories.

Our results highlighted an unexpected association between PSG's publicness and noise annoyance. However, PSG ownership moderation on life satisfaction and perceived safety makes it a potentially useful tool to reduce noise annoyance in dense neighborhoods, more experimental and longitudinal research is in need to validate these results. In the case of perceived neighborhood noise annoyance, the analysis results were mixed; hypotheses 1 and 3 were rejected, while hypothesis 2 was partially validated. Figures 4-31 and 4-32 illustrate the found correlations.
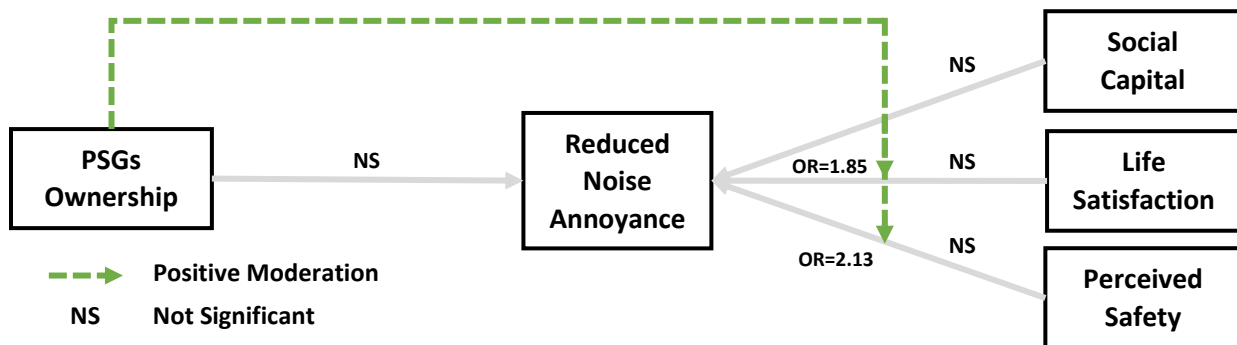
Figure 4-31 Diagram of PSG ownership association with noise annoyance.
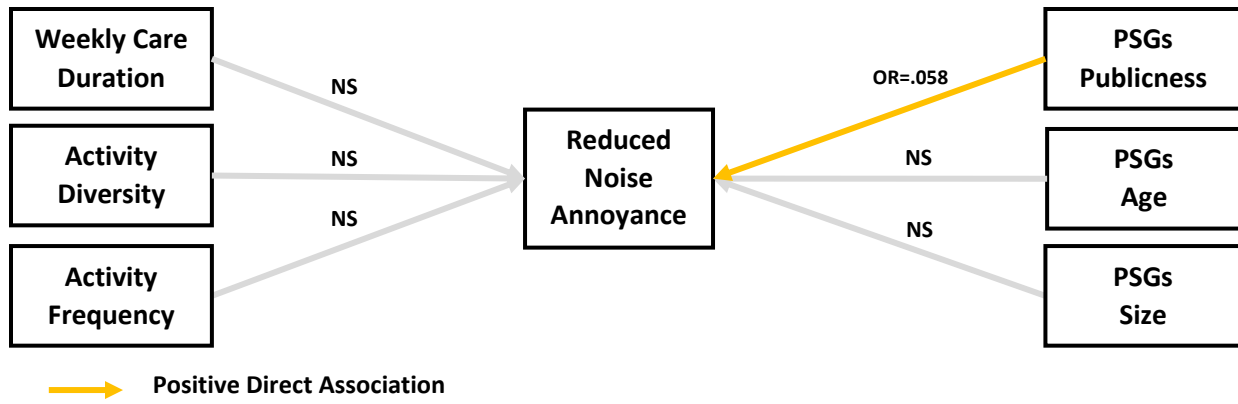
Figure 4-32 Diagram of PSG variables association with noise annoyance.

2.7. Summary: Neighborhood perception

Our findings suggest, as explained in Figure 4-33 and 4-34, that encouraging PSG ownership may potentially be a way to improve neighborhood perception in dense areas, except for social capital where the association was not significant, and for perceived safety as PSG owners felt significantly less safe than nonowners, which is particularly interesting and deserves more academic attention. All moderation effects were positive, further attesting on PSG potential beneficial impact on owners. PSG related variables were also mainly positively associated with neighborhood perception.
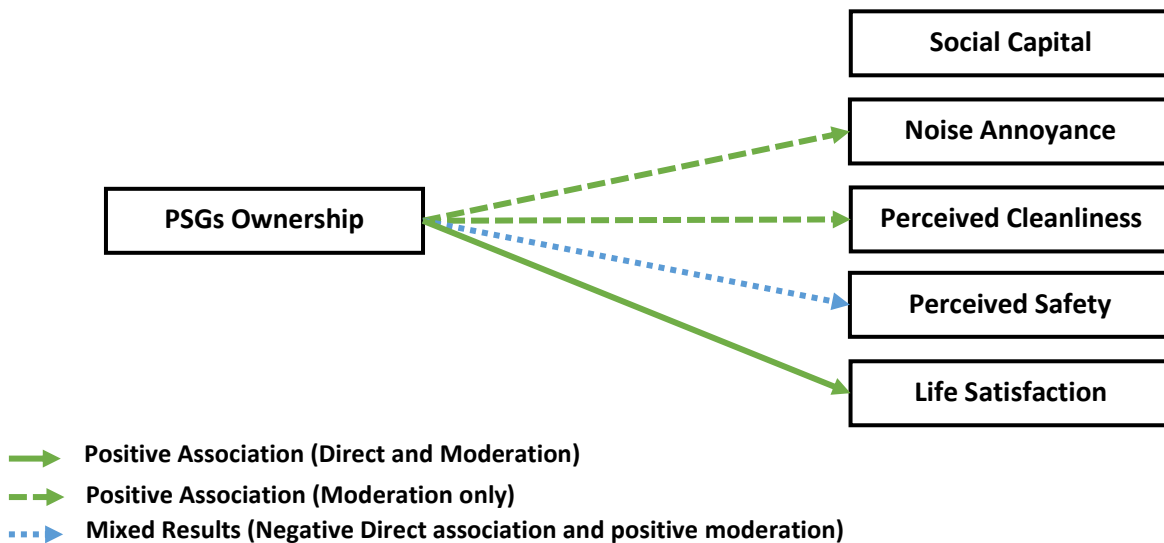
Figure 4-33 Diagram explaining the association between PSG ownership and neighborhood perception.
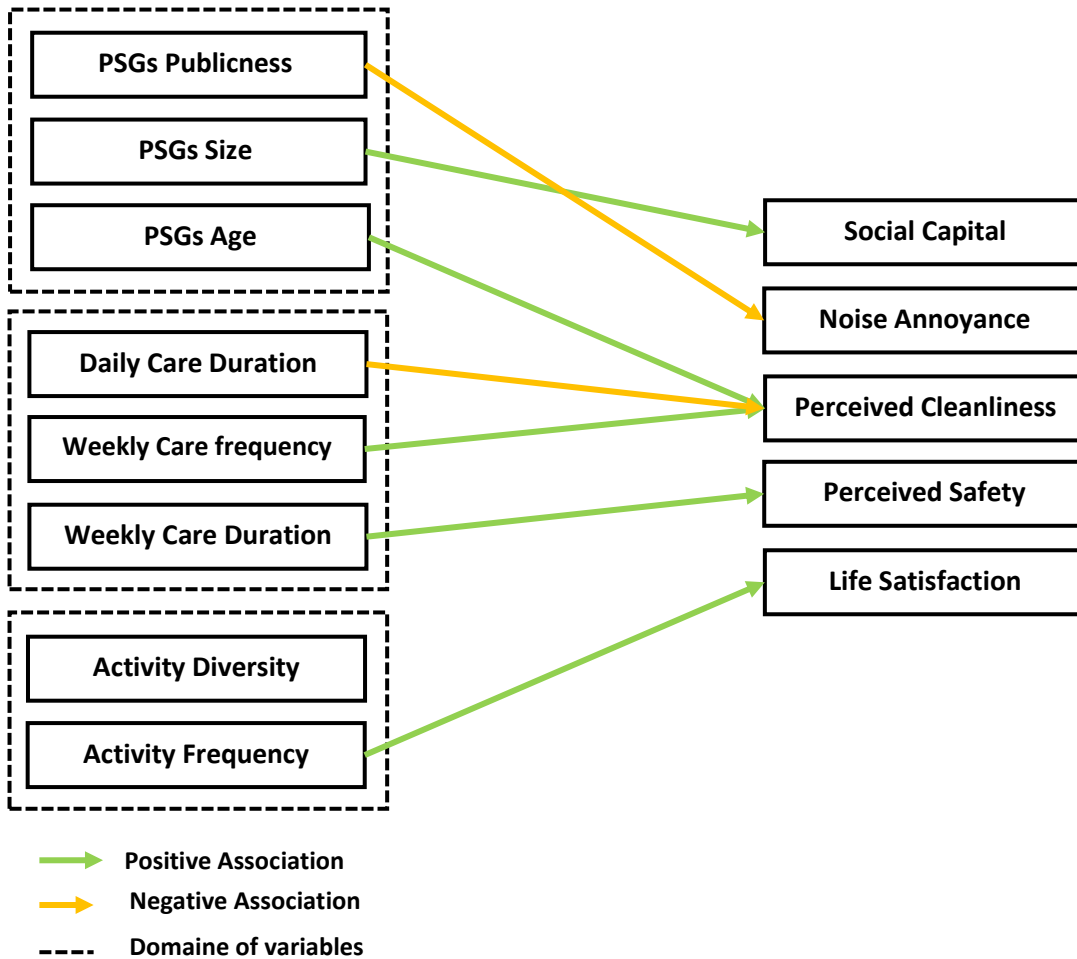
Figure 4-34 Diagram of the associations between PSG characteristics and neighborhood perception. Further research is needed to ascertain these results using bigger sample sizes and longitudinal and experimental data. These results may have been affected by other variables not controlled for in this study or by its limitations, mainly the small sample size and the small number of female participants compared to males.

3. Prosocial behavior and neighborhood attachment variables

3.1. Introduction

Prosocial behaviors and neighborhood attachment were accessed using five variables; wish to move out of the neighborhood, neighborhood protection, and cleaning responsibility, and size of neighborhood areas to protect and clean. As indicated in Table 4-30, there was a significant difference between PSG owners and nonowners in intention to move, neighborhood protection responsibility, and neighborhood areas to protect, while such difference was not found for protection responsibility and areas to protect.

In order to further assess the potential associations between PSG ownership and our five variables, we performed bivariate and multivariate tests.

Table 4-30 Prosocial behaviors and neighborhood attachment

Whole sample	No PSG	With PSG	Whole sample
Intention to move			
Yes (1)	123 (33.3%)	**47 (40.9%)**	**76 (29.9)**
No (0)	246 (66.7%)	**68 (59.1%)**	**178 (70.1)**
Protection responsibility			
Yes (1)	361 (93.0%)	116 (93.5%)	245 (92.8%)
No (0)	27 (7.0%)	8 (6.5%)	19 (7.2%)
Territories to protect	M= 2.68; SD=1.07	M=2.69; SD=1.14	M=2.68; SD=1.04
None	27 (**7%**)	8 (6.5%)	19 (7.2%)
Front house	38 (9.8%)	17 (13.7%)	21 (8.0%)
House and neighbors	169 (43.6)	48 (38.7%)	121 (45.8)
All street	24 (6.2)	5 (4.0%)	19 (7.2%)
All neighborhood	130 (33.5)	46 (37.1%)	84 (31.8%)
Cleaning responsibility			
Yes (1)	338 (87.1)	**101 (81.5%)**	**237 (89.8%)**
No (0)	50 (12.9)	**23 (18.5%)**	**27 (10.2%)**
Territories to clean	M=2.72; SD=1.43	M=2.58; SD=1.57	M=2.79; SD=1.36
None	50 (12.9**%**)	**23 (18.5%)**	**27 (10.2%)**
Front house	17 (4.4**%**)	**7 (5.6%)**	**10 (3.8%)**
House and neighbors	116 (29.9**%**)	**31 (25.0%)**	**85 (32.2%)**
All street	13 (3.4**%**)	**1 (0.8)**	**12 (4.5%)**
All neighborhood	192 (49.5**%**)	**62 (50.0%)**	**130 (49.2%)**

Boldface indicates *p* < .05 for PSG owners versus nonowners.

3.2. Intention to move

As explained in Figure 4-35 and 4-36, this analysis aimed to study PSG ownership and related variables' correlation with survey participants wish to move out of the neighborhood; form the results of the literature review we assumed that PSG ownership might be a sign of neighborhood attachment and resident's intention to stay in place. The bivariate and multivariate analysis objective was therefore, to investigate the veracity of three hypotheses.

H1: PSG ownership is negatively associated with intention to move out of the neighborhood

H2: PSG ownership buffers its association with neighborhood perception variables.

H3: PSG characteristics are negatively associated with the intention to move out of the neighborhood.
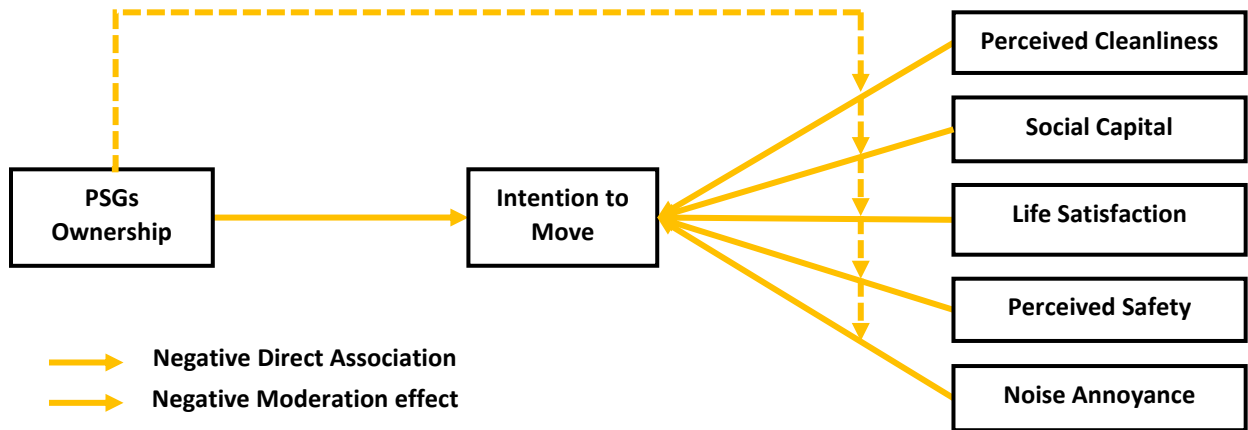
Figure 4-35 Conceptual model of PSG ownership hypothesized relationship with intention to move.
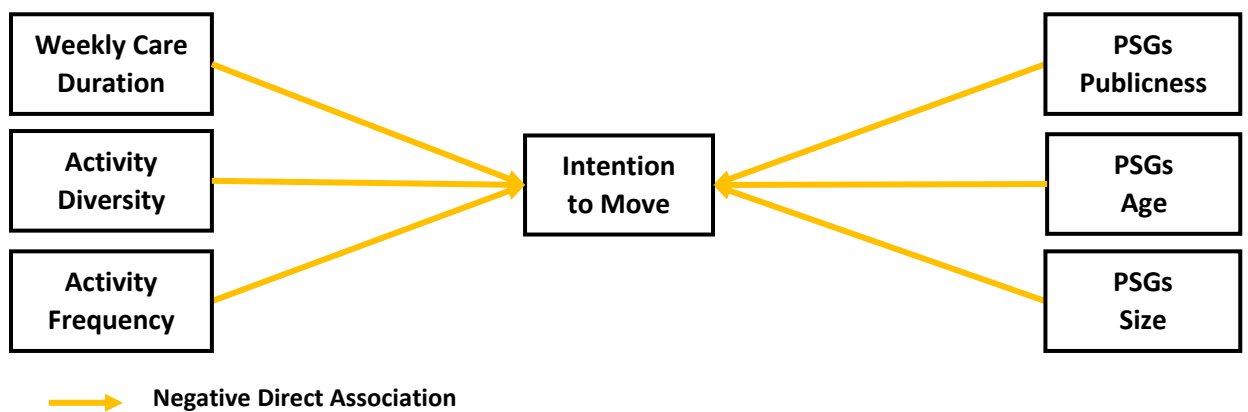
Figure 4-36 Conceptual model of PSG variables hypothesized relationship with intention to move.

3.2.1. Bivariate Analysis

We performed bivariate analyses (t tests and χ2 tests) to identify significant differences between groups with and without PSG.

According to Table 4-31. More than two-thirds of PSG owners (70.1%) reported preferring to stay in the neighborhood compared to 59.1% for those without PSG. This difference between the two groups was significant.

Table 4-31 Intention to Move

Response	Whole sample	No PSG	With PSG
Intention to move			
Yes (1)	123 (33.3%)	**47 (40.9%)**	**76 (29.9)**
No (0)	246 (66.7%)	**68 (59.1%)**	**178 (70.1)**

Boldface indicates p < .05 for PSG owners versus nonowners.

Spearman's correlations were also calculated for our key variables, intention to move, neighborhood safety, life satisfaction, social capital, perceived cleanliness, and noise annoyance. Results showed that for participants without PSG, intention to move was significantly negatively correlated only with social capital (r = -.275, p < .01). There were no significant associations between perceived safety and noise annoyance and other variables. Life satisfaction was significantly associated only with perceived cleanliness and social capital (Table 4-32).

Table 4-32 Spearman's Correlation Matrix for Participants without PSG

	1	2	3	4	5	6
1 Intention to move	1					
2 Perceived Safety	.049	1				
3 Life Satisfaction	-.175	-.056	1			
4 Social Capital	**-.275****	-.003	**.328*****	1		
5 Cleanliness	.086	-.101	**.310*****	-.031	1	
6 Noise annoyance	-.035	-.015	.065	.136	-.102	1

*p < .05; **p < .01; ***p < .001.

For PSG owners, intention to move was negatively associated with all other variables apart from neighborhood perceived safety. All variables were significantly associated with each other, except for neighborhood safety.

Table 4-33 Spearman's Correlation Matrix for PSG Owners

	1	2	3	4	5	6
1 Intention to move	1					
2 Perceived Safety	-.092	1				
3 Life Satisfaction	**-.410***	**.359***	1			
4 Social Capital	**-.352***	**.279***	**.443***	1		
5 Cleanliness	**-.187****	**.241***	**.387***	**.359***	1	
6 Noise annoyance	**-.166****	**.182****	**.227***	**.198****	**.165***	1

***p* < .05; **p < .01; ***p < .001.**

For the whole sample, the intention to move outside of the neighborhood was significantly negatively associated with PSG ownership, life satisfaction, social capital, and noise annoyance. While PSG ownership was also significantly correlated with Life satisfaction only.

Table 4-34 Spearman's Correlation Matrix for the whole sample

	1	2	3	4	5	6	7
1 intention to move	1						
2 PSG Ownership	-.108*	1					
3 Perceived Safety	-.059	.011	1				
4 Life Satisfaction	-.358***	.182***	.268***	1			
5 Social Capital	-.322***	-.008	.199***	.400***	1		
6 Cleanliness	-.087	-.027	.137**	.345***	.222***	1	
7 Noise annoyance	-.122*	-.026	.125*	.179***	179***	.071	1

***p* < .05; **p < .01; ***p < .001.**

3.2.2. Multivariate Analysis

The linearity of our continuous variables with the logit of the dependent variable was evaluated using the Box-Tidwell procedure (Box and Tidwell 1962). All our continuous independent variables were found to be linearly correlated with the logit of the dependent variable. Table 6 shows the results of the binary logistic regression predicting protection responsibility, stratified by PSG ownership.

Table 4-35 Binary Logistic Regression explaining intention to move out of the neighborhood (N = 388)

	Model1		Model2		Model3
	With PSG	No PSG	Step1	Step2	
	OR (CI)	OR (CI)	OR (CI)	OR (CI)	OR (CI)
PSG ownership (yes)			.87 .47/1.63	.74 .38/1.46	
Life satisfaction	**.27*** .15/.51**	.60 .29/1.23	**.33*** .22/.51**	**.34*** .22/.52**	**.25*** .13/.50**

Perceived safety	1.36 .79/2.33	1.26 .64/2.48	1.22 .82/1.81	1.29 .85/1.94	1.37 .75/2.49
Social capital	**.60*** **.39/.94**	.77 .55/1.07	**.70*** **.54/.92**	**.67*** **.49/.91**	**.56*** **.34/.92**
Cleanliness	1.09 .63/1.88	1.19 .63/2.26	1.09 .74/1.59	1.01 .59/1.74	.94 .51/1.72
Noise annoyance	.67 .44/1.02	1.07 .63/1.80	.76 .56/1.03	.94 .56/1.57	**.61*** **.38/.97**
Life satisfaction x PSG ownership				.63 .25/1.54	
Social capital x PSG ownership				.80 .47/1.36	
Perceived Safety x PSG ownership				1.08 .46/2.50	
P. Cleanliness x PSG ownership				.82 .41/1.64	
Noise annoyance x PSG ownership				1.39 .73/2.64	
PSG publicness					1.11 .63/1.95
PSG size					1.03 .92/1.15
PSG age					1.00 .98/.02
Weekly care duration					.99 .98/1.01
Activity diversity					**2.73**** **1.39/5.36**
Activity frequency					.78 .55/1.12
Gender (Female)	.45 .17/1.21	.37 .09/1.58	.46 .21/1.00	.48 .22/1.04	.57 .20/1.62
Age category	.99 .47/2.10	.78 .29/2.08	.99 .57/1.72	.938 .53/1.64	1.09 .50/2.37
Marital status					
Married	**.01*** **.00/.685**	.37 .01/14.72	**.02*** **.001/.62**	**.02*** **.001/.62**	**.01*** **.00/.56**
Single	**.008*** **.00/.37**	.28 .006/13.24	**.02*** **.001/.43**	**.01*** **.00/.41**	**.008*** **.00/.32**
Widowed	.00 .00/.	2.36 .01/385.02	**.01*** **.00/.87**	.01 .00/1.00	.00 .00/.
Divorced	.59 .006/60.11		.18 .004/9.54	.21 .003/13.66	.79 .006/109.94
Education	1.17 .85/1.61	.82 .52/1.30	1.02 .80/1.30	1.03 .80/1.32	1.31 .92/1.86
Household size	1.07 .81/1.42	1.08 .75/1.58	1.02 .83/1.25	1.07 .86/1.33	1.12 .82/1.53
Residence duration	**1.07*** **1.00/1.14**	1.01 .94/1.07	**1.05*** **1.006/1.09**	1.04 .99/1.08	**1.08*** **1.01/1.16**

Homeownership (yes)	**.148***	**.11**	**.15***	**.14***	**.19**
	.05/.38	**.03/.44**	**.07/.31**	**.06/.29**	**.07/.52**
Car ownership (yes)	.67	.90	.72	.71	.56
	.29/1.58	.26/3.03	.37/1.39	.36/1.40	.22/1.43
Constant	.001	.001	.001	.001	.001
χ^2 test	**118.749*****	**32.811****	**143.579*****	**146.217*****	**121.606*****
Nagelkerke R^2	**0.556**	**.369**	**.478**	**.485**	**.587**

OR: Odds ratio; CI: 95% Confidence Interval; *p <.05; **p <.01; ***p <.001.

As can be seen in model 1, In the PSG owners' group, an increase of one point in life quality satisfaction index was associated with a 73% decreased likelihood of survey participants reporting intention to move out of the neighborhood (*OR* = .27, *CI* = .15/.51). Moreover, an increase of one point in social capital index was associated with a 40% decreased likelihood of survey participants reporting intention to move out of the neighborhood (*OR* = .60, *CI* = .39/.94). Homeownership was associated with a 86% decreased likelihood of reporting intention to move out of the neighborhood (*OR* = .14, *CI* = .05/.38). While a one-year increase in time lived in the neighborhood was associated with a 7% increased likelihood of survey participants reporting intention to move out of the neighborhood (*OR* = 1.07, *CI* = 1.00/1.14). Perceived safety, neighborhood cleanliness, and noise annoyance were not significantly associated with the intention to move.

Among participants with no PSG, only Homeownership was found significant. Homeownership was associated with an 89% decreased likelihood of reporting intention to move out of the neighborhood (*OR* = .11, *CI* = .03/.44). Model 2 shows the results of the hierarchical regression, step 1 with the main effect variables only (including PSG ownership this time), and step 2 with the addition of the interaction terms.

Step 1 shows that for the whole sample, an increase of one point in neighborhood life quality index was associated with a 67% decreased likelihood of reporting intention to move out of the neighborhood (*OR* = .33, *CI* = .22/.51). A one-point increase in social capital index was associated with a 30% decreased likelihood of reporting intention to move out of the neighborhood (*OR* = .70, *CI* = 54/.92). Homeownership was associated with an 85% decreased likelihood of reporting intention to move out of the neighborhood (*OR* = .15, *CI* = .07/.31). While a one-year increase in time lived in the neighborhood was associated with a 5% increased likelihood of survey

participants reporting intention to move out of the neighborhood (*OR* = 1.05, *CI* = .07/.31). PSG ownership, Perceived safety, neighborhood cleanliness, and noise annoyance were not significantly associated with intention to move out of the neighborhood.

This result does not support hypothesis 1 that PSG ownership is negatively associated with the intention to move.

Before step 2, we tested for PSG ownership moderation effects for each of our five dependent variables separately, neighborhood life satisfaction, social capital, safety, cleanliness, and noise annoyance. PSG ownership was found to be a moderator for neighborhood life satisfaction, social capital, and cleanliness in an unadjusted model, but after the introduction of the interaction term with the control variables in step 2, no interaction term was significant. This result does not support hypothesis 2 that PSG ownership moderates the relationship between our variables and intention to move, adjusting for control variables.

In model 3, we test the association between PSG characteristics, perception, and related routines on one side and intention to move out of the neighborhood on the other side. Only activity diversity was found significant, but curiously the association was positive, with one new activity increase in diversity of activities done next to PSG associated with 2.73 times increased likelihood of reporting intention to move out of the neighborhood (*OR* = 2.73, *CI* = 1.39/5.36). In addition to social capital and life satisfaction, noise annoyance was also significant with one level decrease in noise annoyance associated with 39% decreased likelihood of reporting intention to move out of the neighborhood (*OR* = .61, *CI* = .38/.97).

The results of model 3 analysis, does not support hypothesis 3, stipulating that PSG related recreational activities are negatively associated with intention to move outside the neighborhood.

3.2.3. Discussion

A consistent body of literature linked increased place attachment to availability and easy accessibility to UGS (Bonaiuto et al. 1999; Zhang et al. 2015). However, to our knowledge, no study has quantified its association with PSG as an informal UGS and a territorial object. In order to cover this gap, we tried to measure participants' attachment to their neighborhoods, using wish to leave the neighborhood, as place attachment implies the willingness to stay in a place or intention to return to a place when away (Manzo and Devine-Wright 2013b).

Results of the bivariate analysis showed that PSG ownership was indeed significantly negatively associated with the intention to leave the neighborhood. However, this association was not significant in the adjusted model.

PSG ownership was also found to be a moderator for the association between intention to move and life satisfaction, social capital, and neighborhood cleanliness but only in unadjusted models, this association did not hold in model 2.

Life satisfaction and social capital scores were both found to be significantly negatively associated with the intention to move from the neighborhood, but only for the group of PSG owners.

The most unexpected result of the analysis was the significant positive association between the diversity of activities undergone next to PSG and intention to leave; this association was not significant in the unadjusted model without control variables ($p > .05$). Nevertheless, in model 3, the association was the strongest, with one more different kind of activities done next to PSG associated with 2.73 times increased likelihood of reporting intention to move out of the neighborhood. These results are not consistent with existing literature, arguing that interaction with UGS increases place attachment. The results of this analysis are to be taken with caution; more longitudinal and experimental studies are necessary to investigate these results further. Overall, our findings suggest that PSG ownership association with place attachment might be more complicated and nuanced than we anticipated. For the variable intention to move out of the neighborhood, hypotheses 1, 2, and 3 were all rejected. Figures 4-37 and 4-38 illustrate the found correlations.
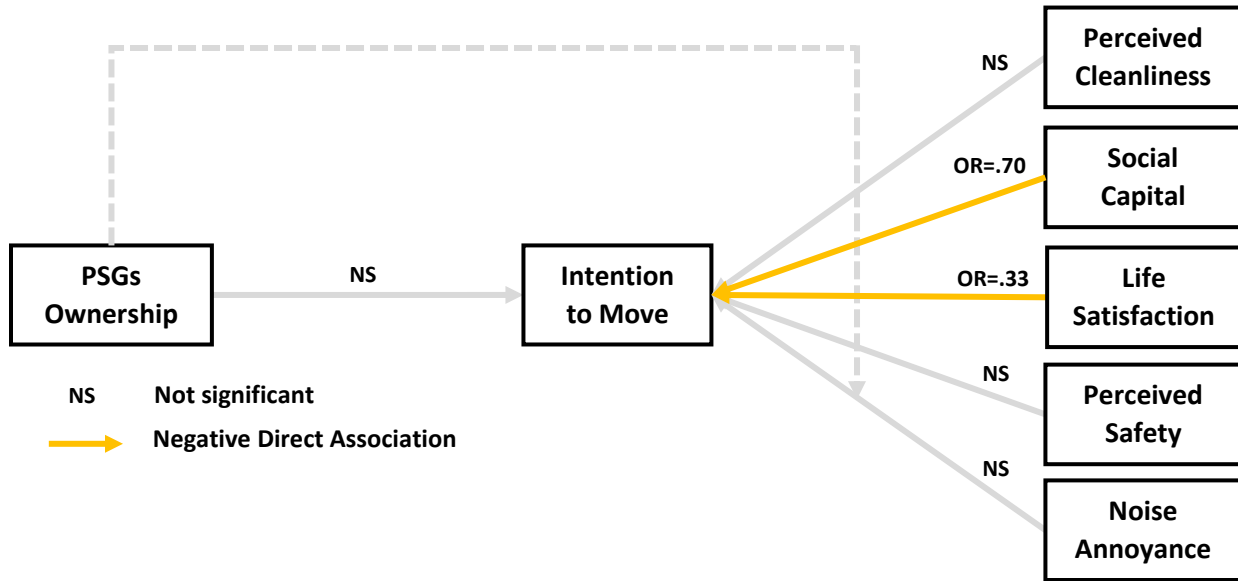
Figure 4-37 Diagram of PSG ownership association with intention to move.
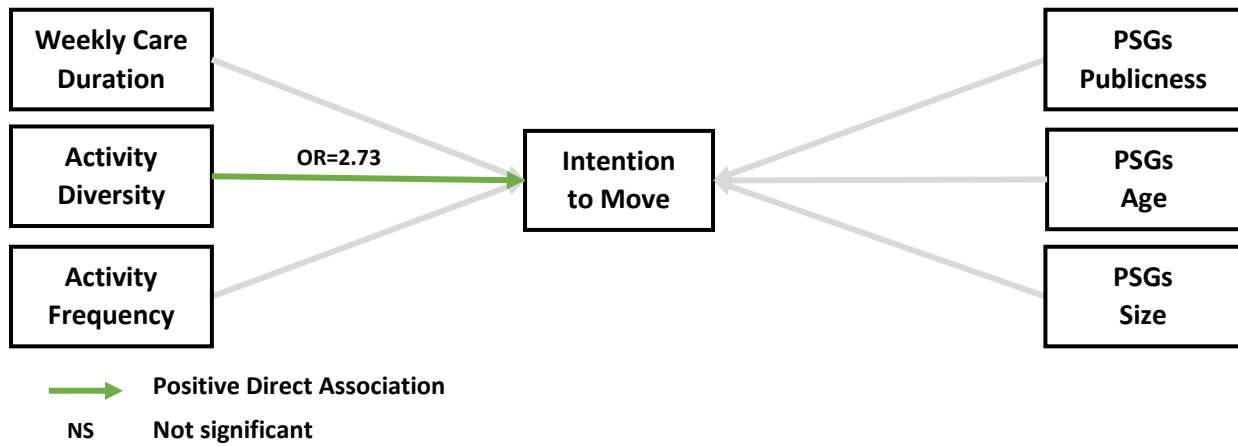
Figure 4-38 Diagram of PSG related variables association with intention to move.

3.3. Protection responsibility

As explained in Figures 4-39 and 4-40, this analysis aimed to study PSG ownership correlation with survey participants responsibility towards protecting their neighborhoods, we assumed that PSG nature as a private property continuously present on public ground would induce a protective behavior towards the space it occupies. The bivariate and multivariate analyses objective were, therefore, to investigate the veracity of two hypotheses.

H1: PSG ownership is positively associated with neighborhood protection responsibility.

H2: PSG ownership enhances its association with neighborhood perception variables.

H3: PSG characteristics are positively associated with neighborhood protection responsibility.
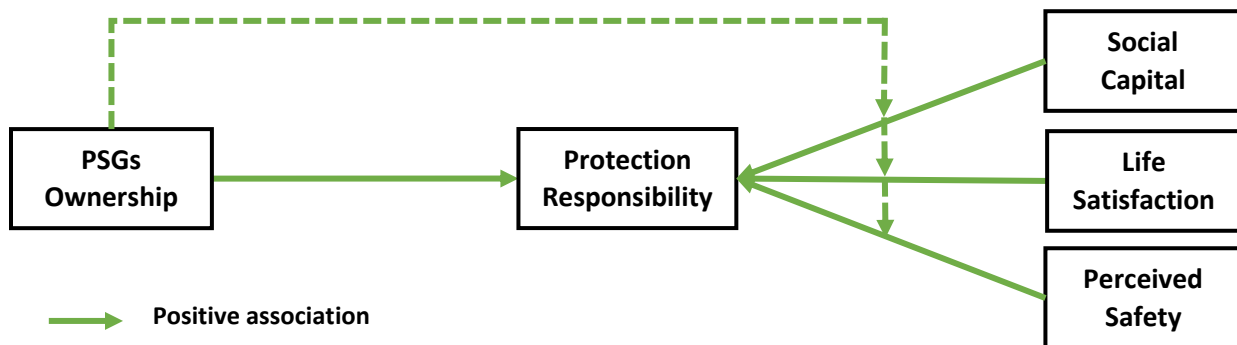
Figure 4-39 Conceptual model of PSG ownership relationship with protection responsibility.
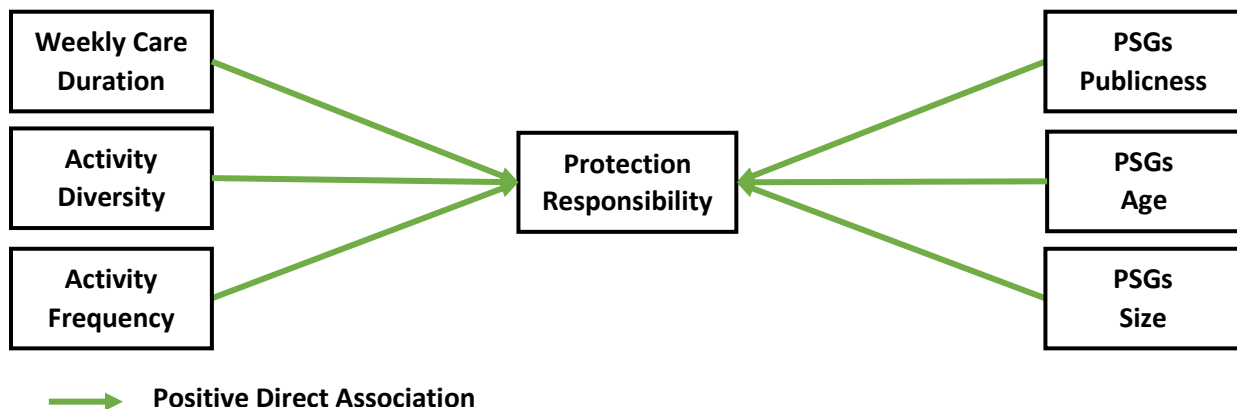
Figure 4-40 Conceptual model of PSG variables hypothesized relationship with protection responsibility.

3.3.1. Bivariate Analysis

We performed bivariate analyses χ2 test to identify significant differences between groups with and without PSG (Table 4-36). There were no significant differences between the two groups in terms of responsibility towards protecting the neighborhood.

Table 4-36 Protection responsibility

Response	Whole sample	No PSG	With PSG
Protection responsibility			
Yes (1)	361 (93.0%)	116 (93.5%)	245 (92.8%)
No (0)	27 (7.0%)	8 (6.5%)	19 (7.2%)

Boldface indicates p < .05 for PSG owners versus nonowners.

Spearman's correlations were also calculated for our key variables, protection responsibility, neighborhood safety, life satisfaction, and social capital. Results showed that for participants without PSG, protection responsibility was not significantly correlated with any variable.

Table 4-37 Spearman's Correlation Matrix for Participants without PSG

	1	2	3	4
1 Protecting Responsibility	1			
2 Perceived Safety	.132	1		
3 Life Satisfaction	.103	-.056	1	
4 Social Capital	-.075	-.003	**.328***	1

*p < .05; **p < .01; ***p < .001.

For PSG owners, protection responsibility was significantly associated with perceived safety (r = .254, p < .001) and life satisfaction (r = .159, p < .05). Social capital, perceived safety, and life satisfaction were all significantly associated with each other.

Table 4-38 Spearman's Correlation Matrix for PSG Owners

	1	2	3	4
1 Protecting Responsibility	1			
2 Perceived Safety	**.254***	1		
3 Life Satisfaction	**.159***	**.359***	1	
4 Social Capital	.077	**.279***	.443***	1

*p < .05; **p < .01; ***p < .001.

For the whole sample, protection responsibility was significantly associated only with life satisfaction ($r = .224$, p<.001) and perceived safety ($r = .138$, p<.01). In contrast, PSG ownership was significantly correlated with Life satisfaction only. Social capital, perceived safety, and life satisfaction were all significantly associated with each other.

Table 4-39 Spearman's Correlation Matrix for the whole sample

	1	2	3	4	5
1 Protection responsibility	1				
2 PSG Ownership	-.014	1			
3 Perceived Safety	**.224***	.011	1		
4 Life Satisfaction	**.138**	**.182***	**.268***	1	
5 Social Capital	.028	-.008	**.199***	**.400***	1

*p < .05; **p < .01; ***p < .001.

3.3.2. Multivariate Analysis

The linearity of our continuous variables with the logit of the dependent variable was evaluated using the Box-Tidwell procedure (Box and Tidwell 1962). All our continuous independent variables were found to be linearly correlated with the logit of the outcome variable. In order to avoid sparse data bias (Greenland et al. 2016) we dropped the variable "divorced" that had few cases per variable in (in Model 1 and Model 2); this procedure did not affect the significance of key variables. Table 4-40 shows the results of the binary logistic regression predicting protection responsibility, stratified by PSG ownership.

Table 4-40 Binary Logistic Regression explaining neighborhood protection responsibility (N = 388)

	Model1		Model2		Model3
	With PSG	No PSG	Step1	Step2	
	OR(CI)	OR(CI)	OR(CI)	OR(CI)	OR(CI)
PSG ownership (yes)			.51 .17/1.53	.55 .15/1.99	
Life satisfaction	1.60 .94/2.72	.98 .32/3.03	**1.50*** **1.01/2.23**	**1.57*** **.1.02/2.40**	1.34 .72/2.50
Perceived safety	**2.20*** **1.10/4.41**	2.12 .41/11.08	**2.47**** **1.41/4.35**	**2.37**** **1.32/4.25**	**2.80*** **1.22/6.41**
Social capital	1.04 .71/1.53	1.00 .41/2.45	1.02 .74/1.40	1.05 .76/1.47	1.05 .68/1.6

Life satisfaction x PSG ownership				1.50 .54/4.14	
Social capital x PSG ownership				1.21 .61/2.40	
Safety perception x PSG ownership				.61 .17/2.19	
PSG publicness					1.23 .60/2.50
PSG size					1.04 .89/1.22
PSG age					.984 .96/1.00
Weekly care duration					1.00 .98/1.03
Activity diversity					2.40 .80/7.22
Activity frequency					.89 .51/1.54
Gender (Female)	.61 .18/2.17	.16 .006/4.52	.56 .19/1.69	.53 .17/1.62	.59 .16/2.19
Age category	2.99 1.00/8.98	.23 .01/3.57	1.72 .79/3.75	1.69 .76/3.75	2.42 .76/7.68
Marital status					
Married					.58 .04/7.51
Single	.66 .16/2.82	.001 .001/2.69	**.26*** **.07/.95**	**.25*** **0.68/.92**	.31 .02/5.11
Widowed			23.190		.91 .15/5.55
Education	**1.63*** **1.11/2.40**	.84 .32/2.20	**1.47*** **1.06/2.06**	**1.47*** **1.04/2.06**	**1.57*** **1.01/2.43**
Household size	.98 .70/1.37	.85 .35/2.06	1.06 .82/1.38	1.01 .77/1.33	1.13 .77/1.65
Residence duration	.99 .92/1.07	**1.16*** **1.02/1.33**	1.03 .98/1.09	1.04 .98/1.10	1.01 .94/1.10
Homeownership (yes)	.59 .15/2.25	.71 .02/19.84	.78 .25/2.44	.77 .24/2.44	.78 .20/3.23
Car ownership (yes)	.95 .31/2.85	1.22 .06/22.77	1.16 .46/2.90	1.26 .49/3.23	1.07 .31/3.66
Constant	144.180	.001	.001	.001	.001
χ^2 test	**32.562****	**21.066***	**38.587*****	**40.680*****	**40.622*****
Nagelkerke R^2	**0.294**	**.501**	**.256**	**.269**	**371**

OR: Odds ratio; Cl: 95% Confidence Interval; *p <.05; **p <.01; ***p <.001.

As can be seen in model 1, for the PSG owners' group, an increase of one level in perceived neighborhood safety was associated with an increased likelihood of survey participants reporting protection responsibility of 2.2 times (*OR* = 2.20, *CI* = 1.10/4.41). We also found a significant association with education level, where one level increase in education level was associated with an increased likelihood of reporting neighborhood protection responsibility of 1.6 times (*OR* = 1.63, *CI* = 1.11/2.40). Life quality satisfaction and social capital were not significantly associated with protection responsibility.

Among participants with no PSG, one month increase in time lived in the neighborhood was associated with an increased likelihood of reporting neighborhood protection responsibility by 1.8 times (*OR* = 1.16, *CI* = 1.02/1.33). All other variables were insignificant.

Model 2 shows the results of the hierarchical logistic regression, step 1 with the main effect variables only (including PSG ownership this time), and step 2 with the addition of the interaction terms.

Step 1 shows that for the whole sample, PSG ownership was associated with a decrease in likelihood to report neighborhood protection responsibility although the association was not significant (*OR* = .51, *CI* = .17/1.53. *p* > .05). An increase of one point in neighborhood life quality index was associated with 1.5 increased likelihood of reporting neighborhood protection responsibility (*OR* = 1.50, *CI* = 1.01/2.23), one level increase in neighborhood perceived safety was associated with two times increased likelihood of reporting protection responsibility (*OR* = 2.47, *CI* = 1.41/4.35), and one level increase in education level was associated with 1.6 times increased likelihood of reporting neighborhood protection responsibility (OR = 1.47.63, 95% CI = 1.06/2.06). Single participants were 0.74 times less likely to report neighborhood protection responsibility than others (OR = .26, CI = .07/.95). PSG ownership was not significantly associated with neighborhood protection responsibility.

This result does not support hypothesis 1, stipulating that PSG ownership is positively associated with neighborhood protection responsibility.

Step 2 tests the effects of PSG ownership as a moderator on the relationship between depression score and neighborhood perceived safety, life quality satisfaction, and social capital. No interaction term was found to be significant; only the variables that were significant in step 1 were significant in step 2. This result does not support hypothesis 2, stipulating that PSG ownership moderates the relationship between neighborhood protection responsibility.

In model 3, we test the association between PSG characteristics, perception, and related routines in one side and neighborhood protection responsibility. Only perceived safety and education level were found significant; none of the PSG related variables were found to be significant. These results do not support hypothesis 3 stipulating that PSG ownership and induced daily routines have a positive association with neighborhood protection responsibility.

3.3.3. Discussion

Previous studies done in Japan have associated PSG ownership in residential neighborhoods with manifestations of territoriality. PSG presence was identified as a sign of active protection of claimed areas intended to dissuade potential offenders (Kobayashi 1992; Suzuki 1984). In order to investigate the presence of such associations in our sample, we studied the groups with and without PSG separately before collapsing the whole sample into one model and introducing the variables measuring the daily routines related to PSG ownership.

The negative association of PSG' ownership with protection responsibility, although not significant, is interested in the fact that it is not consistent with previous research that supports PSG association with territoriality (Suzuki 1984). Further research is needed to ascertain if this result was specific to our sample.

Neighborhood perceived safety had a significant positive association with neighborhood protection responsibility only for PSG owners, with one level increase in safety associated with more than two times increased likelihood of reporting protection responsibility. This result highlights the importance of perceived safety in protection responsibility for PSG owners. The difference in neighborhood protection responsibility between PSG owners and nonowners might be due to the danger related to the actual protection behavior in Morocco where crime and

vandalism are more common (specially in the study area) compared to Japan where previous research was undergone. Japan being one of the safest countries in the world, with one of the lowest homicide, property crime, or vandalism rates (Johnson 2007).

The overflow of personal items like PSG, bicycles and air conditioners occupying public space permanently or semi-permanently in Japanese residential streets and alleys, might be an additional reason for locals to be more involved in neighborhood protection and monitoring their belongings (Ikkai, SHIMIZU, et al. 1999). In the case of neighborhood protection responsibility, hypotheses 1, 2, and 3 were all rejected as summarized in Figures 4-41 and 4-42.
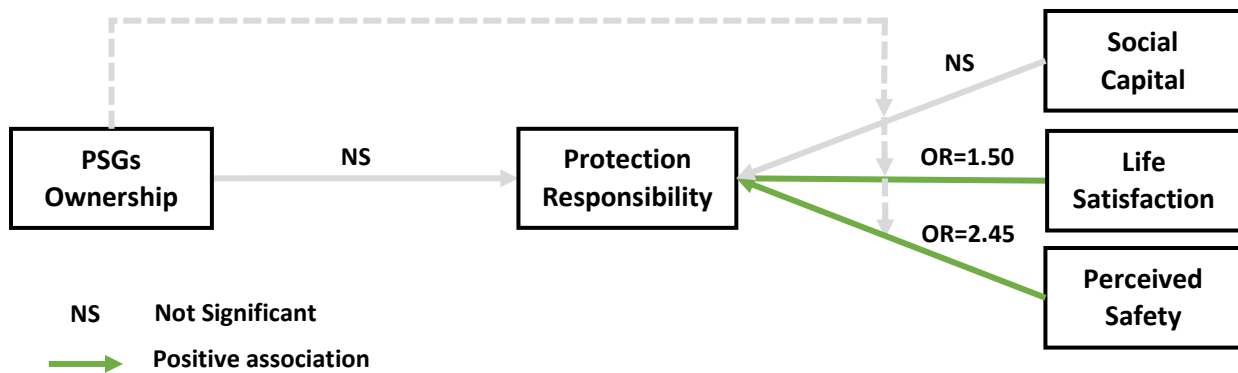
Figure 4-41 PSG ownership association with neighborhood protection responsibility.
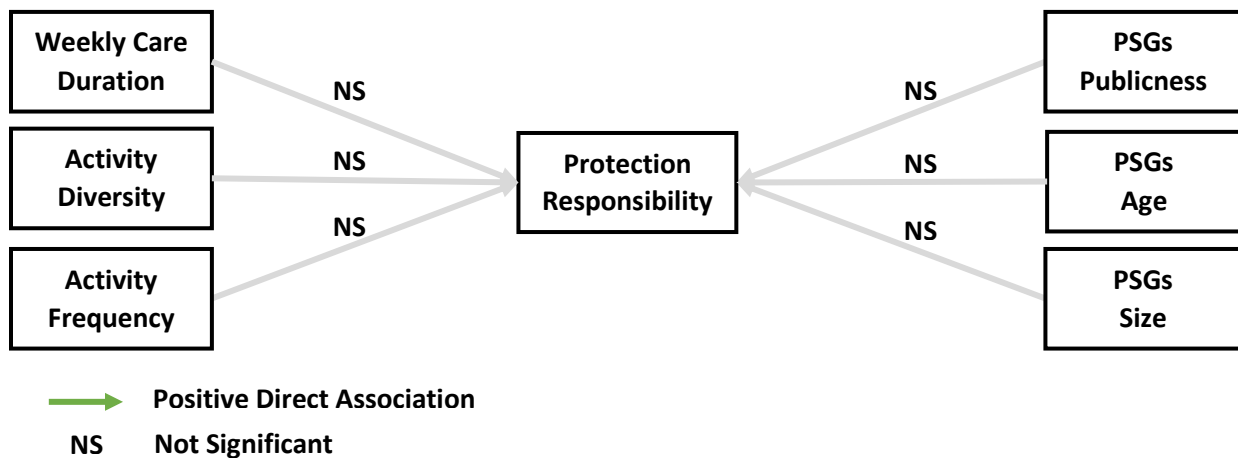
Figure 4-42 PSG related variables association with neighborhood protection responsibility.

3.4. Areas to protect

As explained in Figures 4-43 and 4-44, this analysis aimed to study PSG ownership correlation with the diffusion of neighborhood areas, survey participants felt responsible protecting, we assumed that PSG ownership would make people want to protect more areas than those with no PSG. The bivariate and multivariate analyses objective was therefore to investigate the veracity of three hypotheses.

H1: PSG ownership is positively associated with increased areas to protect.

H2: PSG ownership and enhances its association with neighborhood perception variables.

H3: PSG characteristics are positively associated with neighborhood areas to protect.
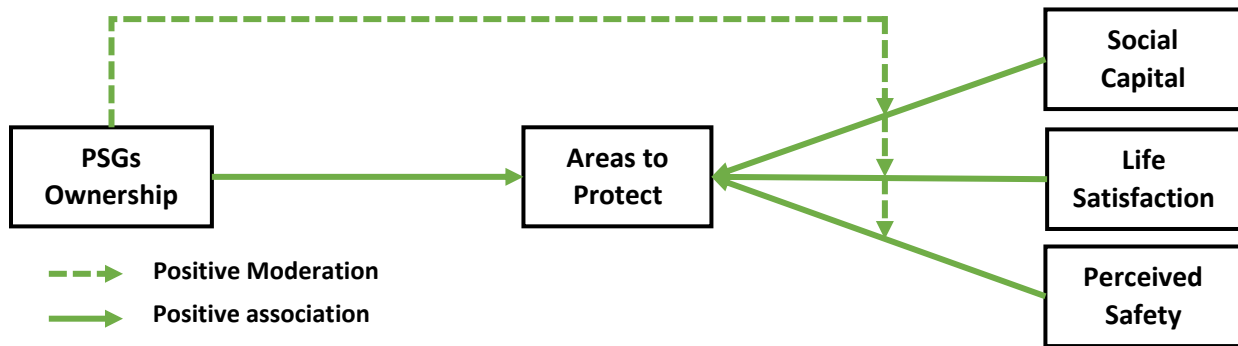
Figure 4-43 Conceptual model of PSG ownership relationship with neighborhood areas to protect.
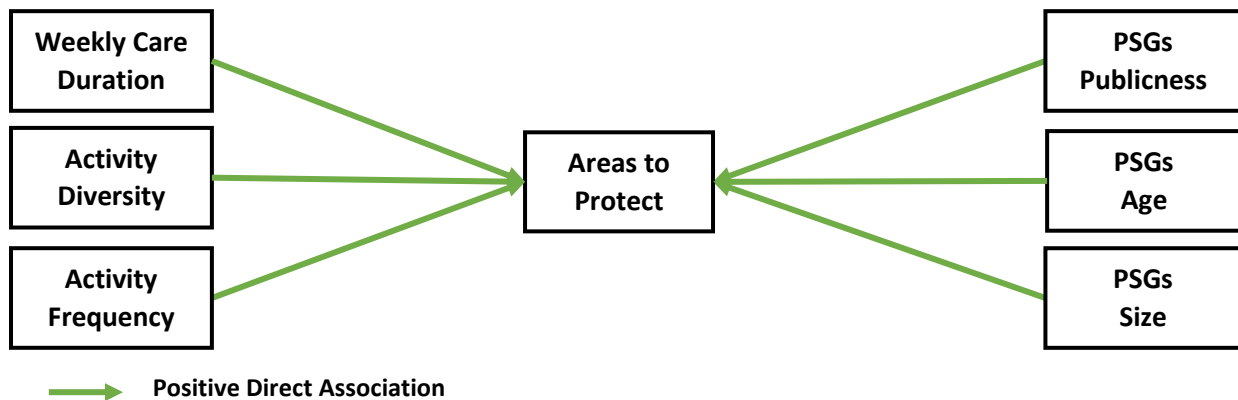
Figure 4-44 Conceptual model of PSG characteristics relationship with neighborhood areas to protect.

3.4.1. Bivariate Analysis

We performed bivariate analyses χ^2 tests to identify significant differences in between groups with and without PSG. Table 4-41 shows that there were no significant differences between the two groups in neighborhood areas to protect.

Table 4-41 Areas to protect

Response	Whole sample	No PSG	With PSG
Areas to protect	M= 2.68; SD=1.07	M=2.69; SD=1.14	M=2.68; SD=1.04
None	27 (7**%**)	8 (6.5%)	19 (7.2%)
Front house	38 (9.8%)	17 (13.7%)	21 (8.0%)
House and neighbors	169 (43.6)	48 (38.7%)	121 (45.8)
All street	24 (6.2)	5 (4.0%)	19 (7.2%)
All neighborhood	130 (33.5)	46 (37.1%)	84 (31.8%)

Boldface indicates p < .05 for PSG owners versus nonowners.

Spearman's correlations were also calculated for our key variables, areas to protect, neighborhood safety, life satisfaction, and social capital.

Results showed that for those without PSG, the diffusion of areas to protect was significantly associated only with neighborhood life quality satisfaction (r = .220, p < .05).

Table 4-42 Spearman's Correlation Matrix for Participants without PSG

	1	2	3	4
1 Areas to protect	1			
2 Perceived Safety	-.176	1		
3 Life Satisfaction	**.220***	-.056	1	
4 Social Capital	.052	-.003	**.328***	1

*p < .05; **p < .01; ***p < .001.

For PSG owners, the diffusion of areas to protect was not significantly associated with any other variable.

Table 4-43 Spearman's Correlation Matrix for PSG Owners

	1	2	3	4
1 Areas to protect	1			
2 Perceived Safety	.073	1		
3 Life Satisfaction	-.104	**.359***	1	
4 Social Capital	-.054	**.279***	.443***	1

*p < .05; **p < .01; ***p < .001.

For the whole sample, the diffusion of areas to protect was not significantly associated with any other variable, including PSG ownership.

Table 4-44 Spearman's Correlation Matrix for the whole sample

	1	2	3	4	5
1 Areas to protect	1				
2 PSG Ownership	.001	1			
3 Perceived Safety	-.003	.011	1		
4 Life Satisfaction	-.019	**.182***	**.268***	1	
5 Social Capital	-.016	-.008	**.199***	**.400***	1

$p < .05$; **$p < .01$; ***$p < .001$.

3.4.2. Multivariate Analysis

The multivariate analysis objective is to assess the associations between our dependent variable and the main independent variables adjusting for control variables in order to remove their effect from the equation and avoid type I and type II errors. In order to avoid sparse data bias (Greenland et al. 2016) we dropped the variables "single," "widow," and "divorced," this procedure did not affect the significance of key variables. Our models did not violate the proportional odds assumption. Consequently, it was safe to analyze the data using ordinal logistic regression tests.

Table 4-45 shows the results of the ordinal regression predicting neighborhood areas participants felt responsible for protecting, stratified by PSG ownership.

Table 4-45 Ordinal Logistic Regression explaining neighborhood areas to protect (N = 388)

	Model 1		Model 2			Model 3
	With PSG	**No PSG**	**Step 1**	**Step 2**	**Step 3**	
	OR(CI)	OR(CI)	OR(CI)		OR(CI)	OR(CI)
PSG ownership (yes)			1.00	1.01	.88	
			.637/1.593	.64/1.60	.55/1.42	
Life satisfaction	**.72***	1.41	.892	.86	.92	.80
	.55/.95	.87/2.28	.72/1.10	.68/1.07	.73/1.16	.60/1.08
Perceived safety	1.23	.66	.913	.87	.97	1.324
	.86/1.76	.36/1.20	.68/1.21	.65/1.17	.72/1.32	.89/1.96
Social capital	1.14	**1.34***	**1.27***	**1.26***	**1.20***	1.18
	.89/1.45	**1.03/1.73**	**1.07/1.50**	**1.06/1.49**	**1.01/1.44**	.90/1.53
Perceived Safety x PSG ownership				**2.00***	1.96	
				1.01/3.96	.98/3.88	

140

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Life satisfaction x PSG ownership					.45** .27/.76	
Social capital x PSG ownership					.85 .60/1.19	
PSG publicness						1.114 .7/1.618
PSG size						.98* .90/.99
PSG age						.89** .80/.95
Weekly care duration						.99 .99/1.00
Activity diversity						.82 .53/1.27
Activity frequency						.94 .74/1.20
Gender (Female)	2.44 1.34/4.41	2.04** 1.24/3.34	.56 .19/1.69	2.00** 1.22/3.28	2.07** 1.26/3.41	1.88 .98/3.59
Age category	1.46 1.00/2.13	1.60** 1.18/2.18	1.72 .79/3.75	1.59** 1.17/2.16	1.53** 1.12/2.08	1.49 .99/2.24
Marital status						
Married	.61 .33/1.11	.60* .37/.98	23.190	.59* .36/.96	.62 .38/1.01	.74 .37/1.48
Education	1.04 .87/1.24	1.10 .95/1.27	1.47* 1.06/2.06	1.09 .94/1.26	1.08 .93/1.25	1.12 .92/1.36
Household size	.89 .75/1.05	.91 .80/1.04	1.06 .82/1.38	.92 .80/1.05	.95 .83/1.09	.96 .80/1.15
Residence duration	.97 .94/1.00	.99 .96/1.02	1.03 .98/1.09	.99 .96/1.01	.98 .96/1.01	.97 .94/1.00
Homeownership (yes)	.66 .37/1.17	.59* .37/.96	.78 .25/2.44	.61* .38/.99	.58* .36/.94	.58 .31/1.07
Car ownership (yes)	1.48 .84/2.61	1.71* 1.07/2.74	1.16 .46/2.90	1.74* 1.08/2.78	1.67* 1.04/2.68	1.30 .70/2.41
Constant						
χ^2 test	32.562**	21.066*	38.587***	40.454***	40.68***	40.622***
Nagelkerke R^2	.294	.501	.256	.127	.269	371

OR: Odds ratio; CI: 95% Confidence Interval; *p <.05; **p <.01; ***p <.001.

As can be seen in model 1, for the PSG owners' group, an increase of one unit in life quality satisfaction index was associated with a decrease of 28% in the territories to protect (OR=.72, CI= .55/.95). Being female was associated with a 144% increase in territories to protect compared to males (*OR*=2.44, *CI*=1.34/4.41). While an increase of one-level in age category was associated

with a 46% increase in territories to protect (*OR*=1.46, *CI*=1.00/2.13). Perceived safety and social capital were not significant.

Among participants with no PSG, an increase of one unit in social capital index was associated with an increase of 34% in the territories to protect (OR=1.34, CI= 1.03/1.73). Being female was associated with a 104% increase in territories to protect compared to males (OR=2.04, CI=1.24/3.34). While an increase of one unit in age category was associated with a 60% increase in territories to protect (OR=1.60, CI=1.18/2.18). Being married was associated with a 39% decrease in territories to protect compared to other categories (OR=.61, CI=.378/.984). Homeownership was associated with a 41% decrease in territories to protect compared to other categories (OR=.59, CI=.371/.962). While car ownership was associated with a 71% increase in territories to protect compared to other categories (OR=1.71, 1.07/2.74). Perceived safety and life satisfaction were not significant.

Model 2 shows the results of the hierarchical ordinal regression; step 1 with the main effect variables only (including PSG ownership this time), steps 2, and 3 with the addition of the interaction terms.
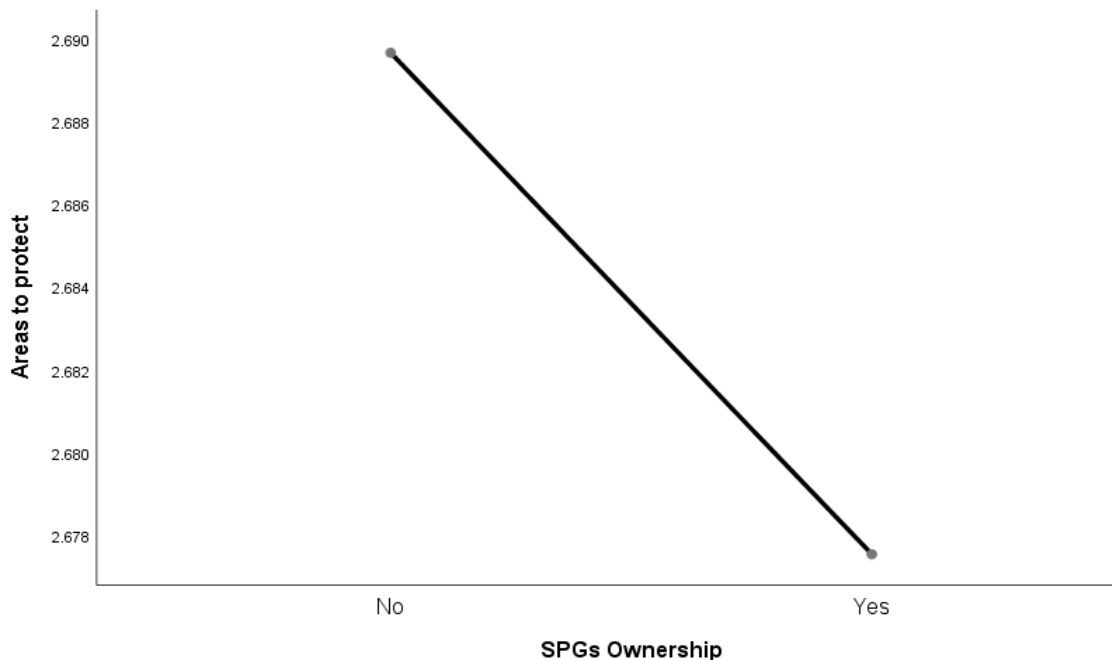
Figure 4-45 Areas to protect by PSG ownership, a negative but not significant relationship

Step 1 shows that for the whole sample, an increase of one point in social capital index was associated with an increase of 27% in the territories to protect (OR=1.27, CI= 1.07/1.50), and one level increase in education level was associated with 47% increase in territories to protect. Perceived safety and life satisfaction and SPS ownership were not significant. This result does not support hypothesis 1 that PSG ownership is directly associated with areas to protect.

Steps 2 and 3 tested the effects of PSG ownership as a moderator on the relationship between areas to protect and neighborhood perceived safety, life quality satisfaction, and social capital. The PSG ownership-perceived safety interaction was significant in Step 2 (OR=2.00, CI= 1.01/3.96), while PSG ownership-life quality satisfaction was significant in step 3 (OR=.454, CI= .271/.761). Meaning, as can be seen in Figure 4-46, that for PSGs owners, an increase in perceived safety was associated with an increase in the size of areas to protect, while For nonowners, the relationship was inversed, an increase in perceived safety was associated with a decrease in areas to protect. Moreover, as can be seen in Figure 4-47 that for PSG owners an increase in life satisfaction score was associated with a decrease in areas to protect, while for nonowners, the association was inversed, an increase in life satisfaction score was associated an increase in the size of areas to protect. This result is mixed and is supporting hypothesis 2.

In model 3, we test the association between PSG characteristics, perception, and related routines in one side and neighborhood protection responsibility on the other side. Only PSG size and age were significantly negatively associated with areas to protect diffusion, with one plant pot increase in PSG size associated with 2% decrease in territories to protect (OR= .98, CI= 1.07/1.50), and one month increase in PSG age associated with 12% decrease in territories to protect (OR= .88, CI= .82/.95).

These results do not support hypothesis 3, stipulating that PSG induced daily routines are associated with neighborhood areas to protect.
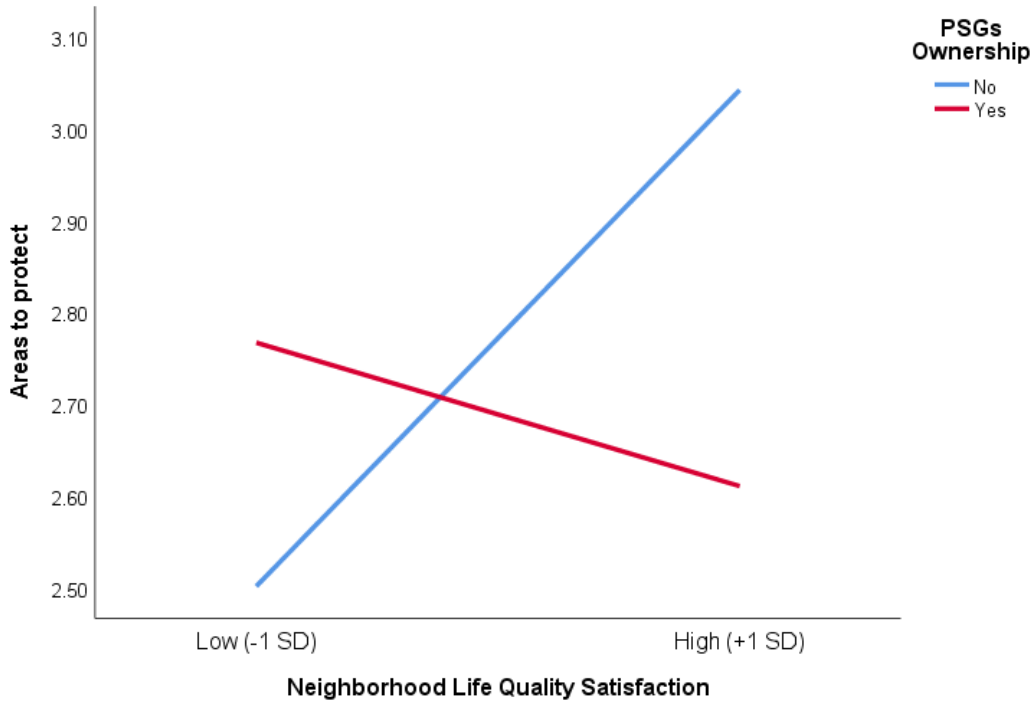
Figure 4-46 Simple slope for PSG ownership moderation of the Areas to protect – Neighborhood satisfaction relationship. The low value for life quality satisfaction is plotted at 1 SD below the mean, and the high value is plotted at 1 SD above the mean
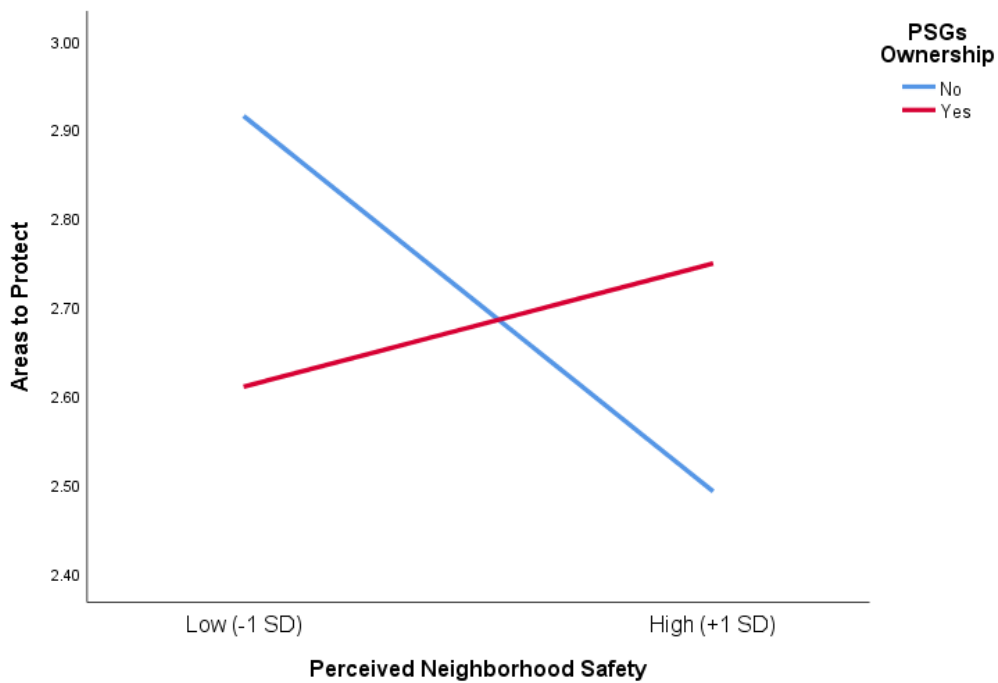
Figure 4-47 Simple slope for PSG ownership moderation of the Areas to protect – Perceived safety. The low value for perceived safety is plotted at 1 SD below the mean, and the high value is plotted at 1 SD above the mean.

3.4.3. Discussion

In this section, we explored the correlation between PSG ownership and the diffusion of the neighborhood areas participants felt responsible for defending.

Our findings are not consistent with UGS association with altruistic behaviors, or with PSG association with territoriality, and may be explained by PSG owners sensitivity to neighborhood safety, as they were less likely to feel responsible protecting unsafe environments, compared to nonowners.

For PSG owners, a higher life satisfaction score was associated with a reduced diffusion of areas to protect, compared to those with no PSG (Figure 4). This negative association might be due to a lack of problematic issues caused by safety.

Owners of older and bigger PSG were also less likely to feel responsible for protecting more areas, which further ascertains PSG ownership negative association with participants' willingness to defend more territories. These results are consistent with the negative correlation between PSG ownership and participants' willingness to defend their neighborhoods established in the previous study. However, they are not in line with existing literature (Ikkai, SHIMIZU, et al. 1999; Kobayashi 1992; Suzuki 1984) identifying PSG as signs of territoriality and neighbors monitoring and protection of their neighborhoods from potential offenders.
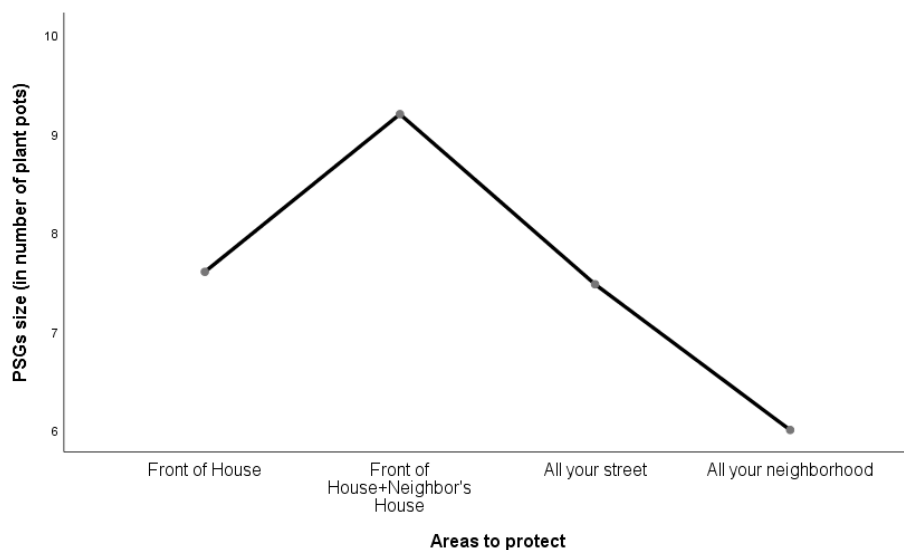
Figure 4-48 Areas to protect by PSG size
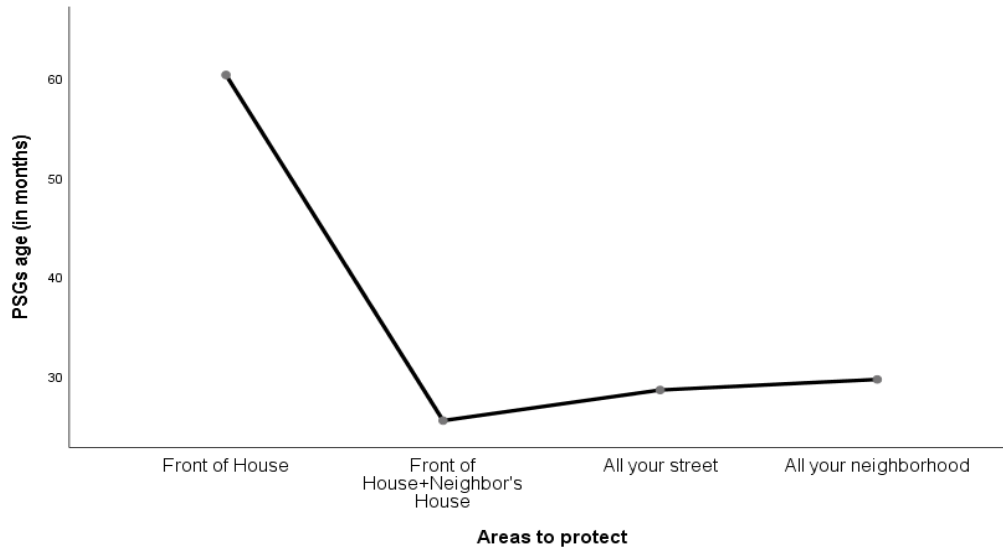
Figure 4-49 Areas to protect by PSG age

We suggest two possible explanations for these findings:

a) PSG might be acting as a barrier that divides areas of responsibility between neighbors, which makes them care only for their territories. PSG have been identified as a way to separate areas of influence in neighborhoods in order to avoid unnecessary territorial conflicts between neighbors (Suzuki 1984).

b) PSG's owners have more experience with the consequences of territorial disputes and weight the risk factor of defending their territories more than those with no PSG. With nonowners more prone to report more areas to protect because of social desirability bias and lack of experience with neighborhood conflicts.

In conclusion, our findings suggest that despite being associated with territoriality, PSG ownership would not be a useful tool in creating defensible neighborhoods more monitored by its dwellers, but these results reflect only the intentional behavior of our participants, the actual neighborhood protection behavior has to be investigated using experimental designs in order to ascertain the veracity of the association between the reported intended behavior and the actual behavior. As explained in Figures 8 and 9, for the diffusion of areas to protect, hypotheses 1 and 3 were rejected, while hypothesis 2 was partially validated only for neighborhood perceived safety. Figures 4-50 and 4-51.
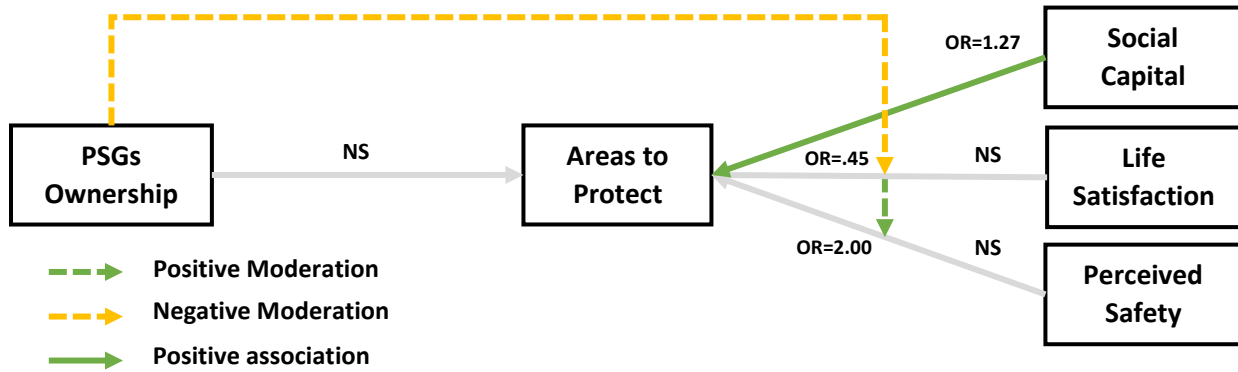
Figure 4-50 PSG ownership association with areas to protect.
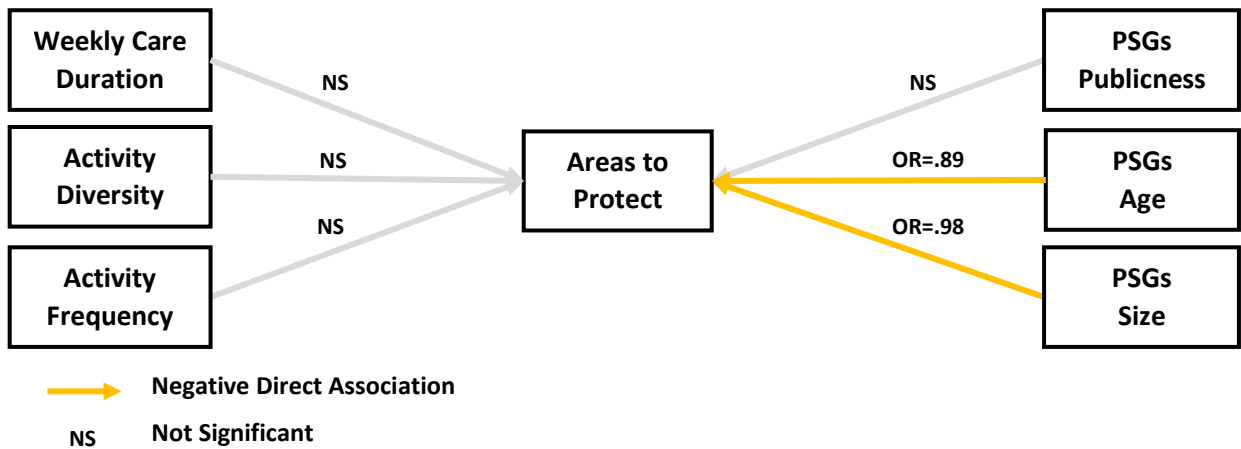
Figure 4-51 PSG variables association with areas to protect.

3.5. Cleaning responsibility

As explained in Figures 4-52 and 4-53, this analysis aimed to study PSG ownership correlation with participants responsibility towards cleaning their neighborhoods. We assumed that the daily routines related to PSG (cleaning and watering) would make owners feel more responsible for cleaning their neighborhoods. The bivariate and multivariate analyses objective were, therefore to investigate the veracity of two hypotheses.

H1: PSG ownership is positively associated with neighborhood cleaning responsibility.

H2: PSG ownership enhances cleaning responsibility association with neighborhood perception variables.

H3: PSG characteristics are positively associated with neighborhood cleaning responsibility.
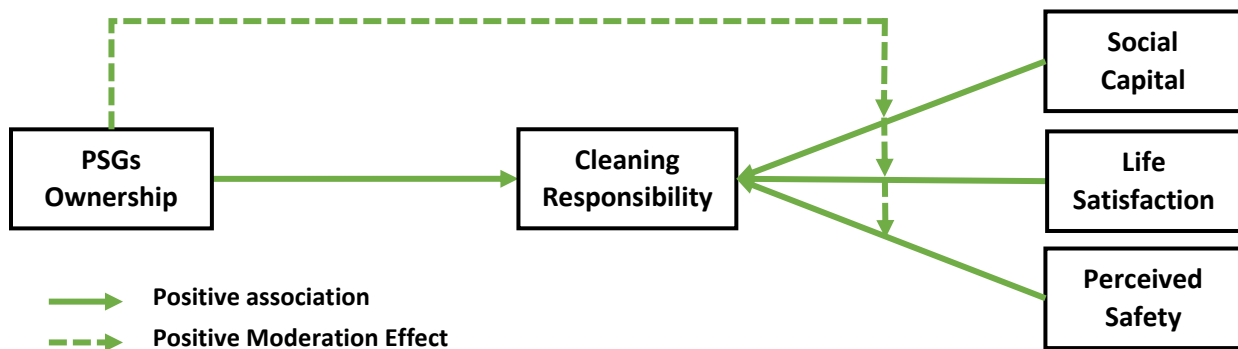
Figure 4-52 Conceptual model of PSG ownership hypothesized relationship with cleaning responsibility.
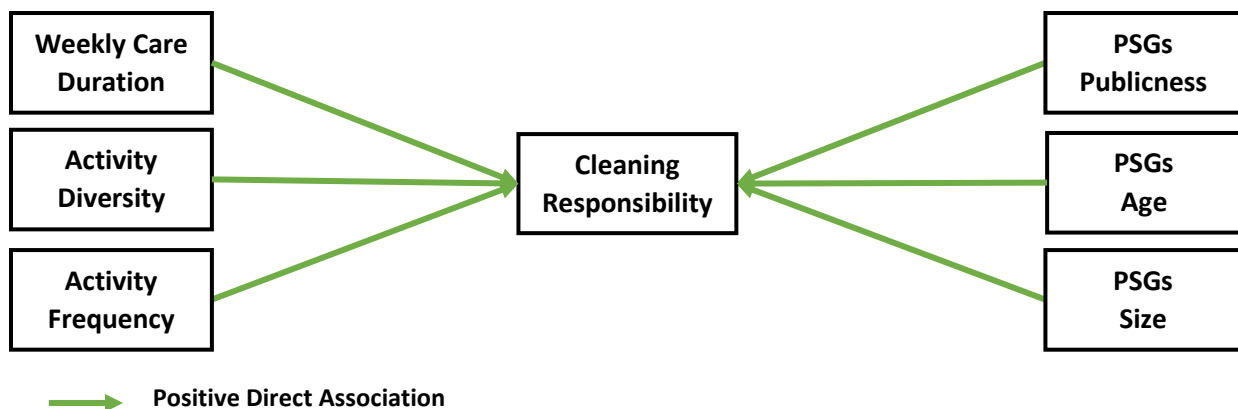
Figure 4-53 Conceptual model of PSG variables hypothesized relationship with cleaning responsibility.

3.5.1. Bivariate Analysis

We performed bivariate analyses (t-tests and χ2 tests) to identify significant differences in between groups with and without PSG. Table 4-46 shows that respondents with PSG were more likely to report neighborhood cleaning responsibility than those without PSG.

Table 4-46 Cleaning responsibility

Response	Whole sample	No PSG	With PSG
Cleaning responsibility			
Yes (1)	338 (87.1)	**101 (81.5%)**	**237 (89.8%)**
No (0)	50 (12.9%)	**23 (18.5%)**	**27 (10.2%)**

Boldface indicates p < .05 for PSG owners versus nonowners.

Spearman's correlations were also calculated for our key variables, cleaning responsibility, neighborhood safety, life satisfaction, and social capital. Results showed that for participants without PSG, cleaning responsibility was not significantly correlated with any other variable.

Table 4-47 Spearman's Correlation Matrix for Participants without PSG

	1	2	3	4
1 Weekly Walking Duration	1			
2 Perceived Safety	.059	1		
3 Life Satisfaction	.046	-.056	1	
4 Social Capital	.057	-.003	**.328***	1

*p < .05; **p < .01; ***p < .001.*

For PSG owners, all variables were significantly associated with each other with p < .01, at least.

Table 4-48 Spearman's Correlation Matrix for PSG Owners

	1	2	3	4
1 Clean responsibility	1			
2 Perceived Safety	**.302***	1		
3 Life Satisfaction	**.169**	**.359***	1	
4 Social Capital	**.197**	**.279***	**.443***	1

*p < .05; **p < .01; ***p < .001.*

For the whole sample, cleaning responsibility was significantly associated with all other variables. while PSG ownership was significantly correlated only with cleaning responsibility and Life satisfaction.

Table 4-49 Spearman's Correlation Matrix for the whole sample

	1	2	3	4	5
1 Cleaning responsibility	1				
2 PSG Ownership	**.116***	1			
3 Perceived Safety	**.219***	.011	1		
4 Life Satisfaction	**.145**	**.182***	**.268***	1	
5 Social Capital	**.140**	-.008	**.199***	**.400***	1

*p < .05; **p < .01; ***p < .001.

3.5.2. Multivariate Analysis

The linearity of our continuous variables with respect to the logit of the dependent variable was evaluated using the Box-Tidwell procedure (Box and Tidwell 1962). All our continuous independent variables were found to be linearly correlated with the logit of the dependent variable. In order to avoid sparse data bias (Greenland et al. 2016) we dropped the variables, "widow" and "divorced" that had had few cases per variable in Model 1 and Model 3; this procedure did not affect the significance of key variables.

Table 4-50 shows the results of the binary logistic regression predicting cleaning responsibility, stratified by PSG ownership.

Table 4-50 Binary Logistic Regression explaining neighborhood cleaning responsibility (N = 388)

	Model1		Model2		Model3
	With PSG	No PSG	Step1	Step2	
	OR(CI)	OR(CI)	OR(CI)	OR(CI)	OR(CI)
PSG ownership			**2.25*** **1.02/4.94**	**3.01*** **1.27/7.11**	
Life satisfaction	1.06 .65/1.74	.63 .32/1.22	.99 .70/1.40	1.01 .69/1.47	.80 .45/1.43
Perceived safety	**2.19*** **1.17/4.12**	1.57 .55/4.42	**2.11**** **1.27/3.34**	**2.03**** **1.22/3.38**	**3.19**** **1.38/7.37**
Social capital	**1.64**** **1.15/2.34**	**1.79**** **1.20/2.68**	**1.50**** **1.19/1.90**	**1.62***** **1.23/1.12**	**2.11**** **1.34/3.31**
Life satisfaction x PSG ownership				1.45 .67/3.14	
Social capital x PSG ownership				1.21 .76/1.91	
Safety perception x PSG ownership				1.54 .56/4.18	
PSG publicness					.93 .45/1.94

	Model 1	Model 2	Model 3	Model 4	Model 5
PSG size					1.05 .90/1.24
PSG age					.98 .97/1.00
Weekly care duration					1.02 .99/1.04
Activity diversity					**3.77*** **1.08/13.14**
Activity frequency					.53 .27/1.03
Gender (Female)	2.69 .70/10.34	.23 .04/1.50	1.16 .43/3.09	1.10 .41/2.99	2.63 .84/15.71
Age category	1.74 .72/4.22	1.42 .30/6.75	1.16 .54/2.47	1.09 .51/2.31	1.56 .58/4.15
Marital status					
Married	1.13 .19/6.47	1.52 .024/94.31	6.15 .89/42.60	5.42 .76/38.69	.72 .10/5.10
Single	.93 .13/6.78	0.27 .001/2.75	1.23 .19/7.90	1.11 .16/7.51	.54 .05/5.40
Widowed			5.06 .84/30.33	4.45 .84/23.68	
Divorced			2.45 .52/11.36	2.41 .51/11.43	
Education	**1.63**** **1.12/2.37**	1.17 .71/1.92	**1.56**** **1.17/2.07**	**1.55**** **1.16/2.06**	**2.01**** **1.24/3.27**
Household size	.90 .67/1.21	.77 .49/1.19	.93 .75/1.17	.89 .70/1.12	.97 .69/1.36
Residence duration	.98 .92/1.04	1.08 .99/1.18	1.01 .96/1.06	1.02 .97/1.07	.99 .93/1.07
Homeownership	.41 .12/1.40	.27 .04/1.64	.39 .15/1.02	.40 .15/1.04	.54 .15/1.94
Car ownership	2.07 .72/5.97	1.44 .33/6.21	1.69 .79/3.64	1.91 .86/4.20	2.25 .66/7.66
Constant	.001	.001	.001	.001	.011
χ^2 test	**42.142*****	**37.56*****	**72.21*****	**75.38*****	**55.75*****
Nagelkerke R^2	.332	.466	.346	.360	.448

OR: Odds ratio; Cl: 95% Confidence Interval; *p < .05; **p < .01; ***p < .001.

As can be seen in model 1, For PSG owners, an increase of one point in social capital was associated with an increased likelihood of reporting neighborhood cleaning responsibility by 1.6 times (*OR* = 1.64, *CI* = 1.15/2.34), an increase of one level in perceived neighborhood safety was associated with 2.2 times increased likelihood of reporting cleaning responsibility of (*OR*=2.19, *CI*=1.17/4.12). We also found a significant association with education level, where one level increase in education level was associated with an increased likelihood of reporting cleaning

responsibility of 1.6 times (*OR*=1.63, *CI*=1.12/2.37). Life quality satisfaction was not significantly associated with cleaning responsibility (*OR*=.1.053, *CI*=-.62/.1.77. *p*=.847).

Among participants with no PSG, an increase of one point in social capital was associated with an increased likelihood of reporting cleaning responsibility by almost 1.8 times (*OR* = 1.79, *CI* = 1.20/2.68). Perceived neighborhood safety and life satisfaction had no significant association with cleaning responsibility.

For PSG owners, Neighborhood perceived safety and education levels were significantly associated with neighborhood cleaning responsibility, while such association was not significant for those with no PSG.

Model 2 shows the results of the hierarchical regression, step 1 with the main effect variables only (including PSG ownership this time), and step 2 with the addition of the interaction terms.

Step 1 shows that PSG owners were more than two times more likely to report feeling responsible for cleaning their neighborhoods than participants with no PSG (*OR* = 2.25, *CI* = 1.02/4.94). While an increase of one level in neighborhood perceived safety was also associated with 2 times increased likelihood of reporting cleaning responsibility (*OR* = 2.11, *CI* = 1.27/3.34). One-point increase in social capital index was associated with 1.5 increased likelihood of reporting cleaning responsibility (*OR* = 1.50, *CI* = 1.19/1.90). We also found a significant association with education level, where one level increase in education level was associated with an increased likelihood of reporting cleaning responsibility of 1.6 times (*OR*=1.56, *CI*= 1.17/2.07).

These results support hypothesis 1, stipulating that PSG ownership is significantly positively associated with neighborhood cleaning responsibility.

Step 2 tests the effects of PSG ownership as a moderator on the relationship between neighborhood cleaning responsibility and neighborhood perceived safety, life quality satisfaction, and social capital. No interaction term was found significant; only the variables that were significant in step 1 were significant in step 2. This result does not support hypothesis 2, stipulating that PSG ownership moderates the relationship between neighborhood cleaning responsibility and other variables.

In model 3, we test the association between PSG characteristics, perception, and related routines in one side and neighborhood cleaning responsibility. Our results indicate that only the diversity of recreational activities undergone next to PSG was significant, with 1 unit increase in PSG diversity associated with 3.8 times increased likelihood of reporting neighborhood cleaning responsibility (*OR* = 3.77, *CI* = 1.08/13.14). This result supports our hypothesis that PSG related recreational activities have a positive association with neighborhood cleaning responsibility.
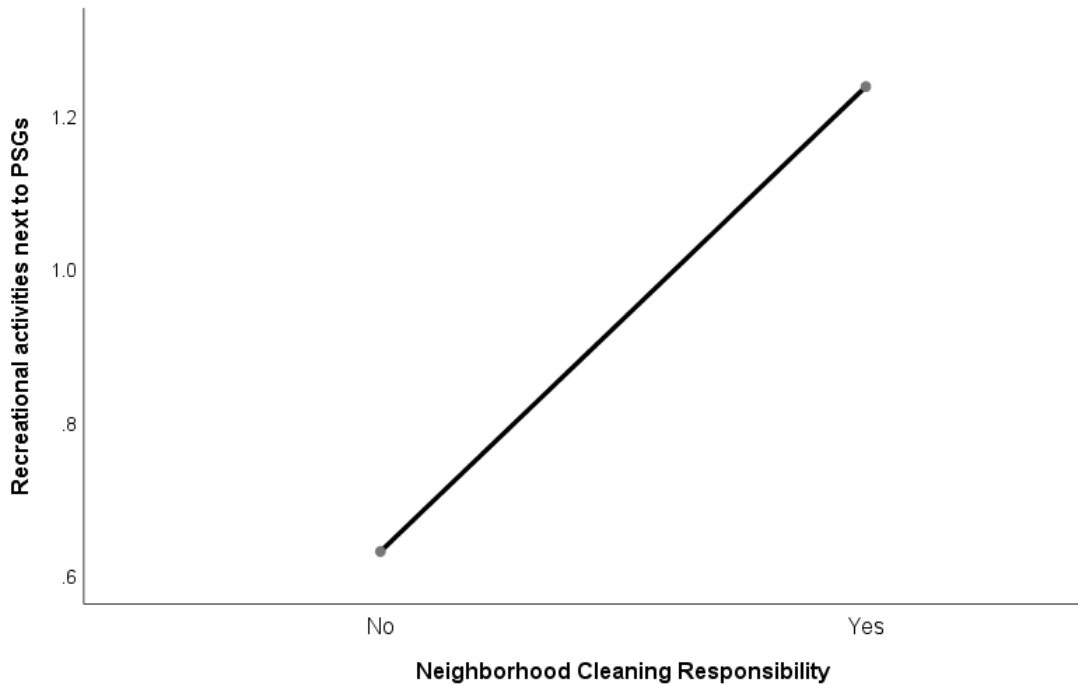
Figure 4-54 Neighborhood cleaning responsibility by the diversity of recreational activities

3.5.3. Discussion

UGS was associated with reduced antisocial behaviors and crime rates (Bates, Bohnert, and Gerstein 2018; Bogar and Beyer 2016) and increased territoriality in residential neighborhoods (Mizukami and Hagihara 2001; Suzuki 1984). In this study, we investigated the potential association between PSG as an informal UGS and PSG owners' feeling of responsibility to clean their neighborhoods.

Our findings suggest that PSG owners felt at least two times more responsible for cleaning their neighborhoods than those with no PSG. This finding may be explained by the fact that among

PSG owners, those that had more diverse recreational activities next to their plant pots were significantly more likely to feel responsible for cleaning their neighborhoods.

These results suggest that PSG ownership may be a factor encouraging more social activities, creating more social capital, which in turn induces more prosocial behaviors and results in well-maintained neighborhoods with less litter. The association between social capital and prosocial behaviors was already established (Chavis and Wandersman 1990), but this study is the first to investigate its correlation with PSG ownership in a dense disadvantaged neighborhood.

Nevertheless, the results of the present study have to be taken with caution as neighborhood cleaning responsibility, and neighborhood cleanliness are two different concepts. It is, therefore, unclear if the intended behavior of PSG owners does result in them cleaning their neighborhoods or not. We did notice during our visits to our study area that front yards with PSG were cleaner than those with no PSG. It is possible that cleaning responsibility already existed and caused residents to start having PSG. Therefore, longitudinal data and experimental designs are indispensable in order to ascertain our results further. As explained in Figures 4-54 and 4-55, hypotheses 1 and 3 were partially validated, while hypothesis 2 was rejected.
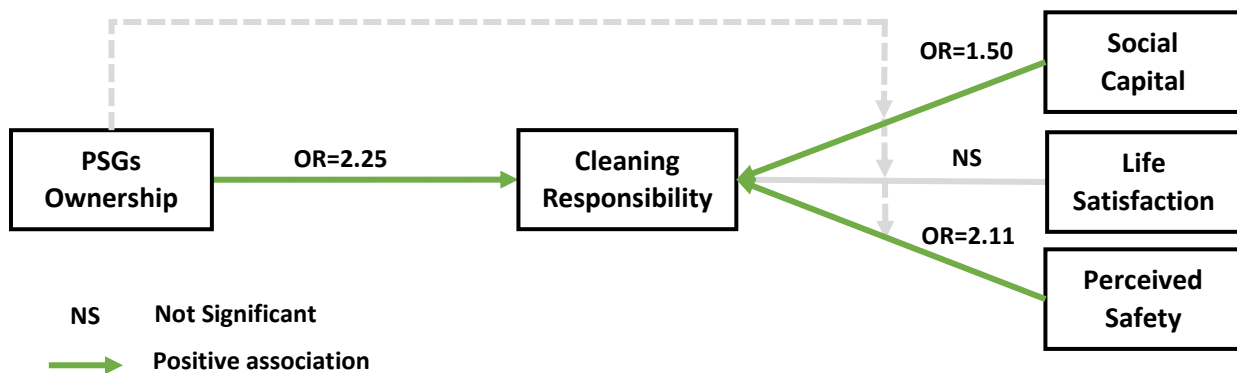
Figure 4-55 Diagram of PSG ownership association with neighborhood cleaning responsibility.
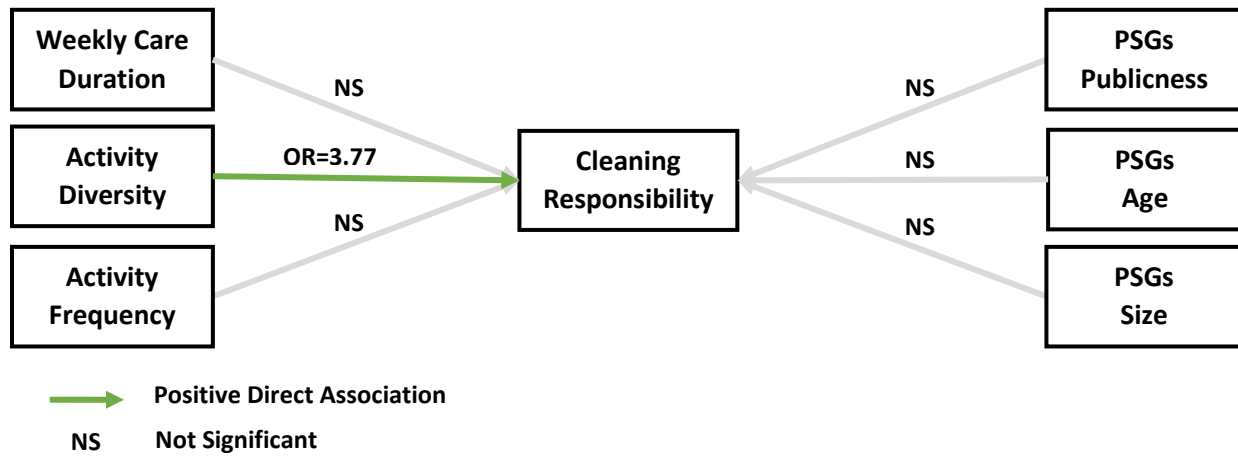
Figure 4-56 Diagram of PSG ownership variables association with neighborhood cleaning responsibility.

3.6. Areas to clean

As explained in Figures 4-56 and 4-57, this analysis aimed to study PSG ownership correlation with the diffusion of neighborhood areas participants felt responsible for cleaning. We assumed, based on our literature review, that PSG ownership would induce an altruistic behavior on owners and make them feel responsible cleaning more areas. The bivariate and multivariate analyses objective was, therefore, to investigate the veracity of two hypotheses.

H1: PSG ownership is positively associated with increased areas to clean.

H2: PSG ownership enhances areas to clean association with neighborhood perception variables.

H3: PSG characteristics are positively associated with neighborhood areas to clean.
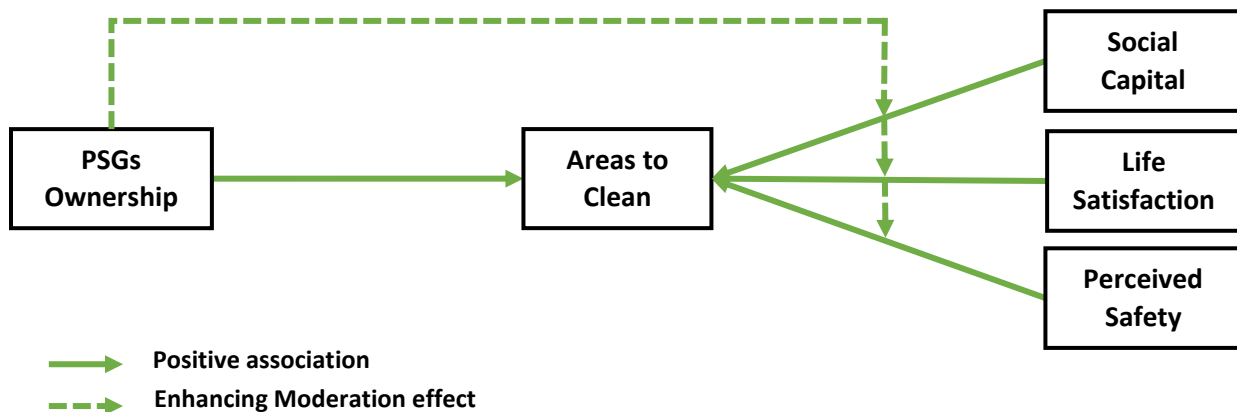
Figure 4-57 Conceptual model of PSG ownership relationship with neighborhood areas to clean.
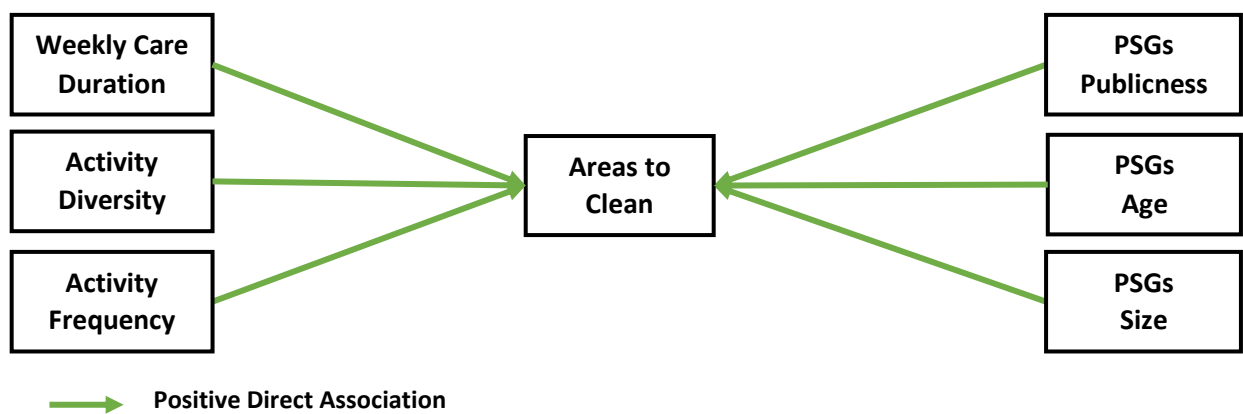
Figure 4-58 Conceptual model of PSG characteristics relationship with neighborhood areas to clean.

3.6.1.1. Bivariate Analysis

We performed bivariate analyses (t tests and χ^2 tests) to identify significant differences between groups with and without PSG. Table 4-51 shows that there was a significant difference between the two groups in the diffusion of areas to clean. PSG owners were more likely to choose more territories compared to participants without PSG.

Table 4-51 Areas to clean

Response	Whole sample	No PSG	With PSG
Areas to clean	M=2.72; SD=1.43	M=2.58; SD=1.57	M=2.79; SD=1.36
Nowhere	50 (12.9%)	**23 (18.5%)**	**27 (10.2%)**
Front house	17 (4.4%)	**7 (5.6%)**	**10 (3.8%)**
House and neighbors	116 (29.9%)	**31 (25.0%)**	85 (32.2%)
All street	13 (3.4%)	**1 (0.8)**	12 (4.5%)
All neighborhood	192 (49.5%)	**62 (50.0%)**	130 (49.2%)

Boldface indicates p < .05 for PSG owners versus nonowners.

Spearman's correlations were calculated, areas to clean, neighborhood safety, life satisfaction, and social capital. As shown in table 2, for participants without PSG, the diffusion of areas to clean was not significantly correlated with any other variable. Only neighborhood life quality satisfaction and social capital were significantly associated ($r = .328$, $p < .001$).

Table 4-52 Spearman's Correlation Matrix for Participants without PSG

	1	2	3	4
1 Areas to clean	1			
2 Perceived Safety	-.095	1		
3 Life Satisfaction	.064	-.056	1	
4 Social Capital	-.081	-.003	**.328*****	1

*p < .05; **p < .01; ***p < .001.

For PSG owners, areas to clean was positively significantly associated only with perceived safety ($r = .194$, $p < .01$). All other variables were significantly associated with each other with $p < .01$ at least (Table 3).

Table 4-53 Spearman's Correlation Matrix for PSG Owners

	1	2	3	4
1 Areas to clean	1			
2 Perceived Safety	**.194****	1		
3 Life Satisfaction	.004	**.359*****	1	
4 Social Capital	-.057	**.279*****	**.443*****	1

*p < .05; **p < .01; ***p < .001.

For the whole sample (Table 4-54), the diffusion of areas to clean was significantly associated only perceived safety ($r = .110$, $p < .05$).

Table 4-54 Spearman's Correlation Matrix for the whole sample

	1	2	3	4	5
1 Areas to clean	1				
2 PSG Ownership	.048	1			
3 Perceived Safety	**.110***	.011	1		
4 Life Satisfaction	.027	**.182***	**.268***	1	
5 Social Capital	-.064	-.008	**.199***	**.400***	1

$p < .05$; **$p < .01$; ***$p < .001$.

3.6.2. Multivariate Analysis

The objective of this analysis is to assess the associations between areas to clean and PSG ownership adjusting for other factors (safety, social capital, satisfaction) and control variables, in order to uncover the potential impact of PSG ownership on the altruistic decision of cleaning more than one's own territory.

Our dependent variable "territories to clean" being ordinal, the fittest analysis is ordinal regression (Osborne 2014). However, the data violated the proportional odds assumption, (meaning the variation between two level of the dependent variable is not the same across two independent variables levels), we opted to conduct a multinomial regression which allows identifying the variation for each level of area to clean separately compared with the first level, "Nowhere" as a reference category. The results are shown in Tables 4-55, 4-56, 4-57, and 4-58.

- **Only in "front of my house".**

  No significant correlation between our main DV and the likelihood of cleaning the front of the house was detected.

Table 4-55 Multinomial Logistic Regression. Only Infront of own house vs. nowhere (N = 388)

	Model1		Model2		Model3
	With PSG	No PSG	Step1	Step2	
	OR(CI)	OR(CI)	OR(CI)	OR(CI)	OR(CI)
PSG ownership yes			1.545	2.679	
			.39/6.13	.53/13.37	

Life quality satisfaction	1.30 .60/2.80	1.01 .22/4.56	1.02 .60/1.71	1.08 .62/1.88	1.16 .38/3.53
Social capital	1.1 .62/2.15	.72 .24/2.153	.97 .6/1.43	1.12 .703/1.810	1.47 .582/3.72
Perceived safety	1.740 .51/5.87	4.092 .08/195.09	2.081 .85/5.08	1.744 .66/4.58	2.904 .358/23.53
Life satisfaction x PSG ownership				1.706 .56/5.17	
Social capital x PSG ownership				1.550 .68/3.49	
Perceived Safety x PSG ownership				.974 .12/7.76	
PSG size					.919 .62/1.35
PSG age					1.008 .98/.03
Weekly care duration					.969 .89/.05
Activity diversity					4.292 .55/33.20
Activity frequency					.541 .14/2.03
PSG publicness					.406 .08/2.00
Age category	.540 .11/2.51	.644 .01/47.33	.818 .30/2.19	.850 .31/2.30	.382 .046/.15
Gender (Female)	.218 .01/3.13	.478 .01/515.65	.239 .04/1.48	.264 .0/1.62	.256 .010/6.74
Marital status					
Married	3.12 .38/25.18	34.38 .06/17651	4.33 .80/23.49	3.786 .69/20.54	2.065 .14/29.51
Education	.831 .44/1.55	.271 .04/1.66	.686 .40/1.17	.698 .41/.19	1.046 .46/2.34
Household size	.701 .39/1.23	.441 .07/2.83	.658 .43/1.00	**.604*** **.38/.94**	.537 .23/1.26
Residence duration	1.001 .89/1.12	.931 .69/1.25	.995 .92/1.07	1.000 .92/1.08	1.018 .87/1.18
Homeownership	.212 .03/1.50	.011 8.219E-/15.98	.194 .03/.99	**.170*** **.01/.92**	.190 .01/2.38
Car ownership	1.421 .21/9.35	1.6E-10 1.6E-1/1.6E-1	.482 .12/1.89	.561 .13/2.29	2.134 .12/36.18

OR: Odds ratio; CI: 95% Confidence Interval; *p <.05; **p <.01; ***p <.001.

- **"Front of my house" and "my neighbor's house"**

Model 1 shows that, for PSG owners, an increase of one level in perceived safety was associated with 2 times (OR = 2.098, CI = 1.04/4.20) increased likelihood choosing to clean their neighbors' front house too, over nowhere. While a one-point increase in neighborhood

social capital was associated with 2 times (OR = 2.32, CI = 1.46/3.67) increased likelihood of choosing to clean their neighbors' front house too.

Table 4-56 Multinomial Regression. Front of own house and close neighbor's vs nowhere

	Model1		Model2		Model3
	With PSG	No PSG	Step1	Step 2	
	OR(CI)	OR(CI)	OR(CI)	OR(CI)	OR(CI)
PSG ownership (yes)			**3.11*** **1.29/7.45**	**3.80**** **1.43/10.06**	
Life satisfaction	1.083 .635/1.848	.458 .177/1.185	.970 .654/1.438	.973 .64/1.48	.739 .393/1.390
Social capital	**2.323**** **1.46/3.67**	**3.775**** **1.79/7.94**	**2.312**** **1.64/3.25**	**2.414**** **1.68/3.47**	**3.230**** **1.80/5.78**
Perceived safety	**2.098*** **1.04/4.20**	1.542 .415/5.734	**1.925*** **1.11/3.33**	**1.891*** **1.04/3.42**	**2.953*** **1.213/.187**
Life satisfaction x PSG ownership				1.372 .553/3.402	
Social capital x PSG ownership				1.178 .60/2.29	
Perceived Safety x PSG ownership				1.347 .38/4.75	
PSG size					1.104 .934/1.305
PSG age					.980 .961/1.001
Weekly care duration					1.026 1.000/1.053
Activity diversity					**4.81*** **1.35/17.06**
Activity frequency					.501 .250/.005
PSG publicness					1.091 .49/2 .43
Age category	1.036 .44/2.44	2.547 .56/11.54	1.250 .652/2.396	1.210 .629/2.327	1.079 .411/2.834
Gender (Female)	1.577 .380/6.539	.395 .046/3.363	.967 .333/2.811	.955 .32/2.81	2.565 .52/12.45
Marital status					
Married	2.093 .573/7.635	**77.545**** **4.58/1310**	**5.17**** **1.78/14.97**	**4.80**** **1.65/13.95**	1.925 .441/8.404
Education	1.371 .919/2.045	1.424 .792/2.560	1.334 .984/1.809	1.31 .96/1.79	1.531 .920/2.550
Household size	1.005 .730/1.384	.708 .407/1.232	.978 .770/1.242	.94 .734/1.208	1.100 .757/1.598
Residence duration	.962 .900/1.028	1.101 .994/1.218	.994 .948/1.043	.99 .95/1.04	.987 .97/1.06
Homeownership	.505	.413	.471	.46	.791

	.14/1.83	.052/3.305	.171/1.295	.16/1.29	.201/3.122
Car ownership	1.837	1.758	1.551	1.68	2.212
	.59/.68	.31/9.97	.66/3.61	.70/3.98	.578/8.461

OR: Odds ratio; CI: 95% Confidence Interval; *p <.05; **p <.01; ***p <.001.

Among participants with no PSG, only social capital was significant, with one-point increase in neighborhood social capital index associated with 4 times increased likelihood choosing to clean neighbors' front house too over not cleaning at all (*OR* = 3.77, *CI* = 1.79/7.94).

These results indicate that there is a significant difference between the two groups.

Model 2 shows the results of the hierarchical regression; step 1 with the main effect variables only (including PSG ownership this time), and step 2 with the addition of the interaction terms.

Step 1 shows that for the whole sample. PSG ownership was associated with a 3 times increased likelihood of choosing to clean neighbors' front house too over not cleaning at all (*OR* = 3.11, *CI* = 1.29/7.45). An increase of one level in perceived neighborhood safety was associated with 2 times (*OR* = 1.92, *CI* = 1.11/3.33) increased likelihood of survey participants choosing to clean their neighbors' front house too, over not cleaning at all. While a one-point increase in neighborhood social capital index was associated with 2.3 times (*OR* = 2.31, *CI* = 1.64/3.25) increased likelihood of survey participants choosing to clean their neighbors' front house too, over not cleaning at all. These results partially support hypothesis 1, that PSG ownership is positively associated with the diffusion of neighborhood areas to clean.

Step 2 tests the effects of PSG ownership as a moderator on the relationship between territories to clean and perceived safety, life quality satisfaction, and social capital. No interaction term was found to be significant; only the variables that were significant in Step1 were significant in step 2. This result does not support hypothesis 2 that PSG ownership moderates the relationship between neighborhood protection responsibility.

In Model 3, we test the association between PSG characteristics, perception and related routines in one side and neighborhood protection responsibility. Only diversity of

activities next to PSG was found significant with one unit increase in kind of activities done next to PSG associated with 4 times (*OR* = 4.814, *CI* = 1.35/17.06) increased likelihood of survey participants choosing to clean their neighbors' front house too, over not cleaning at all.

These results support hypothesis 3 that PSG induced daily routines have a positive association with neighborhood cleaning territories.

- **All my street**

The number of participants that selected "all my street" as territory to clean were 13, with only 1 with no PSG, therefore, the analysis of the difference between the two groups will not provide useful information.

Model 1 shows that, In the PSG owners' group, an increase of one-point in neighborhood social capital index was associated with more than 2 times (OR = 2.428, CI = 1.10/5.32) increased likelihood of survey participants choosing to clean their neighbors' front house too, over not cleaning at all.

Model 2, shows that PSG ownership is positively correlated with cleaning all the street compared to nowhere; the odds ratio is exceptionally high given that only one participant with no PSG chose "All the street," compared to 12 PSG owners. No interaction term was significant.

In model 3, we test the association between PSG characteristics, perception, and related routines in one side and neighborhood protection responsibility. Only weekly care duration was found significant, with one-minute increase weekly care duration associated with 1.036 (OR = 1.036, CI = 1.00/1.06) increased likelihood of survey participants choosing to clean all their street over not cleaning at all.

These results support our hypothesis that PSG induced daily routines have a positive association with neighborhood cleaning territories.

The group being composed exclusively of PSG owners; we can also deduce a correlation between PSG ownership and cleaning all the street.

Table 4-57 Multinomial Regression. All My street vs Nowhere

	Model1		Model2		Model3
	With PSG	No PSG	Step1	Step 2	
	OR(CI)	OR(CI)	OR(CI)	OR(CI)	OR(CI)
PSG ownership yes			169493087	198834672	
Life quality satisfaction	1.240 .55/2.77		1.134 .54/2.36	1.157 -	.882 .36/2.12
Social capital	**2.428*** **1.10/5.32**		**2.405*** **1.14/5.06**	2.227 .-	**3.570**** **1.40/9.07**
Perceived safety	2.690 .889/8.145		2.407 .85/6.80	2.170 -	3.227 .90/11.51
Life satisfaction x PSG ownership				1.199 -	
Social capital x PSG ownership				1.646 -	
Perceived Safety x PSG ownership				2.015 -	
PSG size					.99 .78/1.27
PSG age					.981 .949/1.015
Weekly care duration					**1.036*** **1.00/1.06**
Activity diversity					1.804 .33/9.86
Activity frequency					.782 .30/1.99
PSG publicness					.631 .18/2.13
Age category	1.941 .63/5.93		2.098 .78/5.63	2.006 .747/5.383	2.013 .58/6.93
Gender (Female)	2.791 .41/18.84		1.614 .30/8.67	1.593 .293/8.660	4.059 .50/32.47
Marital status					
Married	1.47 .25/8.46		3.83 .77/19.10	3.594 .720/17.943	1.164 .16/8.40
Education	1.445 .80/2.60		1.307 .76/2.22	1.286 .754/2.195	1.462 .70/3.03
Household size	.804 .49/1.31		.832 .53/1.30	.806 .513/1.266	.780 .445/1.368
Residence duration	.938 .86/1.02		.967 .89/1.04	.969 .896/1.047	.95 .86/1.04
Homeownership	.360 .05/2.32		.330 .06/1.81	.322 .058/1.776	.392 .05/3.02
Car ownership	1.716		1.463	1.580	2.785

	.32/9.20		.31/6.73	.339/7.363	.39/19.86

- **All the neighborhood**

Model 1 shows that, In the PSG owners' group, only perceived safety was significant with one level increase in perceived neighborhood safety associated with 2 times (OR = 2.18, CI = 1.11/4.25) increased likelihood of survey participants choosing to clean all their neighborhood, over not cleaning at all.

Among participants with no PSG, only social capital was significant, with one-point increase in neighborhood social capital index associated with 2 times increased likelihood choosing to clean all the neighborhood over not cleaning at all (OR = 3.77, CI = 1.79/7.94).

These results indicate that there is a significant difference between the two groups.

Model 2 shows the results of the hierarchical regression, step 1 with the main effect variables only (including PSG ownership this time), and step 2 with the addition of the interaction terms.

Step 1 shows that for the whole sample. An increase of one level in perceived neighborhood safety was associated with almost 2 times (OR = 1.85, CI = 1.11/3.08) increased likelihood of survey participants choosing to clean all their neighborhood, over not cleaning at all. While one-point increase in neighborhood social capital index was associated with 1.4 times (OR = 1.38, CI = 1.07/1.78) increased likelihood of survey participants choosing to clean all their neighborhood, over not cleaning at all. These results do not support hypothesis 1 that PSG ownership is associated with neighborhood cleaning territories.

Step 2 tests the effects of PSG ownership as a moderator on the relationship between territories to clean and perceived safety, life quality satisfaction, and social capital. No interaction term was found to be significant, variables that were significant in Step 1 were significant also in step 2, except that PSG ownership was significantly associated with 2.4

times increased likelihood in participants choosing to clean all their neighborhood, over not cleaning at all.

This result does not support hypothesis 2, stipulating that PSG ownership moderates the relationship between neighborhood protection responsibility.

In Model 3, we test the association between PSG characteristics, perception, and related routines in one side and neighborhood protection responsibility. None of the PSG related variables were significant

These results do not support hypothesis 3 that PSG induced daily routines have a positive association with neighborhood cleaning territories.

Table 4-58 Multinomial Regression. All the neighborhood vs Nowhere

	Model1		Model2		Model3
	With PSG	No PSG	Step1	Step 2	
	OR(CI)	OR(CI)	OR(CI)	OR(CI)	OR(CI)
PSG ownership yes			1.986 .889/4.436	**2.464*** **1.015/5.979**	
Life quality satisfaction	1.012 .60/1.70	.764 .35/1.65	.965 .66/1.39	.972 .656/1.441	.754 .41/1.38
Social capital	1.344 .91/1.98	**2.060**** **1.23/3.45**	**1.380*** **1.07/1.78**	**1.446*** **1.082/1.931**	**1.784*** **1.09/2.91**
Perceived safety	**2.179*** **1.11/4.25**	1.309 .419/.088	**1.853*** **1.11/3.08**	**1.818*** **1.060/3.118**	**3.138**** **1.33/7.36**
Life satisfaction x PSG ownership				1.110 .483/2.550	
Social capital x PSG ownership				1.090 .658/1.805	
Perceived Safety x PSG ownership				1.942 .666/5.664	
PSG size					1.031 .87/1.22
PSG age					.980 .96/1.00
Weekly care duration					1.021 .99/1.04
Activity diversity					3.189 .90/11.25
Activity frequency					.543 .27/1.07
PSG publicness					1.022 .47/2.20
Age category	**2.844***	**5.466****	**2.764****	**2.609****	**2.863***

	1.23/6.53	1.54/19.39	1.51/5.05	1.426/4.774	1.13/7.20
Gender					
Female	**5.3***	.670	2.63	2.609	**7.41***
	1.34/20.98	.11/4.03	.97/7.12	.950/7.162	**1.60/34.18**
Marital status					
Married	.684	**36.69****	2.102	1.948	.697
	.19/2.39	**2.68/501**	.77/5.74	.714/5.313	.170/2.849
Education	**2.142****	1.276	**1.776****	**1.745****	**2.540****
	1.43/3.19	.753/2.161	**1.32/2.38**	**1.295/2.351**	**1.54/4.18**
Household size	.887	.921	.96	.93	.971
	.649/1.212	.576/1.473	.767/1.198	.736/1.18	.680/1.387
Residence duration	.990	**1.100***	1.020	1.022	1.005
	.92/1.06	**1.00/1.20**	.97/1.06	.975/1.070	.93/1.08
Homeownership	.442	.173	**.367***	**.363***	.582
	.126/1.552	.027/1.111	**.141/.953**	**.138/.953**	.154/2.197
Car ownership	2.258	2.532	2.068	2.257	2.051
	.74/6.86	.53/12.03	.92/4.61	.991/5.141	.56/7.49

OR: Odds ratio; Cl: 95% Confidence Interval; *p <.05; **p <.01; ***p <.001.

3.6.3. Discussion

Immersion in UGS has been associated with prosocial and altruistic behaviors (Guéguen and Stefan 2016). While PSG presence in residential neighborhoods was identified as a sign of territoriality and increased maintenance of neighborhood streets (Suzuki 1984). In this study, we tried to investigate PSG ownership association with the decision to clean more than one's own territory in a defined neighborhood. According to the theory of reciprocal altruism (Trivers 1971), such behavior has the potential to increase cooperation between neighbors significantly, and therefore lead to cleaner neighborhoods in the long run. In our preliminary inspection of our study area, we did notice that areas with PSG were noticeably cleaner than areas without PSG.

Our findings suggest that PSG owners felt significantly more responsible for cleaning their closest neighbors' territories and their street than those with no PSG, but responsibility feeling did not extend to the totality of the neighborhood. This may be explained by the extended presence of PSG owners on the street, watering, cleaning, or having recreational activities next to their plants. These routines might be inducing more socialization with next-door neighbors, especially that PSG care duration, recreational activities, and social capital were all positively associated with cleaning next-door neighbor territory, and follow almost the same pattern in their interaction with our variable as shown in Figures 4-59, 4-60 and 4-61.
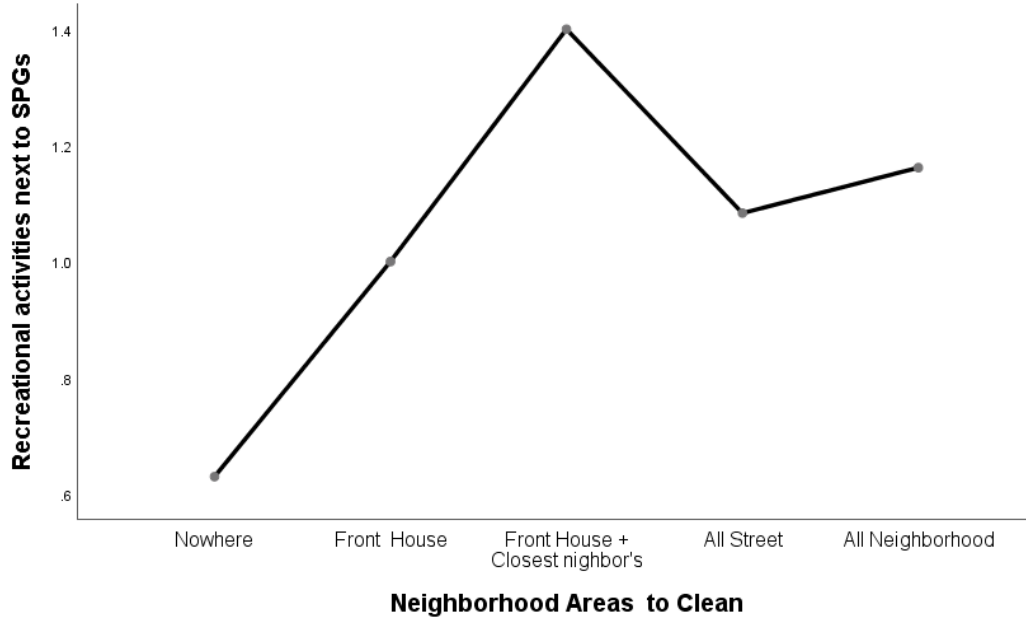
Figure 4-59 Neighborhood areas to clean by recreational activities mean.
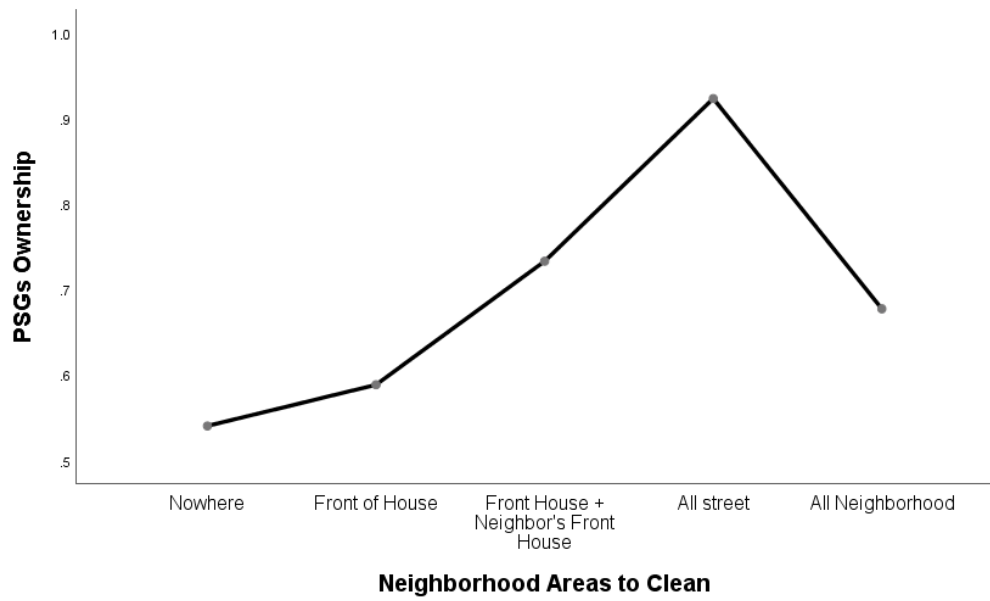
Figure 4-60 Neighborhood areas to clean by PSG ownership mean.
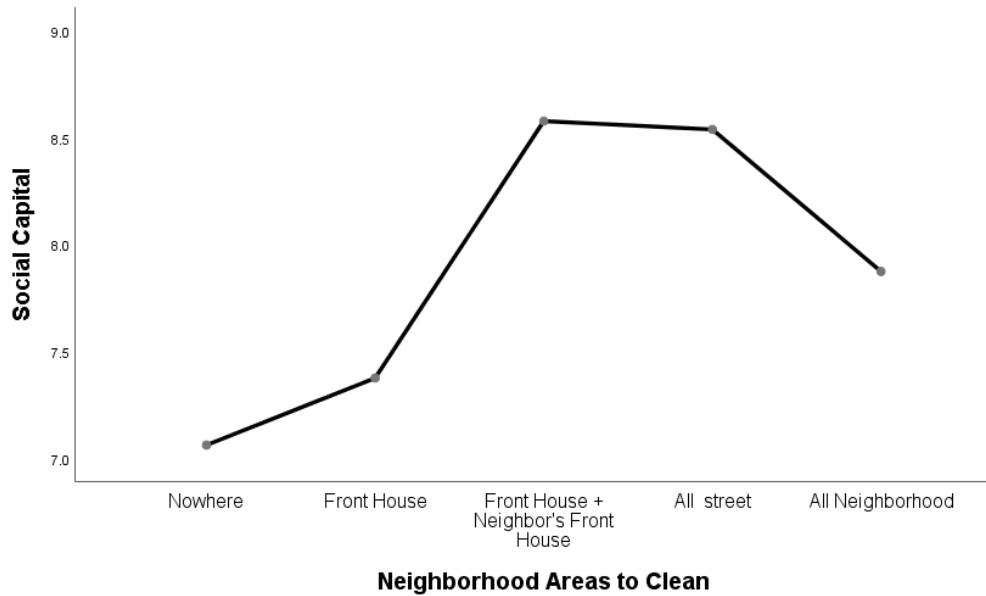
Figure 4-61 Neighborhood areas to clean by social capital score mean.

These results are consistent with our literature review, suggesting that UGS reduces crime (Bogar and Beyer 2016) and induces prosocial behaviors (Guéguen and Stefan 2016), which implies that encouraging PSG ownership may be a valuable way to induce and design cooperative behaviors between neighbors in dense disadvantaged residential neighborhoods. This finding is significant in designing cleaner neighborhoods, although more studies with bigger sample sizes and longitudinal data are needed in order to assess causality between our variables thoroughly. As explained in Figures 4-62 and 4-63, hypotheses 1 and 3 were validated, while hypothesis 2 was rejected.

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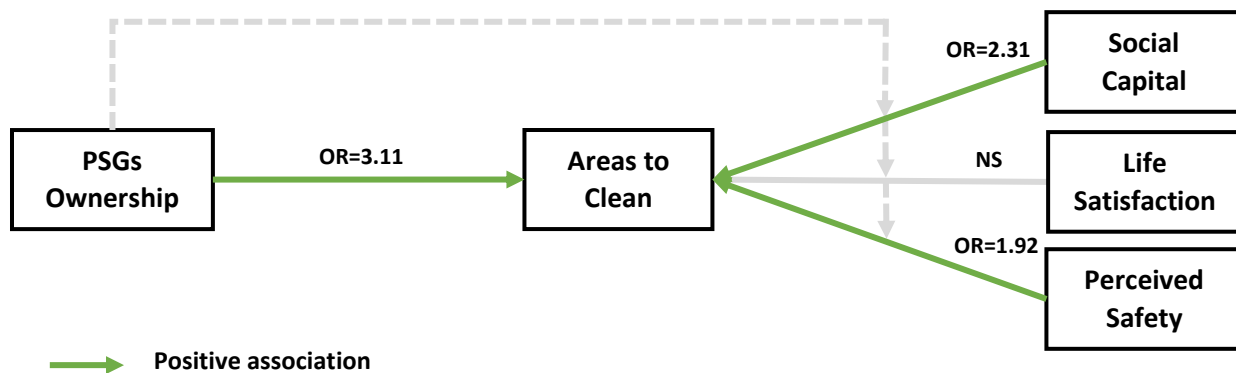
Figure 4-62 Diagram of PSG ownership association with areas to clean.


```
Weekly Care          NS                              NS           PSGs
 Duration                                                      Publicness

  Activity      OR=4.81                               NS          PSGs
  Diversity  ──────────────▶   Ares to                            Age
                               Clean  ◀──
  Activity          NS                                NS          PSGs
 Frequency                                                        Size


   ──────▶   Positive Direct Association
   ──────▶   Not Significant
```
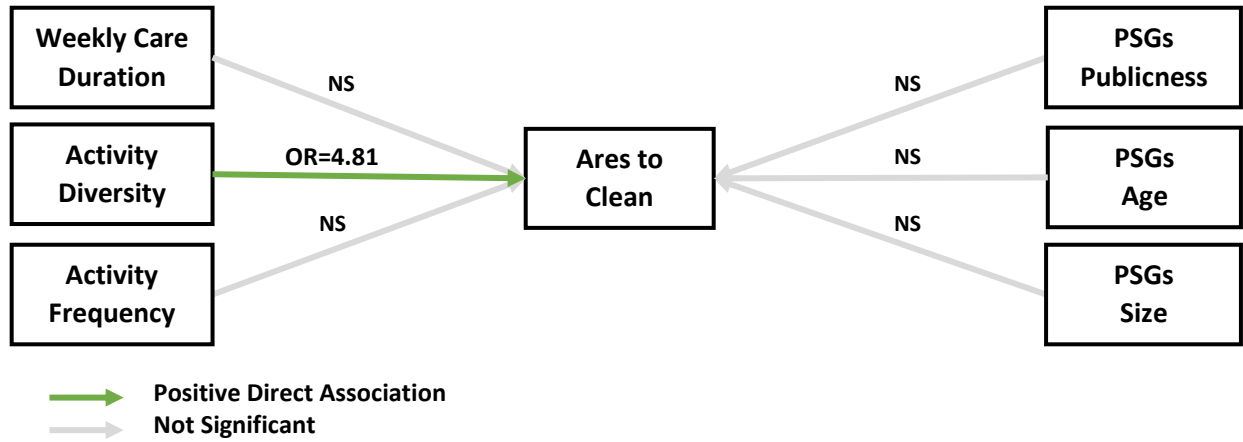
Figure 4-63 Diagram of PSG variables association with areas to clean.

3.7. Summary: prosocial behaviors and neighborhood attachment

As explained in Figure 4-64, PSG ownership significant associations with prosocial behaviors mainly positive, as it was positively associated (directly or by moderation effect) with neighborhood responsibility to clean and the diffusion of neighborhood areas to clean. Nevertheless, PSG ownership' association with the diffusion of areas to protect was mixed, with a negative effect on its association with life satisfaction and a positive effect on its association with perceived safety. While its association with neighborhood attachment was not significant.

───── **Positive Association**

───── **Mixed Results (Positive and negative moderation effect)**
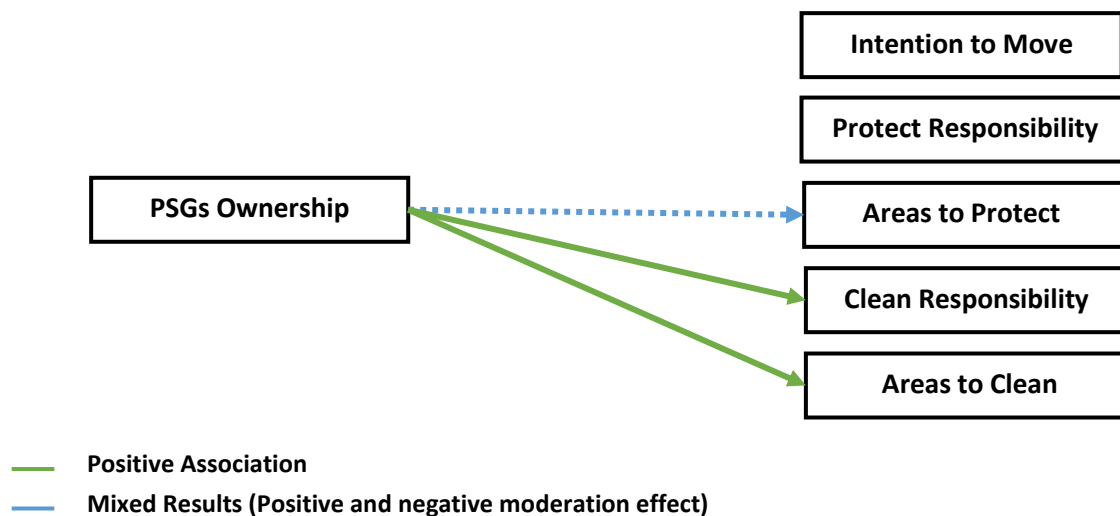
Figure 4-64 Diagram explaining the type of association (direct and by moderation effect) between PSG ownership and prosocial behavior and neighborhood attachment variables.

In contrast, PSG related variables were mainly negatively associated with prosocial behavior and neighborhood attachment, as out of five significant correlations, only two were positive (Figure 4-65).

From Figures 4-64 and 4-65 we remark a clear consistent positive relationship between PSG and cleaning responsibility. This result suggests that PSG might provide a venue for socializing activities important enough to induce altruistic and prosocial behaviors. This might explain the apparent cleanliness of front yards with PSG compared with those without PSG. However, this association did not extend to behaviors that may represent a significant risk factor for their safety, like protection from potential offenders, as PSG owners felt responsible for protecting more

areas only when safe. Curiously, PSG ownership was not associated with neighborhood attachment.
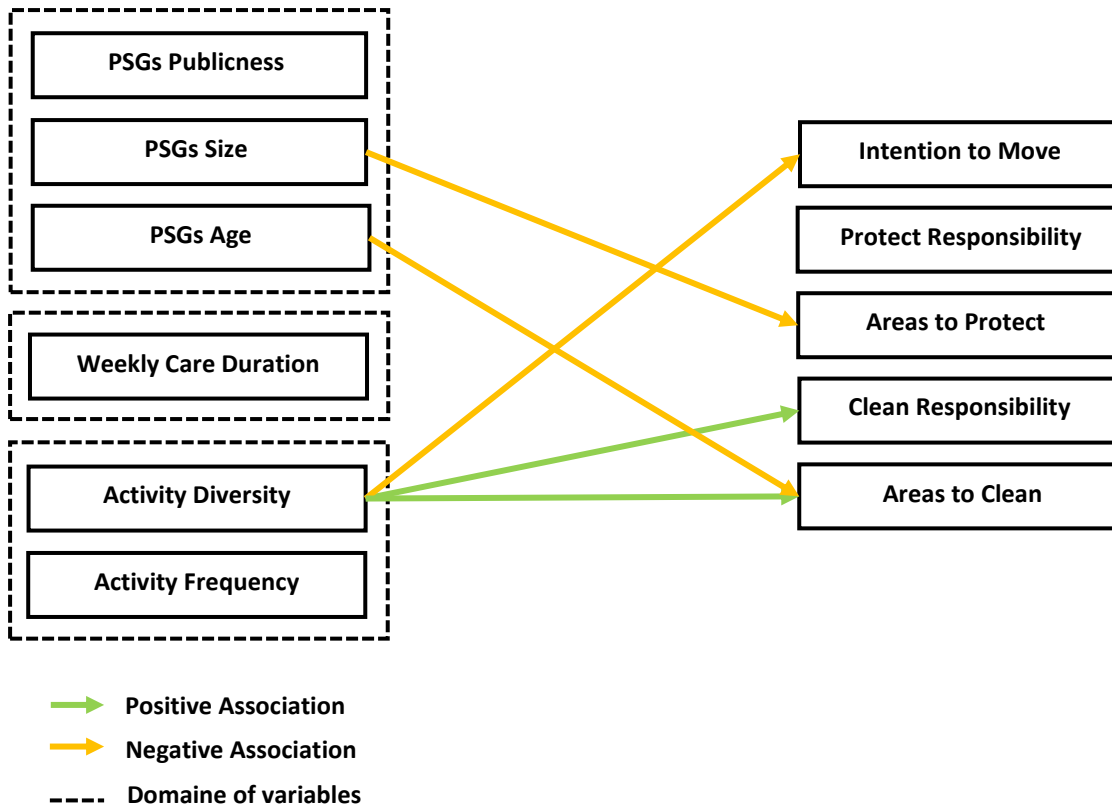
Figure 4-65 Diagram explaining the type of association between PSG characteristics and prosocial behavior and neighborhood attachment variables.

These results suggest that PSG ownership might be an effective way to induce cleaning behaviors in dense disadvantaged areas that may significantly improve neighborhood cleanliness. Further research is needed to ascertain these results using much bigger sample sizes, as ordinal and dichotomous regressions require large sample sizes.

4. Health variables

4.1. Introduction

Our sample's health characteristics were assessed using two variables, weekly walking duration as a measure of moderate physical activity, and the PHQ-9 questionnaire assessing depression score as a measure for mental health. As indicated in Table 4-59, only the PHQ-9 depression score was significantly different between the two groups. In order to further study the potential associations between PSG ownership and health, we analyzed our two variables separately using bivariate and multivariate tests.

Table 4-59 health variables

Response	Whole sample	No PSG	With PSG
Weekly walking duration	M=111.47; SD=135.50	M=111.21; SD=157.40	M=111.6; SD=124.21
PHQ-9 depression score	M=1.38; SD=2.221	**M=0.76; SD=1.38**	**M=1.68; SD=2.47**

Boldface indicates p < .05 for PSG owners versus nonowners.

4.2. Physical activity

As explained in Figures 4-65 and 4-66, this analysis aimed to study PSG ownership correlation with participants physical activity level, we assumed that PSG presence on neighborhood streets would make owners go out on promenades more frequently than others. The bivariate and multivariate analyses objective were, therefore, to investigate the veracity of three hypotheses.

H1: PSG ownership is positively associated with increased physical activity levels.

H2: PSG ownership enhances physical activity's association with neighborhood perception variables.

H3: PSG characteristics are positively associated with increased physical activity levels.
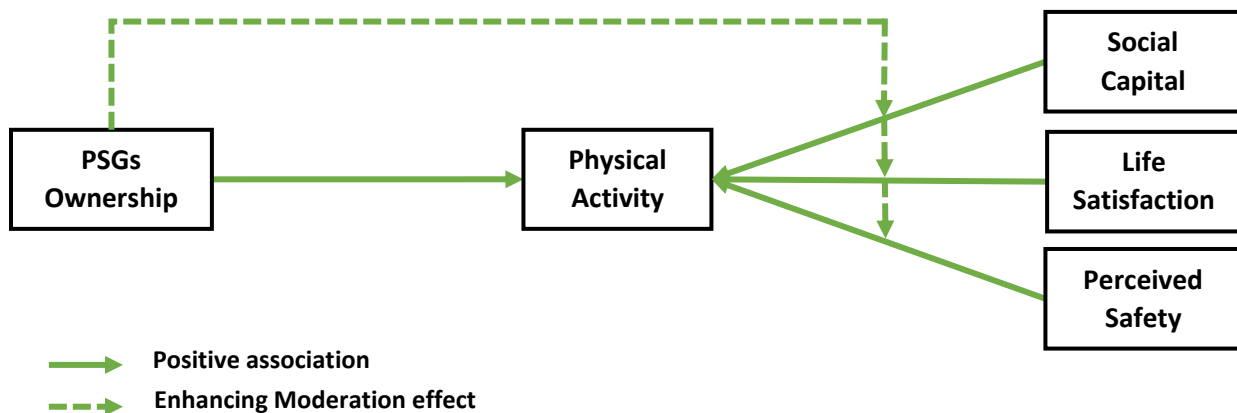
Figure 4-66 Conceptual model of the relationship between PSG ownership and physical activity levels.
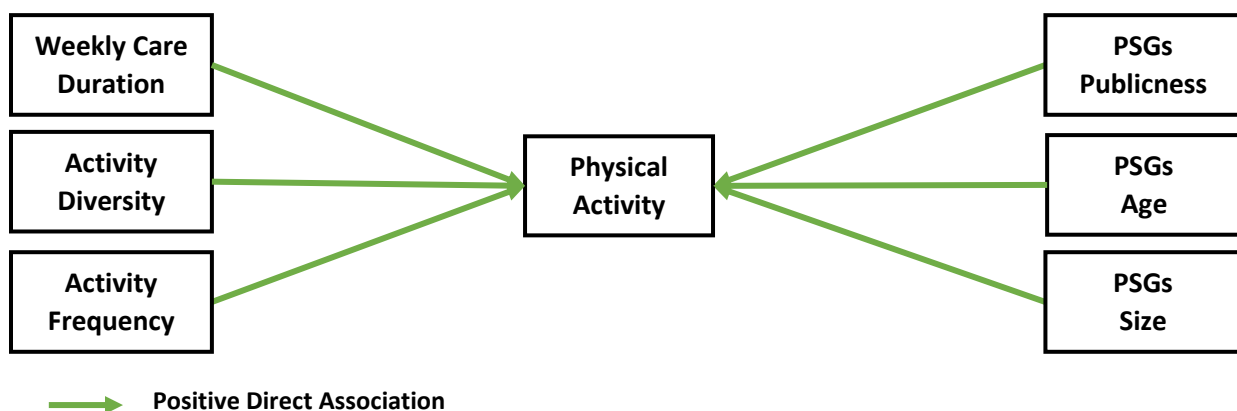
Figure 4-67 Conceptual model of PSG characteristics relationship with physical activity levels.

4.2.1. Bivariate Analysis

We used bivariate analyses (t-tests and χ2 tests) to identify significant differences between our two groups. As shown in Table 4-60, there is no significant difference between PSG owners and nonowners in weekly walking duration. The average walking duration in the neighborhood, reported by survey participants is 111.47 minutes (SD=135.50), which is below the 150 minutes of moderate physical activity recommended by the world health organization (Who 2010), although some studies suggested 30 minutes being enough to start benefitting from physical activity (Public health England 2017; Public Health England 2018). Overall, only 27.6% of our sample walked more than 150 minutes a week.

Table 4-60 Descriptive information on the principal variables (N = 388)

Response	Whole sample	No PSG	With PSG
Weekly walking duration	M=111.47; SD=135.50	M=111.21; SD=157.40	M=111.6; SD=124.21
Less than 150 minutes	281 (72.4)	89 (71.8%)	192 (72.7%)
More than 150 minutes	107(27.6%)	35 (28.2%)	72 (27.3%)

Boldface indicates p < .05 for PSG owners versus nonowners.

Spearman's correlations were also calculated among our four key variables, weekly walking duration, neighborhood safety, neighborhood satisfaction and social capital, for respondents with and without PSG. Results showed that for those without PSG (Table 4-61), weekly walking duration was significantly correlated with life quality satisfaction (r=.358; p<.001) only, while social capital and life quality satisfaction were significantly correlated to each other (r=.328; p<.001). There were no significant associations between neighborhood safety and other variables.

Table 4-61 Spearman's Correlation Matrix for Participants without PSG

	1	2	3	4
1 Weekly walking duration	1			
2 Social Capital	.101	1		
3 Life Satisfaction	**.358*****	**.328*****	1	
4 Perceived Safety	-.061	-.003	-.056	1

***p < .05; **p < .01; ***p < .001.**

For PSG owners, as shown in Table 4-62, weekly walking duration was significantly associated with life quality satisfaction (r=.202, p<.001) and social capital only (r=.192, p<.005).

Neighborhood safety, Life quality satisfaction, and social capital were all positively associated with each other (p<.001).

Table 4-62 Spearman's Correlation Matrix for PSG owners

	1	2	3	4
1 Weekly walking duration	1			
2 Social Capital	**.192****	1		
3 Life Satisfaction	**.202****	**.443*****	1	
4 Perceived Safety	.087	**.279*****	**.359*****	1

*p < .05; **p < .01; ***p < .001.

For the whole sample, as shown in Table 4-63, weekly walking duration was significantly correlated with social capital and life satisfaction only. PSG ownership was significantly correlated only with Life satisfaction.

Table 4-63 Spearman's Correlation Matrix for the whole sample

	1	2	3	4	5
1 Weekly walking duration	1				
2 PSG ownership	-.009	1			
3 Social Capital	**.161****	-.008	1		
4 Life Satisfaction	**.232*****	**.182*****	**.400*****	1	
5 Perceived Safety	.041	.011	**.199*****	**.268*****	1

*p < .05; **p < .01; ***p < .001.

4.2.2. Multivariate Analysis

Table 4-64 shows the results of the WLS predicting weekly walking duration, stratified by PSG ownership. In model 1, we compared the two groups of participants with and without PSG, in model 2, we verified if PSG ownership moderated the correlation between our main variables and in model 3, we tried to identify PSG characteristics that were significantly associated with walking duration controlling for covariates.

Table 4-64 WLS explaining weekly walking duration in minutes (N=388)

	Model1		Model 2			Model 3
	With PSG	No PSG	Step 1	Step2	Step3	
	b (CI)	b (CI)	b (CI)	b (CI)	b (CI)	b (CI)
PSG ownership (yes)			1.10 -23.25/25.44	.65 -23.53/24.84	-.11 -25.97/25.74	

	(1)	(2)	(3)	(4)	(5)	(6)
Life satisfaction	7.25 -4.28/18.79	**33.45** 12.77/54.12	**14.713*** 6.50/22.92	**12.74** 4.43/21.05	**13.36*** 2.28/24.44	1.33 -8.70/11.36
Social capital	6.00 -2.28/14.30	**19.08** 4.76/33.40	**8.02*** 1.01/15.02	**13.48** 5.17/21.79	**13.21** 4.29/22.12	1.63 -5.75/9.02
Perceived safety	-7.17 -24.92/10.57	14.32 -31.48/60.14	1.359 -13.74/16.46	5.13 -10.19/20.46	5.59 -10.66/21.84	3.64 -7.6/15.18
Social capital x PSG ownership				**16.637*** 2.83/30.43	**16.320*** 2.01/30.63	
life satisfaction x PSG ownership				-	1.50 -16.16/19.16	
PSG publicness						9.76 -1.94/21.48
PSG size						-1.38 -2.82/.058
PSG age						**-.54** -.90/-.18
Weekly care duration						**.40*** .04/.75
Activity diversity						**16.91*** 1.08/32.75
Activity frequency						3.66 -5.87/13.20
Gender (Female)	-4.13 -29.45/21.19	**77.50** 17.92/137.06	-2.547 -25.24/20.14	.489 -22.19/23.17	.852 -22.26/23.96	-12.66 -34.91/9.58
Age category	**21.37 *** 4.40/38.35	27.04 -19.11/73.20	**26.242** 11.49/40.989	**23.884** 9.11/38.66	**23.970** 9.13/38.80	4.44 -11.03/19.92
Marital status						
Married	19.91 -11.52/51.36	58.53 -7.72/124.80	**49.81*** 25.43/74.2	**46.060*** 21.64/70.47	**45.786*** 21.12/70.45	-
Widowed	91.58 -36.25/219.43	107.54 361.67/146.6	49.334 60.30/159.0	36.909 -72.46/146.28	36.626 -72.96/146.21	123.53 -23.55/270.63
Divorced		**-149.77** -245.75/-53.8				29.32 -4.62/63.27
Single	7.73 -34.46/49.92	-	**66.130** 30.64/101.61	**57.798** 21.88/93.71	**58.208** 21.91/94.50	10.60 -16.73/37.93
Education	**20.47*** 11.11/29.83	-3.31 -22.23/15.60	7.706 -.1/15.51	**8.717*** .92/16.51	**8.77*** .94/16.61	**20.83*** 14.60/27.06
Household size	7.91 -.55/16.37	-10.22 -23.40/2.94	**-5.757*** -10.98/-.53	-4.336 -9.66/.99	-4.18 -9.81/1.45	**16.63*** 11.31/21.96
Residence duration	-.34 -1.65/.97	2.843 -.63/5.50	.639 -.17/1.45	.17 -.72/1.07	.15 -.78/1.08	.12 -.91/.1.16
Homeownership (yes)	.036 -30.16/30.23	37.95 -32.17/108.07	16.424 (10.53/43.38	17.403 -9.38/44.19	17.50 -9.35/44.35	**27.24** 7.88/46.61
Car ownership (yes)	**31.00*** 6.71/55.30	-41.55 -89.68/6.57	10.951 -8.71/30.61	4.072 -16.27/24.42	4.02 -16.36/24.41	**26.02** 10.88/41.15
Constant	-527.335	-5318.62	-1306.013	-377.967	-340.48	-392.11
F test	**14.437***	**6.514***	25.269	24.285	22.702	**18.347***

b: Unstandardized Regression Coefficient; Cl: Confidence Interval; *p<.05; **p<.01; ***p<.001.

As can be seen in model 1, for PSG owners, neighborhood life quality satisfaction (b = 7.25, CI = -4.28/18.79. p > .05), Social Capital (b = .055, CI = -2.28/14.30. p > .05) and neighborhood safety (b=-7.17, CI = -24.92/10.57. p > .05) were not significantly associated with weekly walking duration.

However, for participants without PSG, weekly walking duration was significantly associated with life satisfaction and social capital and. A one-point increase in life quality satisfaction index was associated with a 33 minutes increase in weekly walking duration (b = 33.45, CI = 5.48/21.72 p < .005), and a one-point increase in social capital index was associated with 19 minutes increase in weekly walking duration (b = 19.08, CI = 4.76/33.40. p < .05).

Model 2 shows the results of the hierarchical regression; step 1 with the main effect variables only (PSG ownership, perceived safety, social capital and neighborhood safety), and Step 2 and 3 with the introduction of the interaction terms one by one identify the effect of each one separately.

In step 1, only life satisfaction and social capital were significantly associated with walking duration. A one-point increase in life quality satisfaction was associated with 14 minutes increase in walking duration (b=14.713, CI=6.50/22.92; p<.001), and a one-point increase in social capital was associated with 8 increase minutes in weekly walking duration (b=8.016, CI=1.01/15.02. p<.05). This result does not support hypothesis 1, stipulating that PSG ownership is positively associated with walking duration.

In Step 2 and Step 3, we verified if PSG ownership moderated the relationship between walking duration, and life quality satisfaction, and social capital. Only the interaction term between PSG ownership and social capital was significant in step 2 and 3, the additional variation explained between step 1, and Step 2 was 1% (F(1,334)=5.624, p < .05. R² change = .008). PSG ownership antagonized the weekly walking duration-social capital relation. Meaning, as can be seen in Figure 4-68, that for PSGs owners, an increase in social capital score was associated with a decrease in walking duration, while for nonowners, this relation was inverted. An increase in social capital score was associated with an increase in weekly walking duration.
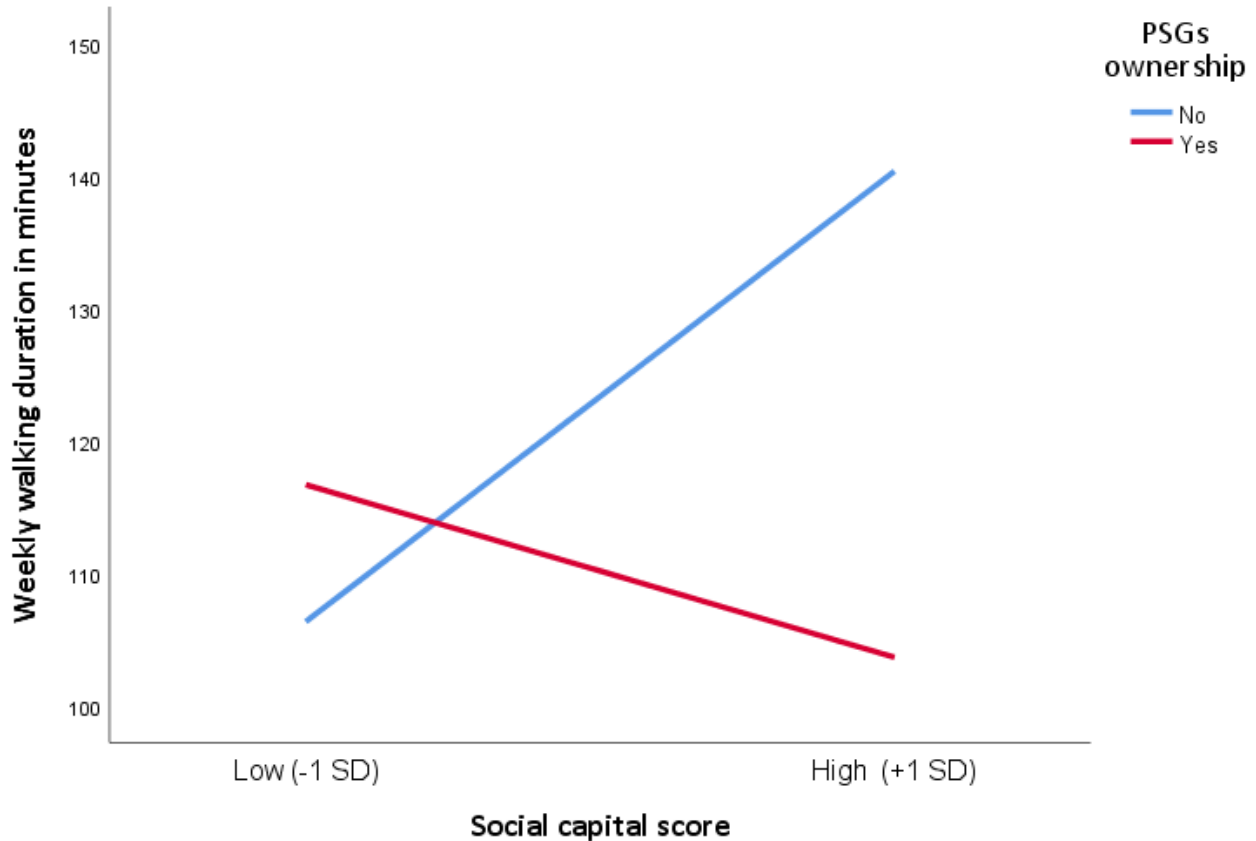
Figure 4-68 Simple slope for PSG ownership moderation of the weekly walking duration – social capital relationship. The low value for social capital is plotted at 1 SD below the mean, and the high value is plotted at 1 SD above the mean.

Model 3 results show that one month increase in PSG age was associated with ½ minute decrease in walking duration (b = -.54, CI = -.90/-.18; p<.01), one minute increase in weekly care duration (cleaning, watering PSG) was associated with a ½ minute increase in walking duration (b=.40, CI=.038/.75; p<.05), while one unit increase in diversity of recreational activities done next to PSG (eating, siting, chatting with neighbors, etc.) was associated with 17 minutes increase in walking duration (b=16.91, CI=1.08/32.75; p<.05). These results support hypothesis 3 that more interaction with PSG is associated with more walking duration but only for PSG owners.

4.2.3. Discussion

According to the world health organization (Who 2010), physical inactivity is the leading cause for more than a quarter of all breast and colon cancers and diabetes, and is responsible for 6% of deaths globally, making it the fourth leading mortality risk factor in the world. However, despite

these alarming numbers, physical inactivity is still increasing in both developed and underdeveloped countries in part because of the increasing urbanization of the world population (Assah et al. 2011; Ojiambo et al. 2012).

A consistent body of research highlighted the critical role of built environments in defining physical activity levels. The availability of UGS, in particular, was linked to an increase in physical activity (Akpinar 2016; Schipperijn et al. 2013) in addition to an increase in neighborhood safety perception (Bennett et al. 2007; Garvin et al. 2013; Gorham et al. 2009), life quality satisfaction (Stronegger, Titze, and Oja 2010; Zhang et al. 2015), and social capital (Fu et al. 2018; Jennings and Bamkole 2019b). Therefore, creating new UGS or improving accessibility to existing ones may be an effective and far-reaching strategy to increase PA levels.

Our findings were, however, not consistent with the existing literature. PSG ownership was not significantly associated with physical activity level, nevertheless, it has an antagonizing moderation effect on the walking duration-social capital association. Curiously, higher social capital score was associated with less physical activity with the relation being inversed for nonowners. A possible explanation might be that PSG owners with higher social capital prefer to stay closer to their PSG socializing or chatting and therefore walked less than others with no PSG. Although, more time spent caring for the PSG and more diverse activities next to it were both significantly correlated with longer walking duration, which is consistent with existing literature.

For participants without PSG, social capital and neighborhood satisfaction had a significant correlation with physical activity levels. For PSG owners, no such correlation was found, even though PSG owners had a higher life satisfaction score than nonowners in the bivariate analysis, and there was no significant difference in social capital score between the two groups. The WLS also unveiled a significant correlation between PSG related daily routines (daily care duration and diversity of recreational activities) and physical activity levels. However, no difference in physical activity levels between those with and without PSG was found in the bivariate analysis, which is interesting. Figures 4-69 and 4-70 summerise the results.
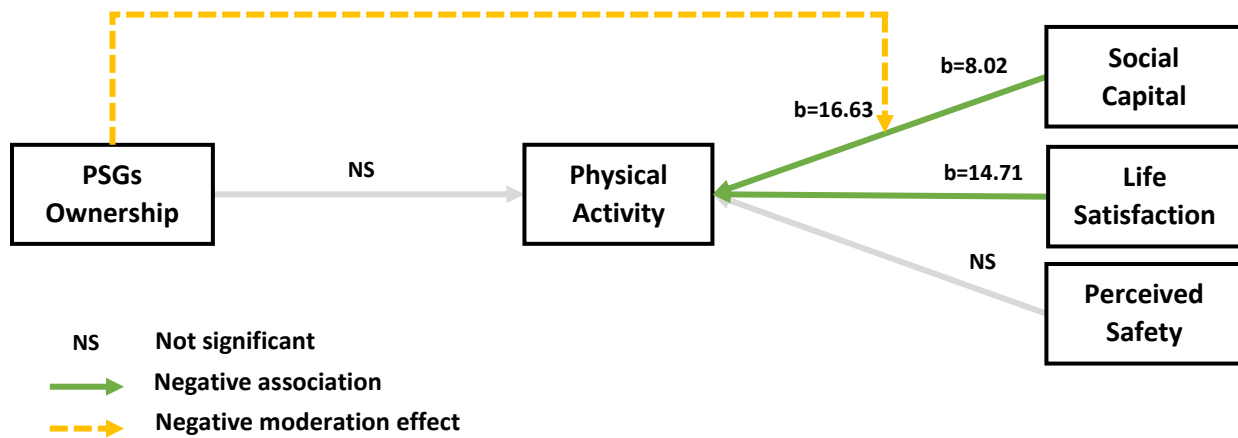
Figure 4-69 Diagram of PSG ownership association with physical activity level.
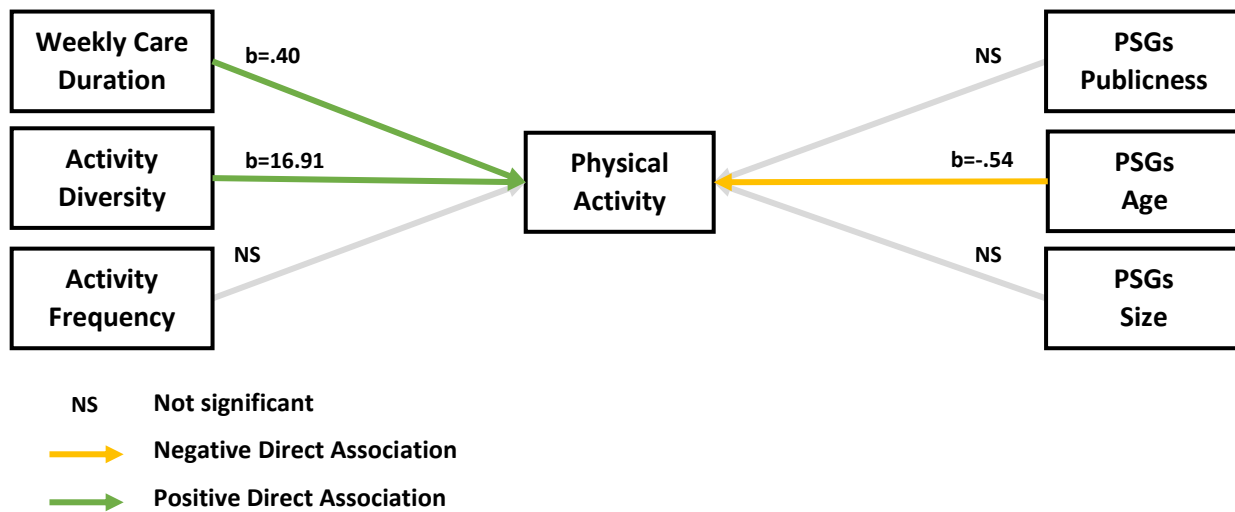
Figure 4-70 Diagram of PSG variables association with physical activity level.

4.3. Depression

As explained in Figures 4-71 and 4-72, this analysis aimed to study PSG ownership correlation with depression level, basing on our literature review, we hypothesize that owner's interaction with PSG would have a positive impact on their mental health. The bivariate and multivariate analyses objective was, therefore, to investigate the veracity of two hypotheses.

H1: PSG ownership is negatively associated with the PHQ-9 depression score

H2: PSG ownership buffers depression score association with neighborhood perception variables.

H3: PSG characteristics are negatively associated with the PHQ-9 depression score.
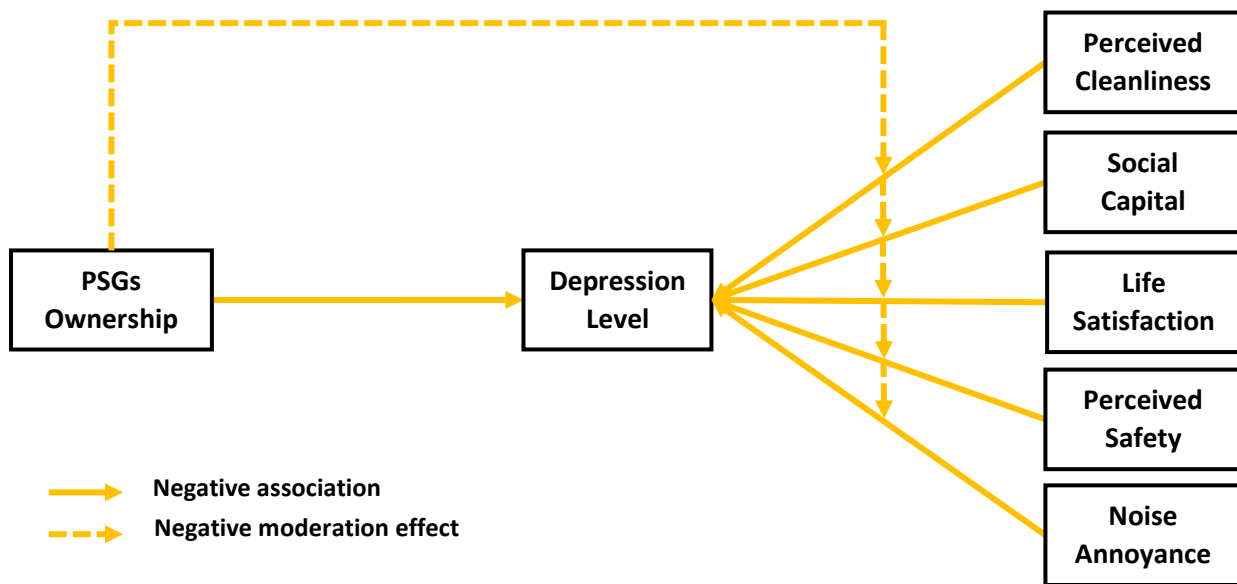
Figure 4-71 Conceptual model of PSG ownership relationship with the PHQ-9 depression score.
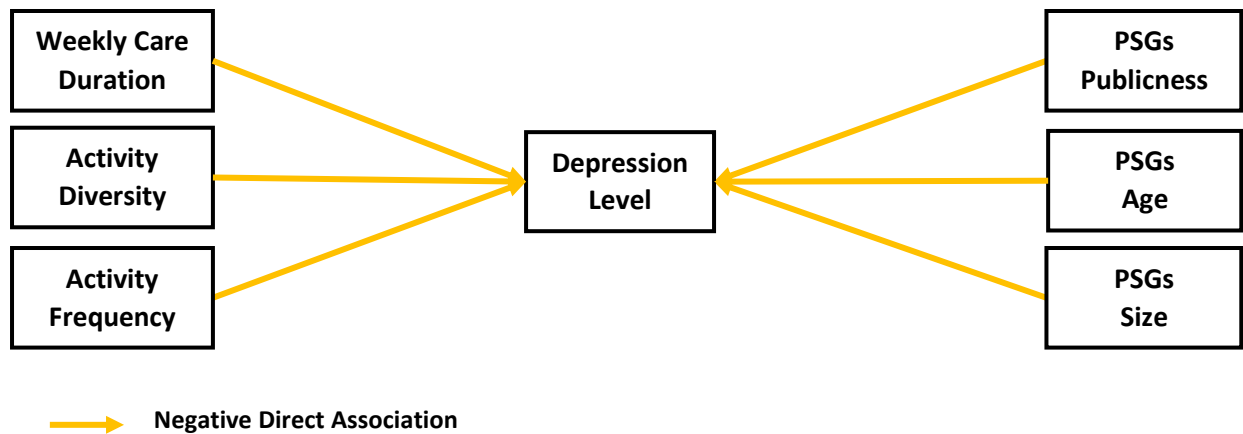
Figure 4-72 Conceptual model of PSG variables relationship with the PHQ-9 depression score.

4.3.1. Bivariate Analysis

We performed bivariate analyses (t-tests and χ^2 tests) to identify significant differences between groups with and without PSG.

As can be seen in Table 4-65, PSG owners had a significantly higher depression score than those with no PSG. For the whole sample, the average depression score is 1.38 (SD=2.22) on a scale of 0–27, which indicates an overall minimal depression (Kroenke and Spitzer 2002). The vast majority of survey participants (52%) reported no depression, while 7.3% of our sample had mild depression, and only 1.3% had moderate depression, lower than the rate in general Moroccan population, which is 26.5% (Moussaoui 2007).

Table 4-65 PHQ-9 depression score

Response	Whole sample	No PSG	With PSG
PHQ-9 depression score	M=1.38; SD=2.221	**M=0.76; SD=1.38**	**M=1.68; SD=2.47**
No depression	201 (52.1%)	**80 (64.5%)**	**121 (46.2%)**
Minimal depression 1-4	152 (39.4%)	**38 (30.6%)**	**114 (43.5%)**
Mild depression 5-9	28 (7.3%)	**6 (4.8%)**	**22 (8.4%)**
Moderate depression 10-14	5 (1.3%)		**5 (1.9%)**

Boldface indicates p < .05 for PSG owners versus nonowners.

Spearman's correlations were calculated for depression score, neighborhood safety, life satisfaction, and social capital. Results showed that for participants without PSG, depression score was significantly correlated only with neighborhood life quality satisfaction ($r =$

-.195; p < .05), there were no significant associations between perceived neighborhood safety and other variables, while neighborhood satisfaction and social capital were significantly associated (*r* = .328= *p* < .001).

Table 4-66 Spearman's Correlation Matrix for Participants without PSG

	1	2	3	4	5	6
1 PHQ-9 depression score	1					
2 Social Capital	-.147	1				
3 Life Satisfaction	**-.195***	**.328***	1			
4 Perceived Safety	-.083	-.003	-.056	1		
5 Noise annoyance	-.137	.136	.065	-.015	1	
6 perceived cleanliness	.018	-.031	**.310***	-.101	-.102	1

***p* < .05; ***p* < .01; ****p* < .001.**

For those with PSG, the PHQ-9 depression score was significantly associated with no other variable. Neighborhood safety, Life quality satisfaction and social capital were all positively associated with each other (p<.001).

Table 4-67 Spearman's Correlation Matrix for PSG owners

	1	2	3	4	5	6
1 PHQ-9 depression score	1					
2 Social Capital	.083	1				
3 Life Satisfaction	-.004	**.443***	1			
4 Perceived Safety	.060	**.279***	**.359***	1		
5 Noise annoyance	-.083	**.198***	**.227***	**.182***	1	
6 perceived cleanliness	-.075	**.359***	**.387***	**.241***	**.165***	1

***p* < .05; ***p* < .01; ****p* < .001.**

For the whole sample, the PHQ-9 depression score was significantly correlated only with PSG ownership (*r* = .198, *p* < .001). PSG ownership was also significantly correlated with Life satisfaction.

Table 4-68 Spearman's Correlation Matrix for the whole sample

	1	2	3	4	5	6	7
1 PHQ-9 depression score	1						
2 PSG ownership	**.198***	1					
3 Social Capital	.006	-.008	1				
4 Life Satisfaction	-.014	**.182***	**.400***	1			
5 Perceived Safety	.031	.011	**.199***	**.268***	1		
5 Noise annoyance	**-.101***	-.026	**.179***	**.179***	**.125***	1	
6 perceived cleanliness	-.055	-.027	**.222***	**.345***	**.137***	.071	1

***p* < .05; ***p* < .01; ****p* < .001.**

4.3.2. Multivariate Analysis

Table 4-69 shows the results of the WLS predicting depression score, stratified by PSG ownership.

As can be seen in m

odel 1, among PSG owners, none of our principal independent variables were significantly associated with depression score.

Table 4-69 Weighted Least square regression explaining depression score (N = 388)

	Model1		Model2		Step3	Model3
	No PSG	**With PSG**	**Step1**			
	b(CI)	**b(CI)**	**b(CI)**		**b(CI)**	**b(CI)**
PSG ownership			**.37** .10/.64	**0.47*** 0.20/0.75	**.56*** .26/.86	
Life satisfaction	**-.84*** -1.14/-.53	.03 -.17/.23	**-.18** -.35/-.01	**-0.21** -0.38/-0.04	**-.22** -.40/-.04	.03 -.17/.23
Perceived safety	-.10 -.43/.23	-.10 -.33/.13	.02 -.18/.22	-0.04 -0.24/0.17	-.02 -.23/.20	.04 -.21/.28
Social capital	.09 -.05/.24	.10 -.08/.28	.05 -.06/.15	0.06 -0.04/0.17	.09 -.02/.20	.01 -.13/.16
Noise annoyance	-.11 -.37/.15	-.18 -.39/.02	-.14 -.28/.01	**-0.16** -0.30/-0.01	-.16 -.36/.05	-.14 -.32/.05
Perceived Cleanliness	-.20 -.47/.07	-.11 -.35/.12	-11 .26/.04	-0.08 -0.23/0.07	**.56*** .26/.86	**.24** .02/.46
Life satisfaction x PSG ownership				**0.49** 0.14/0.84	**.45** .05/.86	
Social capital x PSG ownership					.13 -.08/.33	
Perceived safety x PSG ownership					.08 -.32/.49	
N. annoyance x PSG ownership					.0004 -.30/.30	
P. Cleanliness x PSG ownership					.19 -.09/.47	
Gender (Female)	-.18 -.68/.31	-.30 -.67/.07	-.14 -.43/.14	-0.22 -0.50/0.07	-.23 -.52/.06	-.21 -.60/.18
Age category	.24 -.21/.69	.03 -.33/.38	.09 -.17/.35	0.07 -0.19/0.33	.07 -.20/.34	**-.40** -.72/-.09
PSG publicness						-.10 -.38/.19
PSG size						-.02 -.07/.04
PSG age						.01 -.004/.02

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Weekly care duration						**-.010*** **-.02/-.002**
Activity diversity						-.04 -.39/.30
Activity frequency						.07 -.11/.23
Marital status						
Married	.91 -2.33/4.14	-.19 -1.57/1.19	.07 -1.53/1.67	-0.05 -1.64/1.54	.10 -1.50/1.70	-.52 -2.53/1.49
Widowed	1.50 -2.03/5.04	1.67 -.16/3.51	1.30 -.50/3.10	1.40 -0.38/3.19	1.52 -.28/3.31	.51 -2.06/3.08
Divorced	.21 -3.09/3.52	-.75 -2.37/.88	-.62 -2.24/1.00	-0.64 -2.24/0.96	-.42 -2.05/1.21	.35 -2.71/3.40
Single	.89 -2.34/4.13	-.62 -2.00/.76	-.22 -1.81/1.37	-0.35 -1.93/1.23	-.15 -1.75/1.45	-1.83 -3.84/.18
Education	.13 -.06/.31	.12 -.01/.26	**.16** **.06/.26**	**0.16***** **0.06/0.26**	**.15***** **.05/.25**	**.23***** **.10/.35**
Household size	-.15 -.32/.02	.04 -.07/.15	-.02 -.11/.07	-0.05 -0.14/0.04	-.05 -.14/.04	**.19***** **.09/.29**
Residence duration	-.03 -.05/.00	.01 -.01/.04	-.02 -.03/.00	-0.01 -0.03/0.004	-.02 -.03/.00	**-.03**** **-.06/-.01**
Homeownership	-.48 -1.07/.12	.24 -.18/.65	-.17 -.51/.17	-0.11 -0.44/0.23	-.11 -.45/.23	.42 -.04/.87
Car ownership	.56 -.24/1.36	**-.86**** **-1.47/-.25**	**-.59**** **-1.08/.10**	-0.47 -0.96/0.02	-.44 -.93/.06	**-1.10** **-1.86/-.35**
Constant	57.33	-26.36	**33.39***	28.69	32.15	-2.57
F test	2.939***	4.892***	6.069***	6.263	5.236***	1.482

b: Unstandardized Regression Coefficient; CI: Confidence Interval; *p <.05; **p <.01; ***p <.001.

Among participants with no PSG, an increase of 1 point in life quality satisfaction index was associated with a 0.84-point decrease in depression score (b=-.84, CI=-1.14/-.53), no other variable was significant.

Model 2 shows the results of the hierarchical regression, step 1 with the main effect variables only, and steps 2 and 3 with the addition of interaction terms.

Step 1 shows that PSG ownership was associated with a 0.37-point increase in depression score (b=.37, CI=.10/.64), while a 1-point increase in life quality satisfaction was associated with 0.18 points decrease in depression score (b=-.18, CI=-.35/-.01). This result does not support hypothesis 1, stipulating that PSG ownership is negatively associated with depression score.

Steps 2 and 3 investigates PSG ownership moderation effects on the relationship between depression score on one side and perceived safety, life satisfaction, and social capital on the other

side. Only the interaction term between PSG ownership and life quality satisfaction was found significant (b=.45, CI=.05/.86), the additional variation explained between step 1 and step 2 of the analysis was 1.7% (F(1,341)=7.575, p < .01. R^2 change =.017), which means, as can be seen in Figure 4-73, that for PSG owners, an increase in life satisfaction score had no significant association with depression score. While for nonowners, an increase in life satisfaction score was associated with a decrease in depression score. This result does not support hypothesis 2, stipulating that PSG ownership buffers the relationship between depression score and neighborhood life quality satisfaction.

In Model 3, only weekly care duration was significantly associated with depression score, with one minute increase in care duration associated with 0.01 decrease in depression score (b=-.01, CI=-.02/.002), while a one-minute increase in PSG daily care duration was associated with 0.038 point increase in depression score (b=.038, CI=.01/.06; p<.01). This last result supports hypothesis 3, stipulating that PSG induced daily routines are negatively associated with depression score.
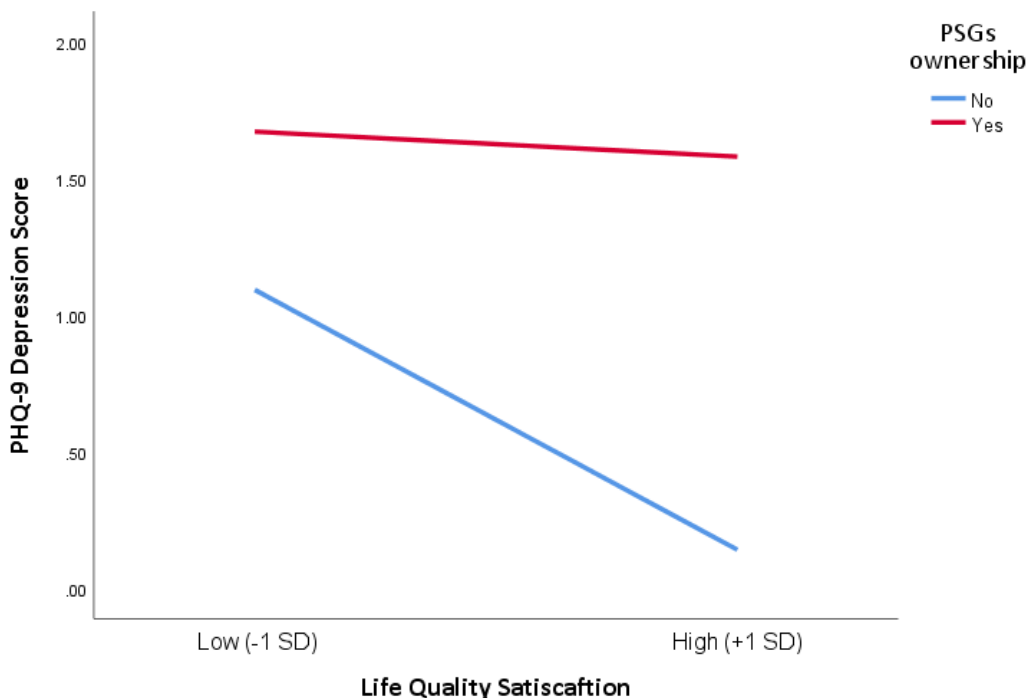
Figure 4-73 Simple slope for PSG ownership moderation of the PHQ-9 depression score – life quality satisfaction. The low value for life quality satisfaction is plotted at 1 SD below the mean, and the high value is plotted at 1 SD above the mean.

4.3.3. Discussion

Understanding the potential impact of PSG, as a low-cost easy-to-implement alternative to formal UGS, on mental health is of great importance in order to generalize the great benefits of UGS on human wellbeing in general.

The analysis of PSG related variables' association with depression score revealed a mostly negative association. The only significant correlation was also negative, indicating that more time spent watering and cleaning PSG was associated with reduced depression levels, which is consistent with previous research findings that suggest interaction with vegetation reduces depression. Curiously, the findings also revealed a strong significant positive association between PSG ownership and higher depression levels. This association was significant even after controlling for life satisfaction, noise annoyance, and neighborhood perceived cleanliness and safety. PSG ownership also had an enhancing moderation effect on the association between life satisfaction and depression. These results are not in line with previous findings that suggest greener neighborhoods are correlated with better mental health, which suggests that despite being green elements, PSG may also have some undesirable effects on its owner's mental health. The association between higher depression scores and PSG ownership found in this research might be related to PSG perception as private property (Figure 4-74), suggesting a connection with territoriality.

We suggest three possible explanatory hypotheses to these findings:

a) PSG ownership cause people to have higher depression levels: PSG perception as a private property present outside of owners' area of control, in one of Tangier's most dangerous neighborhoods (La Cava et al. 2012), may have caused the depression level difference between the two groups of PSG owners and nonowners. Low perceived control was associated with higher depression and stress levels (Wardle et al. 2004), looking after the PSG in an uncontrolled environment may be a source of stress. The fact that neighborhood safety, social capital, and neighborhood satisfaction were all significantly correlated in the bivariate analysis only for PSG owners' group, suggests that PSG owners are more sensitive to their neighborhood's characteristics than others.
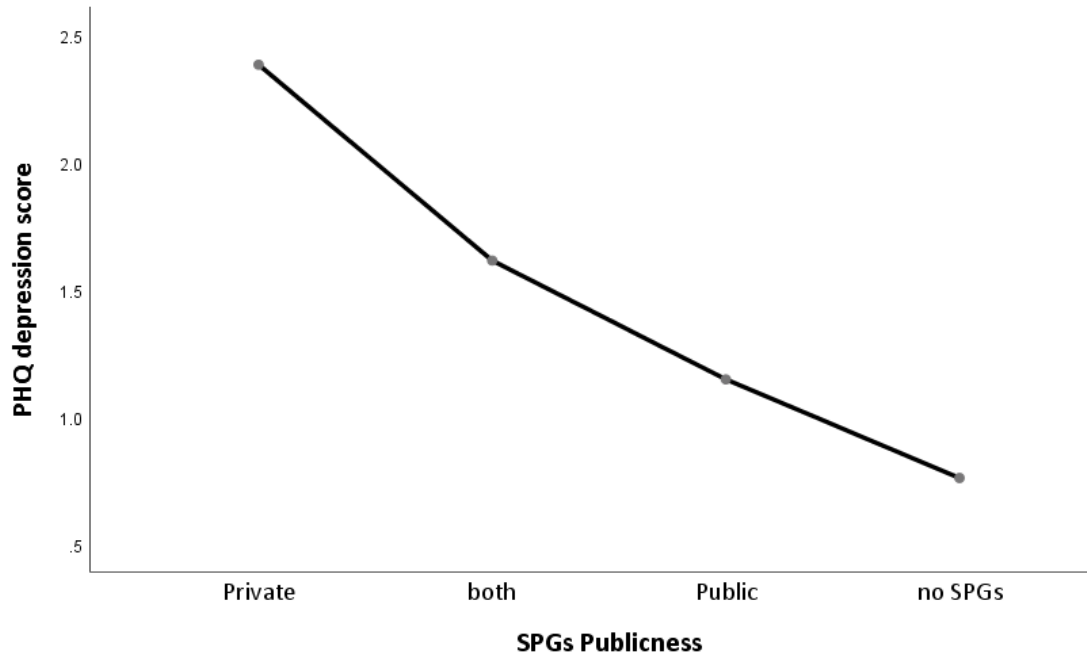
Figure 4-74 Depression score by PSG publicness

b) People with higher depression levels are more likely to have a PSG than others: following the P-E fit theory and Golant's (Golant 2011) theoretical model of residential normalcy may help explain this hypothesis. The low per capita UGS in the neighborhood affected specific resident's psychological well-being, triggering higher depression scores. Those resident's reaction was to modify their neighborhoods to become more fit to their expectations using PSG as a coping mechanism. PSG ownership can, therefore, be considered an assimilative strategy, according to Golant's theory.

c) PSG owners are trying to claim, or reclaim, their front doors as their territories using PSG: PSG connection with territoriality was already established in previous research (Ikkai, SHI MIZU, et al. 1999; Masuda and Hino 2018; TAKAHASHI, ITOH, and SHIMOMURA 2005; 青木義次 and 湯浅義晴 1993), while defeat and territorial loss are associated to an increase in depression levels (Rohde 2001). PSG ownership might be a sign of territorial dispute between neighbors or between locals and outsiders.

To conclude, PSG ownership might have a harmful effect on the owner's mental health, which suggest more research be done to ascertain the validity of our findings. Increasing the perceived

publicness of PSG, by encouraging the creation of shared or community PSG, owned and cared for by multiple families instead of one, might dissipate PSG positive association with depression. More research is needed in order to verify our results. For depression, score hypotheses 1 and 2 were rejected, while hypothesis 3 was confirmed as explained in Figures 4-75 and 4-76.
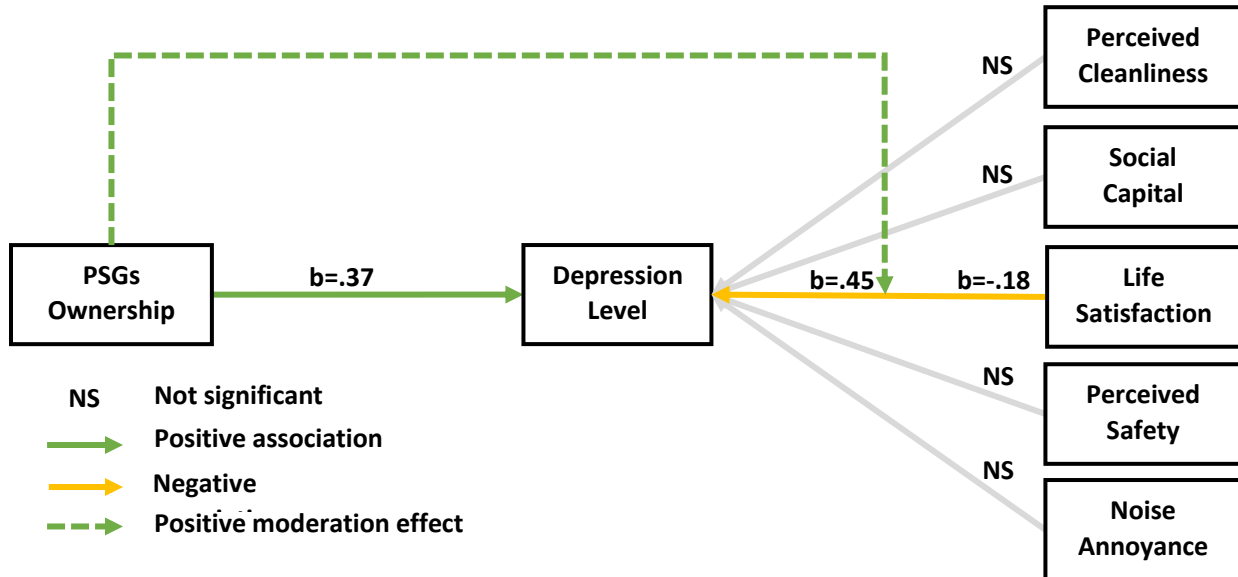
Figure 4-75 Diagram of PSG ownership association with PHQ-9 depression score.
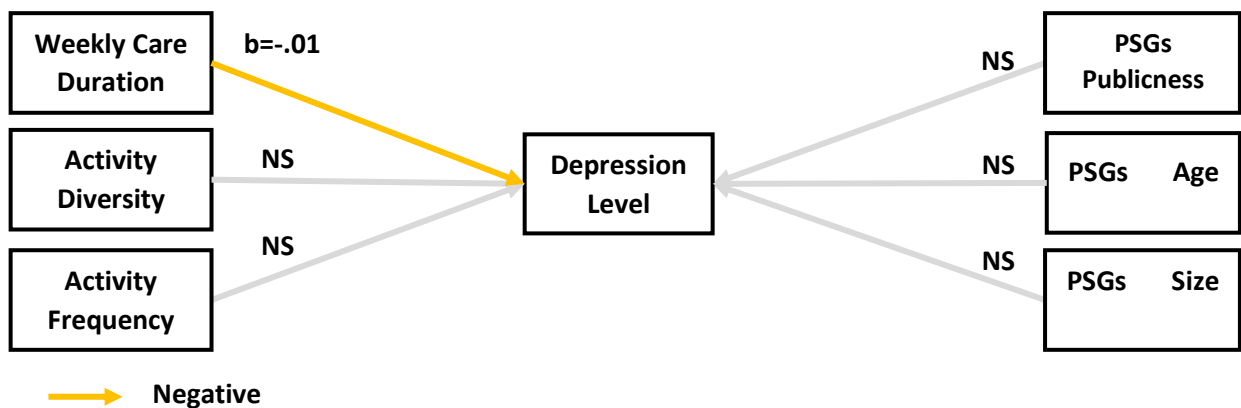
Figure 4-76 Diagram of PSG variables association with PHQ-9 depression score.

4.4. Summary: Health

Our findings (Figures 4-76 and 4-77) suggest that PSG ownership's negative association with mental health and physical activity cannot be explained by its nature as a green element, as more interaction with PSG was associated with lower depression and more extended physical activity. PSG character as private property and a territorial tool offers a better explanation to these findings, especially that PSG owners felt significantly less safe in their neighborhoods than nonowners. Overall, the increase in depression score associated with PSG ownership is minimal (0.37 in an index range of 0-27), PSG ownership may, therefore, not be considered as a significant risk factor.

These results suggest exerting caution before encouraging PSG ownership in dense disadvantaged neighborhoods. PSG might be amplifying the impact of negative neighborhood characteristics on owners. As we have seen previously, PSG ownership was also negatively associated with perceived neighborhood safety. Further research is needed to ascertain these results and study PSG association with health, but in light of our results, experimental designs would not be ethically appropriate.
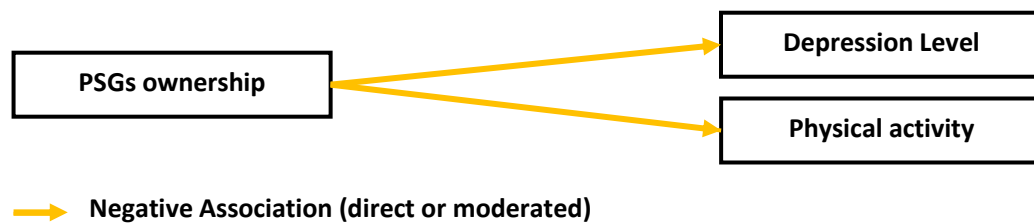
Figure 4-77 Diagram explaining the type of association (direct and by moderation effect) between PSG ownership and health variables.
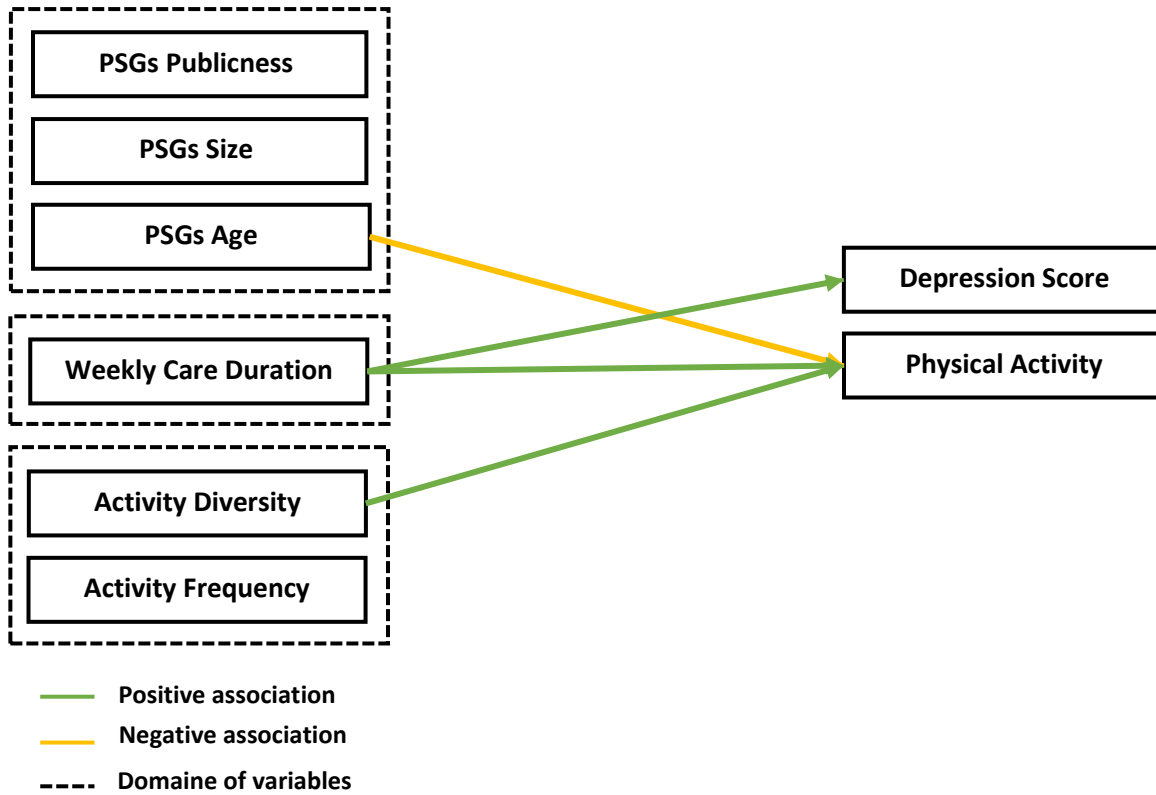
Figure 4-78 Diagram explaining the type of association between PSG characteristics and health variables.

5. Discussion of the analysis results

The objective of the first survey was to investigate the relationship between PSG ownership and three domains of variables, neighborhood perception, prosocial behaviors related to neighborhood maintenance, and human health. We hypothesized that, because formal UGS had a positive association with these variables (Bogar and Beyer 2016; Guéguen and Stefan 2016; Kuo et al. 1998; Van Renterghem and Botteldooren 2016), PSG as an informal green space and as a tool delimiting household territory in residential neighborhoods, would potentially be correlated in the same way with our measures.

The collected data was tested to identify the direct correlation between PSG ownership and our variables, and for the presence of moderation with our principal covariant. In Table 4-70, we summarized PSG ownership and related characteristics direct associations and moderation effect (for PSG ownership only).

Table 4-70 Variables association with PSG ownership

Response	Association with PSG ownership	Association with PSG characteristics
Life satisfaction score	Significantly associated with increase in life satisfaction score. **Moderation:** Antagonized perceived safety association with life satisfaction.	**Positive association:** More frequent recreational activities increase life satisfaction score
Social capital score	No significant direct associations. No Moderation detected.	**Positive association:** Increasing plant pots number increased social capital score.
Perceived Cleanliness	No significant direct associations. **Moderation:** Enhanced social capital score' association with perceived cleanliness.	**Positive association:** increasing plant pots and weekly care frequency increased social capital **Negative association:** Increasing daily care duration decreased social capital
Perceived Safety	Significantly associated with decrease in perceived safety. **Moderation:** Enhanced life satisfaction score' association with perceived safety.	**Positive association:** increased PSG weekly care duration increased safety perception **Negative association:** all other variables (not significant).
Noise annoyance	No significant direct associations. **Moderation:** Antagonized life satisfaction score and perceived safety's association with less noise annoyance.	**Negative association:** increased PSG perceived publicness associated with increased noise annoyance
Intention to move	No significant direct associations. No Moderation effects.	**Negative association:** more diversity in recreational activities done next to PSG

		increased intention to move out of the neighborhood
Protection responsibility	No significant direct associations. No Moderation detected.	No significant associations.
Areas to protect	No significant direct associations. **Moderation:** Antagonized perceived safety' association with areas to protect. Antagonized life satisfaction' association with areas to protect.	**Negative association:** PSG size and age both decreased areas to protect.
Cleaning responsibility	Significantly associated with increased neighborhood cleaning responsibility. No Moderation effects.	**Positive association:** more diversity in recreational activities done next to PSG increased cleaning responsibility.
Areas to clean	Significantly associated with responsibility to clean all the street, but not with cleaning all the neighborhood No Moderation effects.	**Positive association:** more diversity in recreational activities done next to PSG and increased PSG weekly care duration increased responsibility to clean all the street at least.
Physical activity	No significant direct associations. **Moderation:** Antagonized social capital association with weekly walking duration.	**Positive association:** increased weekly care duration and recreational activities diversity increased weekly walking duration. **Negative association:** PSG age decreased weekly walking duration.
PHQ-9 Depression score	Significantly associated with increased depression score. **Moderation:** Buffered life satisfaction association depression score.	**Positive association:** increased PSG perceived publicness decreased depression. **Negative association:** Daily care duration increased depression score.

In general, PSG owners were more sensitive to their living environment characteristics than nonowners. PSG ownership direct and moderated significant associations with our variables were positive to mixed, except for health variables where the association was negative only. Curiously the most influential association between PSG ownership and our variables was with depression and life satisfaction scores, PSG owners had at the same time higher life satisfaction levels (b=.36) and higher depression levels (b=.37) compared to nonowners. The low perceived safety may explain this result among PSG owners (56% less than nonowners), which may be causing higher stress levels, an effect that is attenuated by the high life satisfaction. Overall, the increase in depression score associated with PSG ownership is minimal (0.37 in an index range of 0-27). PSG ownership may, therefore, not be considered as a significant risk factor.

The majority of the significant associations between PSG related variables and our DVs were positive (10 out of 16). PSG physical characteristics (PSG size and age), accounted for half the negative correlations, which suggests that a change in PSG characteristics may inverse the sense of this association.

Increased interaction with PSG, in terms of optional recreational activities or necessary maintenance daily routines, were positively associated with our three domains of variables.

These results are consistent with existing literature linking GS with improved neighborhood perception, behavior, and health. Suggesting that encouraging PSG ownership may indeed have the same benefits as formal UGS, however, in order to investigate the causality relations further, experimental studies are necessary.

All the significant associations are summarized in Figures 4-79, 4-80, and 4-81.
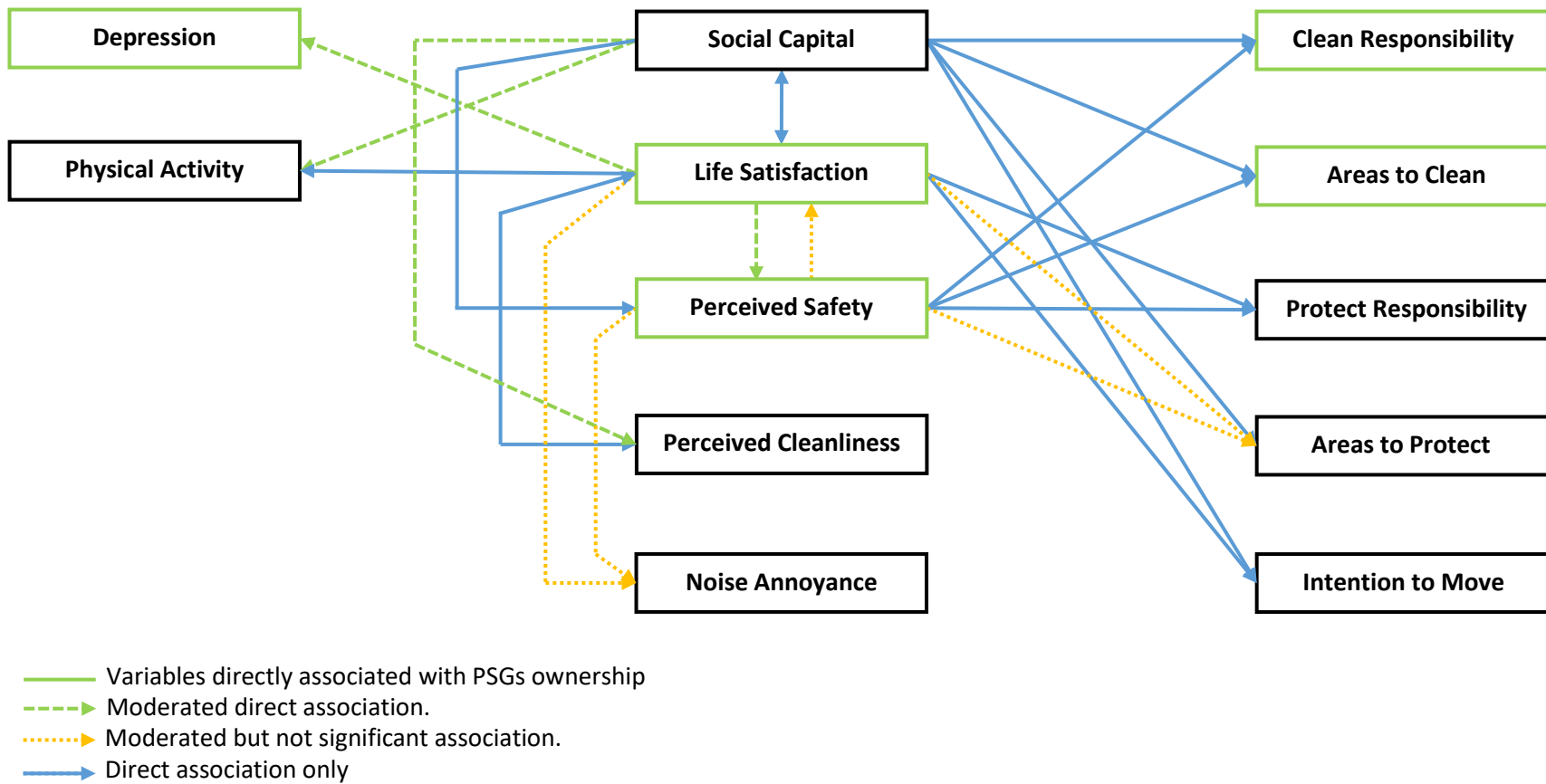
Figure 4-79 Diagram summarizing PSG ownership impact on significant direct and moderated associations between variables.
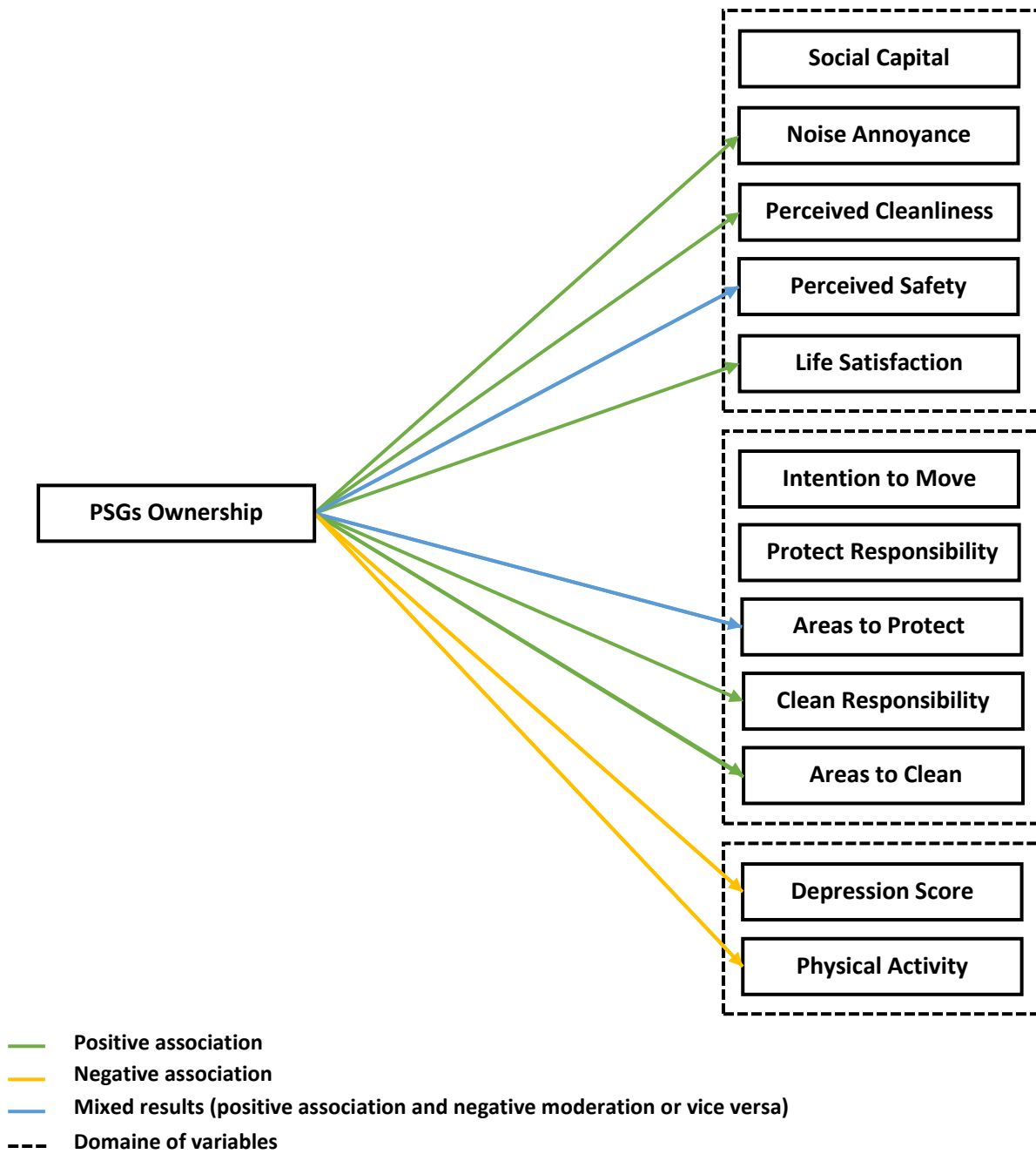
Figure 4-80 Diagram explaining the type of association (direct and moderation effect) between PSG ownership and studied variables.
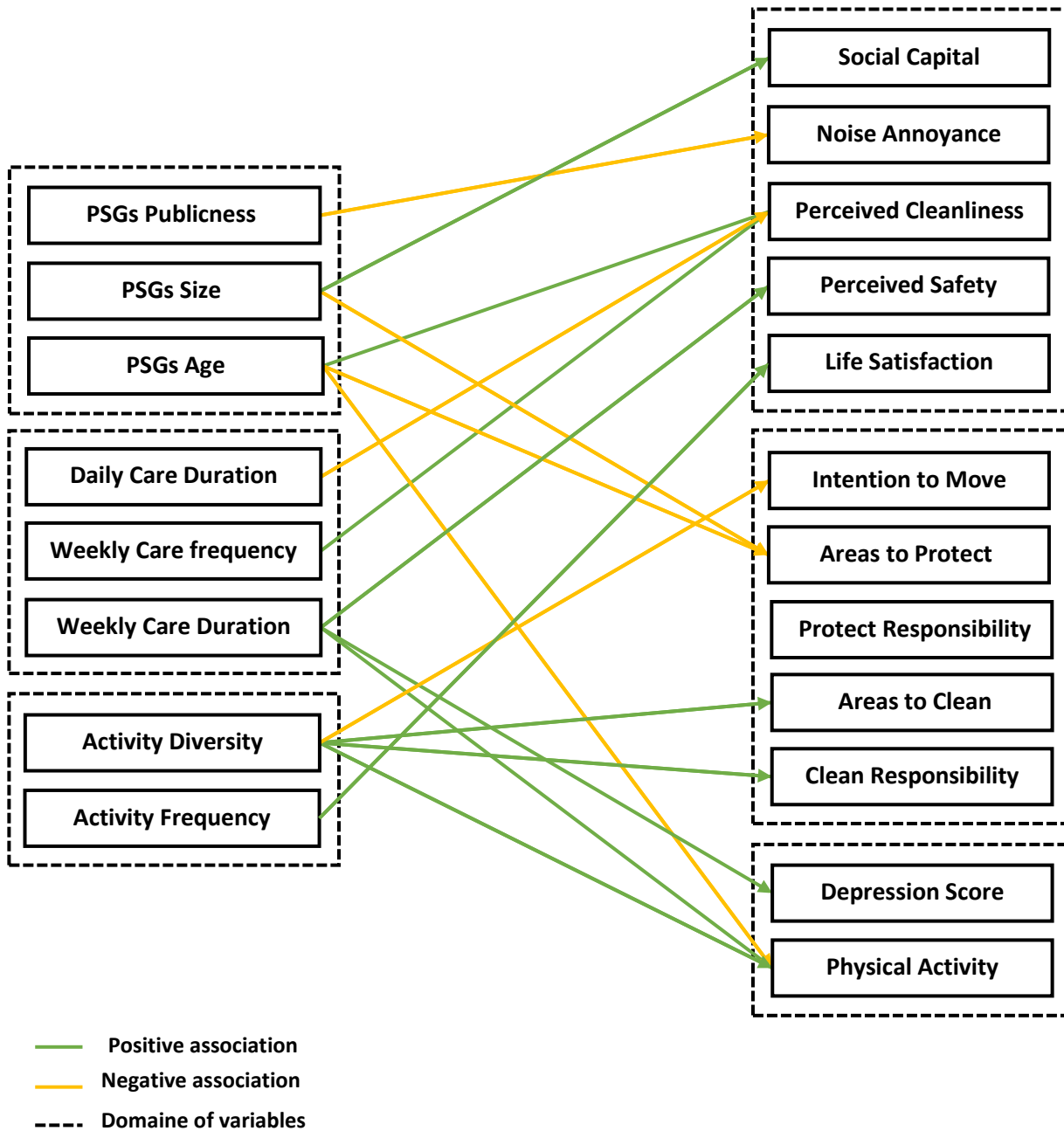
Figure 4-81 Diagram explaining the type of association between PSG characteristics and studied variables.

Chapter 5 : field experiment study results

1. Introduction

The purpose of this second study is to compare neighborhood perception of our two streets with and without PSG in order to identify the potential association between PSG presence and outsider's perception of neighborhood physical and social characteristics, controlling for demographic variables (age, gender, household size, marital status). In order to do so, we first conducted bivariate analyses to show the association patterns among key variables, We then conducted ordinal or binary logistic regressions (depending on the type of dependent variable) using SPSS 25. The analysis results were used to validate or reject hypothesis 4 (Figure 5-1):

Hypothesis 4: PSG presence on neighborhood streets is positively associated with outsider's neighborhood perception.
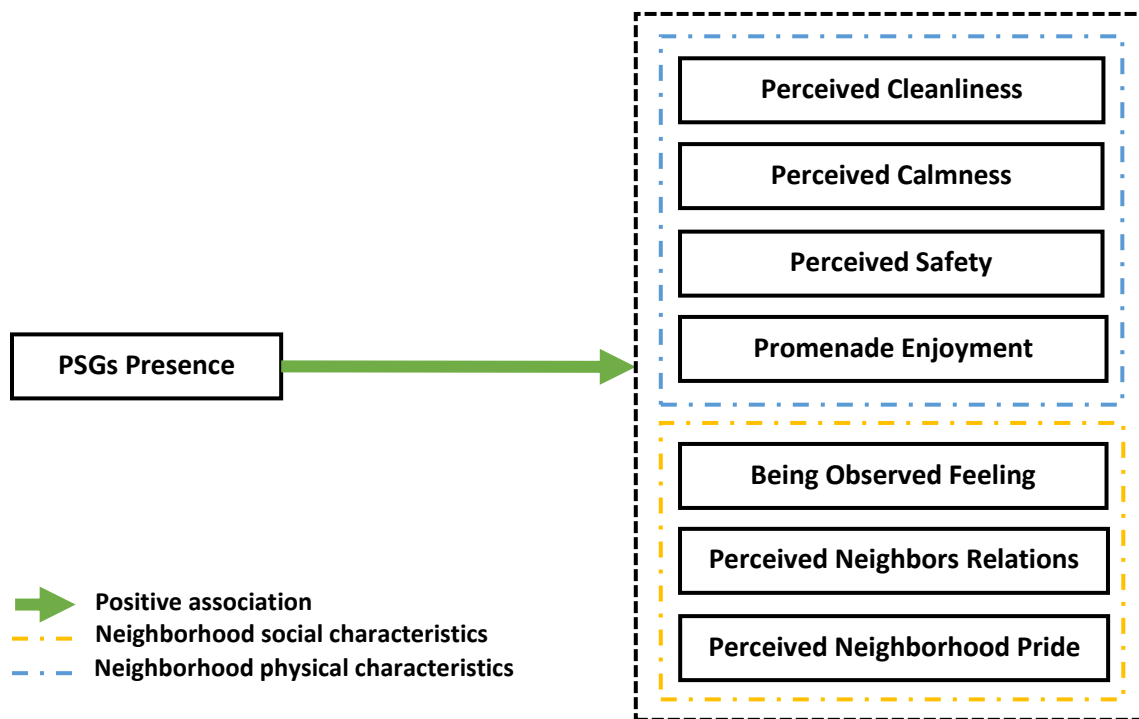
Figure 5-1 Diagram of PSG presence on neighborhood streets hypothesized association with outsider's perception of its physical and social characteristics.

2. Demographic characteristics

The descriptive characteristics of our sample are shown in Table 5-1. The majority of the subjects are Male (88.2%). The average age was 2.20 (SD=0.48), which is between 18 and 35 years old, the average level of education was 3.78 (range 0–6; SD=1.11), or between high school and bachelor, the average household size was 4.92 (SD = 1.55).

Table 5-1 Demographic information of experiment participants (N=51)

Response	N (%)
Age group	
Less than 18	2 (2%)
18-35	37 (72.5%)
36-50	12 (23.5%)
Marital status	
Single	36 (70.6%)
Married	14 (27.5)
Gender	
Male	45 (88.2%)
Female	6 (11.8%)
Occupation	
Student	22 (43.1%)
Employed	28 (54.9%)
Housewife	1 (2%)
Education	M = 3.78, SD = 1.11
Vocational training	11 (21.6%)
High school	5 (9.8%)
Bachelor	19 (37.3%)
Masters	16 (31.4%)
Household size	M = 4.92, SD = 1.55
Car ownership	
Yes	32 (62.7%)
No	19 (37.3%)

Boldface indicates *p* < .05 for PSG owners compared to those with no PSG.

3. Bivariate Analysis

As can be seen in Table 5-2, the experiment participants rated the two streets as being "clean" or "very clean," the variables perceived cleanliness and calmness, were designed to be ordinal, but the results show that they are instead dichotomous, as they contain only two categories. We will, therefore, use an ordinal regression. The vast majority of the survey participants (97%) felt safe or very safe in their neighborhoods.

Table 5-2 Descriptive Information of principal variables

Response	Whole sample	No PSG	With PSG
Cleanliness	M=4.86, SD=.34	M=4.86, SD=.34	M=4.86, SD=.34
Clean	14 (13.7%)	7 (13.7%)	7 (13.7%)
Very clean	88 (86.3%)	44 (86.3%)	44 (86.3%)
Calmness		M=4.49, SD=.50	M=4.55, SD=.50
Calm	49 (48%)	26 (51%)	23 (45.1%)
Very calm	53 (52%)	25 (49%)	28 (54.9)
Safety		**M= 4.08, SD=.52**	**M=4.33, SD=.47**
Not safe	1 (1%)	1 (1%)	
Neutral	2 (2%)	2 (3.9%)	
Safe	74 (74%)	40 (78.4%)	34 (66.7%)
Very safe	25 (25%)	8 (15.7%)	17 (33.3%)
Feeling observed		M= 2.86, SD=.89	M=2.98, SD=.88
Not observed	44 (43.1%)	24 (47.1%)	20 (39.2%)
Neutral	22 (21.6%)	10 (19.6%)	12 (23.5%)
observed	36 (35.3%)	17 (33.3%)	19 (37.3%)
Promenade enjoyment		**M=3.76, SD=.68**	**M=4.08, SD=.33**
Didn't enjoy	6 (5.9%)	6 (11.8%)	
Neutral	2 (2%)	1 (2.0%)	1 (2.0%)
Enjoyable	88 (86.3%)	43 (84.3%)	45 (88.2%)
Very enjoyable	6 (5.9%)	1 (2.0%)	5 (9.8%)
Belonging pride		**M=3.69, SD=.51**	**M=3.9, SD=.53**
Neutral	27 (26.5%)	17 (33.3%)	10 (19.6%)
Proud	69 (67.6%)	33 (64.7%)	36 (70.6%)
Very Proud	6 (5.9%)	1 (2.0%)	5 (9.8%)
Neighbors relationship		**M=3.24, SD=.51**	**M=3.47, SD=6.44**
Neutral	72 (70.6%)	41 (80.4%)	31 (60.8%)
Good	24 (23.5%)	8 (15.7%)	16 (31.4%)
Very good	6 (5.9%)	2 (1%)	4 (7.8%)

Boldface indicates *p* < .05 for PSG owners compared to those with no PSG.

The bivariate analyses (t-tests and χ^2 tests) used to identify significant differences in between groups with and without PSG (Table 5-1), revealed that There were no significant differences

between the rating of the two streets in terms of cleanliness, calmness, or feeling of being oserved. However, streets with PSG were rated as safer and more enjoyable, with neighbors being perceived as having better relationships and feeling prouder of their neighborhood.

We calculated Spearman's correlations for our key variables, PSG presence, street cleanliness, calmness safety, promenade enjoyment, neighbor's relationship, and belonging pride.

For streets with no PSG (Table 5-3), neighborhood perceived cleanliness was significantly associated only with neighborhood calmness, perceived safety was significantly associated with feeling of being observed and promenade enjoyment. And residents' pride was associated with promenade enjoyment and quality of resident's relations. All significant correlations were positive.

Table 5-3 Spearman's correlation for streets without PSG

	1	2	3	4	5	6	7
1 Cleanliness	1						
2 Calmness	**.391****	1					
3 Safety	.078	.141	1				
4 Feeling observed	.182	.180	**.328***	1			
5 Promenade enjoyment	.162	-.021	**.405****	.169	1		
6 Residents pride	.088	-.080	.047	-.040	**.433****	1	
7 Residents relations	.196	.029	-.117	-.040	.141	**.290***	1

*p < .05; **p < .01; ***p < .001.

For streets with PSG (Table 5-4), residents perceived relations with perceived safety and feeling of being monitored, all other associations were not significant.

Table 5-4 Spearman's correlation for streets with PSG

	1	2	3	4	5	6	7
1 Cleanliness	1						
2 Calmness	.211	1					
3 Safety	-.201	.056	1				
4 Feeling observed	.120	-.023	.254	1			
5 Promenade enjoyment	-.076	.211	.207	.208	1		
6 Residents pride	.027	.124	.124	.067	.155	1	
7 Residents relations	.103	-.047	**.278***	**.307***	.233	.198	1

*p < .05; **p < .01; ***p < .001.

For the whole sample (Table 5-5), PSG presence was significantly correlated with perceived safety, promenade enjoyment, resident's neighborhood pride, and perceived quality of the resident's relationship. Neighborhood perceived cleanliness was significantly associated only with neighborhood calmness. Perceived safety was also significantly associated with feeling of being monitored and promenade enjoyment. Residents' pride, promenade enjoyment, and perceived resident's relationship were all significantly associated with each other. All significant correlations were positive, except for PSG presence association with promenade enjoyment and residents' pride.

Table 5-5 Spearman's correlation for both streets

	1	2	3	4	5	6	7	8
1 PSG presence	1							
2 Cleanliness	.000	1						
3 Calmness	.059	**.301****	1					
4 Safety	**.240***	-.069	.113	1				
5 Feeling observed	-.068	.152	.083	**.297****	1			
6 Promenade enjoyment	**-.268****	.053	. 103	**.335****	**.199***	1		
7 Residents pride	**-.197***	.053	.028	.121	.016	**.337****	1	
8 Residents relations	**.213***	.138	.000	.154	.161	**.228***	**.263****	1

*p < .05; **p < .01; ***p < .001.

4. Multivariate Analysis

The objective of the multivariate analysis is not to study the whole models, but to assess the associations between our dependent variable and the main independent variables, adjusting for control variables. This procedure is required in order to remove their effects from the equation. None of our DVs violated the assumptions for their respective analysis.

4.1. perceived Neighborhood cleanliness

Perceived cleanliness has only two valid levels "clean" and "very clean"; we will, therefore, use a binary logistic regression test. Table 5-6 shows the results of the binary logistic regression predicting neighborhood cleanliness. Results showed that none of our independent variables were significant. In the case of perceived cleanliness, hypothesis 4 was rejected.

Table 5-6 Binary Logistic Regression explaining perceived cleanliness by outsiders (N = 102)

	Fit	P value	OR	95% CI
PSG presence		1.000	1.000	.311/3.216
Gender		.160	.318	.064/1.574
Age		.283	.433	.094/1.996
Education		.188	.637	.326/1.245
Household size		.289	.801	.532/1.207
Single		.289	.369	.059/2.329
Constant		.015	5923.012	
χ2 test	6.300			
Nagelkerke R2	.110			

OR: Odds ratio; Cl: 95% Confidence Interval.

4.2. perceived Neighborhood calmness

Perceived calmness has only two valid levels "calm" and "very calm"; we will, therefore, use a binary logistic regression test. Table 5-7 shows the results of the binary logistic regression predicting neighborhood calmness. Results showed that none of our independent variables were significant. In the case of perceived calmness hypothesis 4 was rejected.

Table 5-7 Binary Logistic Regression explaining perceived calmness by outsiders (N = 102)

	Fit	*P* value	*OR*	95% *CI*
PSG presence		.688	1.175	.535/2.582
Gender		.806	.857	.250/2.940
Age		.710	1.192	.472/3.011
Education		.878	.971	.669/1.410
Household size		.629	.934	.710/1.230
Single		.581	1.344	.470/3.842
Constant		.940	.866	
χ^2 test	.676			
Nagelkerke R^2	.009			

OR: Odds ratio; Cl: 95% Confidence Interval.

4.3. perceived Neighborhood safety

Perceived safety is an ordinal variable. The model did not violate the assumption of proportional odds. Therefore we used an ordinal logistic regression. Table 5-8 shows the results of the ordinal logistic regression predicting neighborhood safety.

Table 5-8 Ordinal Logistic Regression explaining perceived safety by outsiders (N = 102)

	Fit	*P* value	*OR*	95% *CI*
PSG presence		**.021**	**3.274**	**1.196/8.961**
Feeling observed		**.001**	**2.796**	**1.491/5.246**
Cleanliness		.190	.390	.095/1.593
Gender		.954	.954	.195/4.677
Age		.555	.699	.214/2.289
Education		.207	1.353	.846/2.162
Household size		.102	1.329	.945/1.868
Single		**.044**	**.251**	**.065/.961**
χ^2 test	21.288**			
Nagelkerke R^2	.255			

OR: Odds ratio; CI: 95% Confidence Interval.

Results show only PSG presence, feeling of being monitored, and marital status were significant, with the presence of PSG associated with 3 times increased likelihood of perceiving the neighborhood safer (OR = 3.27, CI = 1.19/8.96). One level increase in feeling of being observed was associated with 2.8-times increased likelihood of perceiving the neighborhood as safer (OR = 2.79, CI = 1.49/5.24). Moreover, being single was associated with a 75% increased likelihood of perceiving the neighborhood as safer compared to being married (OR = .25, CI = .06/.96). In the case of perceived safety hypothesis, 4 was validated.

4.4. Feeling of being observed

Feeling observed is an ordinal variable; the model did not violate the assumption of proportional odds. Therefore we used an ordinal logistic regression. Table 5-9 shows the results of the ordinal logistic regression predicting feeling observed.

Table 5-9 Ordinal Logistic Regression explaining feeling observed by outsiders (N = 102)

	fit	*P* value	*OR*	95% *CI*
PSG presence		.651	.833	.378/1.836
Safety		**.002**	**4.063**	**1.674/9.859**
Cleanliness		.120	2.528	.786/8.128
Gender		.334	.547	.161/1.861
Age		**.040**	**2.668**	**1.047/6.798**
Education		.344	.838	.581/1.209

	fit	P value	OR	95% CI
Household size		.090	.788	.599/1.038
Single		.055	2.867	.976/8.421
χ^2 test	20.106*			
Nagelkerke R^2	.207			

OR: Odds ratio; CI: 95% Confidence Interval; *p <.05; **p <.01; ***p <.001.

Results show only Perceived safety and age category were significant. With one level increase in perceived safety associated with 4-times increased likelihood of feeling observed (OR = 4.06, CI = 1.67/9.85), and one category increase in age-associated with 2.6 times increased likelihood of feeling observed (OR = 2.66, CI = 1.04/6.79). In the case of feeling of being monitored, hypothesis 4 was rejected.

4.5. Promenade enjoyment

Promenade enjoyment is an ordinal variable; the model did not violate the assumption of proportional odds. Therefore, we used an ordinal logistic regression. Table 5-10 shows the results of the ordinal logistic regression predicting promenade enjoyment.

Table 5-10 Ordinal Logistic Regression explaining promenade enjoyment by outsiders (N = 102)

	fit	P value	OR	95% CI
PSG presence		**.047**	**5.174**	**1.024/26.156**
Safety		**.003**	**9.451**	**2.144/41.665**
Cleanliness		.825	1.245	.179/8.644
Calmness		.268	2.263	.534/9.588
Gender		.959	.947	.121/7.435
Age category				
Less than 18		.604	2.566	.073/89.985
18-35		.059	5.481	.939/32.011
Education		.499	1.228	.677/2.226
Household size		.110	1.460	.918/2.323
Single		**.048**	**.147**	**.022/.985**
χ^2 test	**29.478****			
Nagelkerke R^2	.384			

OR: Odds ratio; CI: 95% Confidence Interval; *p <.05; **p <.01; ***p <.001.

Results show that only PSG presence, neighborhood safety, and marital status were significant. Promenade in streets with PSG was 5 times more likely to be perceived enjoyable than

promenade in streets with no PSG (OR = 5.177, CI = 1.02/26.156). One level increase in perceived safety was associated 9.4 times increase in the likelihood of rating the promenade as enjoyable (OR = 9.45, CI = 2.144/41.665), and being single was associated with an 83% decrease in the likelihood of rating the promenade as enjoyable compared with being married (OR = .14, CI = **.022/.985**). In the case of perceived safety, hypothesis 4 was validated.

4.6. Neighbors relationship quality

Neighbors' relationship is an ordinal variable; the model did not violate the assumption of proportional odds. Therefore, we used ordinal logistic regression. Table 5-11 shows the results of the ordinal logistic regression predicting promenade enjoyment.

Table 5-11 Ordinal Logistic Regression explaining perceived neighbors' relations quality (N = 102)

	fit	*P* value	*OR*	95% *CI*
PSG presence		**.045**	**2.666**	**1.021/6.959**
Safety		.231	1.850	.676/5.060
Cleanliness		.171	3.398	.590/19.577
Calmness		.654	.804	.310/2.088
Gender		.739	.777	.176/3.430
Age category		.688	1.240	.434/3.539
Education		.278	.793	.522/1.205
Household size		.718	1.060	.771/1.458
Single		.594	.722	.218/2.389
χ^2 test	**11.370****			
Nagelkerke R^2	.139			

OR: Odds ratio; CI: 95% Confidence Interval; *p <.05; **p <.01; ***p <.001.

Results show that only PSG presence was significant. Neighbors in streets with PSG were 2.66 times more likely to be perceived as having good relationships than neighbors in streets with no PSG (OR = 2.66, CI = 1.02/6.95). For neighbors' perceived safety hypothesis 4 was validated.

4.7. Neighbors belonging pride

Neighbors relationship is an ordinal variable, the test of parallel lines was significant; however, the analysis of the cumulative dummy variables coded from the variable neighbor's pride revealed that the assumption of proportional odds was not violated. Therefore we used an

ordinal logistic regression. Table 5-12 shows the results of the ordinal logistic regression predicting neighbors belonging pride.

Table 5-12 Ordinal Logistic Regression explaining perceived belonging pride by outsiders (N = 102)

	fit	*P* value	*OR*	95% *CI*
PSG presence		**.025**	**2.788**	**1.137/6.832**
Cleanliness		.375	1.812	.488/6.730
Calmness		.811	1.117	.451/2.766
Gender		.061	4.179	.934/18.695
Age category		.953	.970	.354/2.658
Education		.665	1.094	.729/1.643
Household size		.359	1.153	.851/1.562
Single		.437	1.571	.502/4.912
χ^2 test	11.203			
Nagelkerke R^2	.135			

OR: Odds ratio; CI: 95% Confidence Interval; *p* <.05; **p* <.01; ***p* <.001.

Results show only PSG presence was significant. Neighbors in streets with PSG were 2.78 times more likely to be perceived as having more belonging pride than neighbors in streets with no PSG (OR = 2.78, CI = 1.13/6.83). For perceived belonging pride, hypothesis 4 was validated.

4.8. Conclusion

Our findings indicate that encouraging PSG ownership may have a positive impact on outsiders' perception of neighborhood physical and social components. These results suggest a very promising application for PSG in improving neighborhood reputation and the destigmatization of disadvantaged populations. PSG function as a cue of care that might induce the feeling of being observed on outsiders seems to have no effect on our subjects.

Further research is needed to ascertain these results using a bigger sample size and more rigorously controlled experimental designs, as our results may have been affected by the differences in the physical characteristics of the two studied streets. we tried to rule out this possibility by choosing two similar parkours as much as we could, but this possibility cannot be ruled out completely.
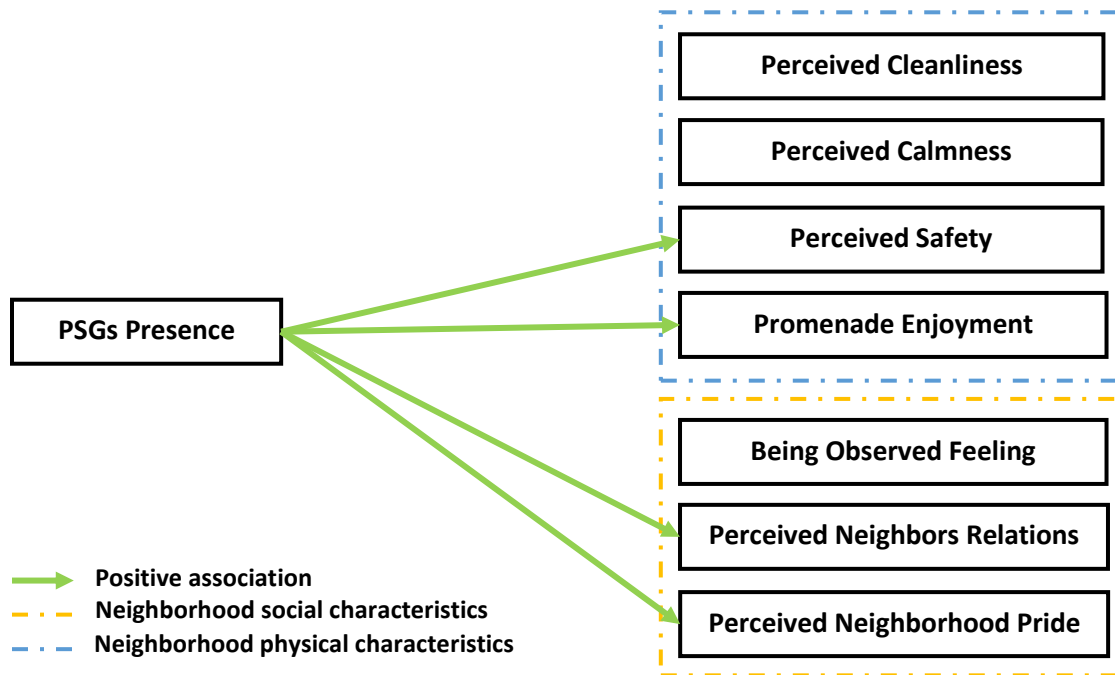
Figure 5-2 Diagram explaining neighborhood perception association with PSG presence.

Chapter 6 : Conclusion

1. Comparison between Locals' and outsiders' neighborhood perception

Understanding the impact of PSG presence on neighborhood and neighbor's perception by outsiders is of great importance. As a private property unlawfully occupying the public ground, PSG could be perceived as a sign of disorder, which was associated in previous studies with racial prejudice, and may stigmatize neighborhood dwellers (Sampson and Raudenbush 2004). From another perspective PSG presence, as an informal UGS, can increase neighborhood greenery and territoriality significantly, which may lead to streets to be perceived cleaner, safer, calmer, and in general, more enjoyable. In turn, this might lead to a destigmatization and improved perception of local populations by outsiders, and even have an economic impact on locals by increasing housing prices (Beautiful 2016; Buonanno, Montolio, and Raya-Vílchez 2013).

The promenade experiment had two main objectives; first, to compare local and outsiders' neighborhood perception, and second, to study the potential links, existing between PSG presence in neighborhood streets and local's perception.

As shown in Table 6-1, PSG ownership significant associations with neighborhood perceived characteristics were mixed, positive, and negative, while PSG presence on neighborhood streets had only positive associations with studied variables.

Table 6-1 Comparison between outsider's and insider's neighborhood perception

Response	insiders	outsiders
Cleanliness	PSG ownership was not significantly directly correlated with neighborhood cleanliness, but PSG ownership moderated cleanliness association with social capital.	PSG presence had no significant association with street cleanliness rating.
Safety	PSG owners were 56% less likely to perceive their neighborhoods as safe/ very safe compared to those with no PSG. PSG ownership also enhanced the perceived safety - life satisfaction association.	Streets with PSG were perceived 3 times safer than streets with no PSG.
Noise annoyance (Calmness)	PSG ownership was not significantly directly correlated with neighborhood calmness, but PSG ownership enhanced neighborhood calmness association with social capital.	Streets with PSG were perceived calmer than those with no PSG, but this difference wasn't significant in bivariate or multivariate analysis.

PSG ownership and PSG presence on neighborhood streets were found to have opposite significant associations with neighborhood perceived safety for outsider and insiders. For outsiders PSG presence on neighborhood streets increased neighborhood perceived safety, while for insiders PSG ownership decreased neighborhood perceived safety. This result suggests that PSG can be used to increase neighborhood safety perception for outsiders while it had the opposite effect on owners.

We explained PSG ownership negative association with safety by suggesting that PSG character as private property, present on unsafe public grounds, might induce a feeling of unsafety for owners, but more research is required in order to fully understand this association and manipulate PSG characteristics (instead of privately owned PSG encouraged community owned PSG) in order for it to have a positive association with both outsiders and insiders.
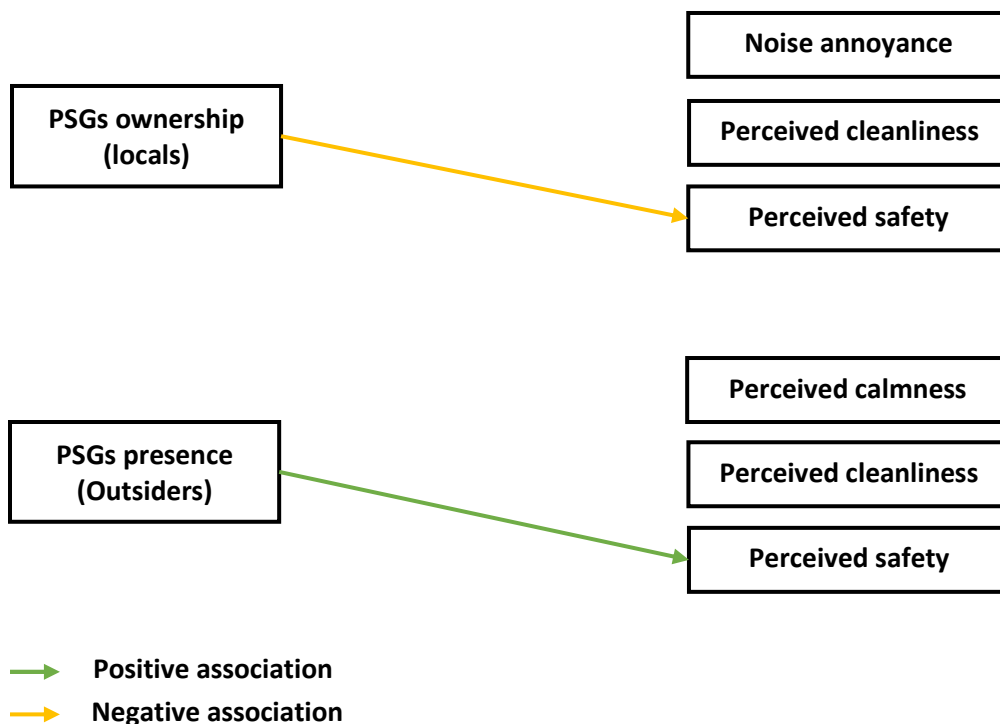
Figure 6-1 Diagrams comparing PSG ownership and presence on neighborhood streets *direct* associations with neighborhood perceived characteristics for outsiders and insiders.

2. Discussion

The objective of our research was to investigate whether urban green space (UGS) shortage in dense disadvantaged neighborhoods, can be addressed using potted street gardens (PSG), given its established ability to increase neighborhood perceived greenery significantly. We argued that the benefits of UGS on all aspects of urban life made its unequal distribution across urban communities an environmental injustice that affects more and more city dwellers, as urban populations continue to grow, especially in developing countries.

Therefore, we investigated the potential association between PSG ownership and neighborhood perception, and human health and behavior in one side, and between PSG presence on neighborhood streets and outsiders' perception of neighborhood physical and social characteristics on the other. We choose the Beni-Makada district in Tangier, Morocco, as a study area because of its low per capita green space ($0.27m^2$) and the high abundance of PSG. The study area also represents an interesting case study as more than two-thirds of survey participants started their PSG after a governmental program encouraged PSG ownership in the district's dense neighborhoods. We hypothesized that PSG's ability to increase neighborhood greenery perception might allow it to have effects that extend beyond merely greening the landscape, to affect neighborhood perception and local's health and behavior as formal UGS does. Therefore, we used a cross-sectional study and a promenade experiment to verify this hypothesis.

The cross-sectional study aimed to investigate PSG ownership direct association and moderation effects on neighborhood perception, human behavior, and health, while the experiment's objective was to examine outsiders' perception of neighborhood social and physical characteristics and compare it with locals' perception. Results of the survey data analysis showed that PSG ownership had a far more mixed and complex relationship with our variables than we anticipated; some associations were in line with previous researches, while others contradicted it.

PSG ownership had a mainly positive association (direct or by moderation) with neighborhood perception variables as it correlated significantly with increased life satisfaction, neighborhood perceived cleanliness, and decreased noise annoyance levels. In contrast, its association with perceived safety was mixed, with a negative direct association, as PSG owners were 56% less

likely to feel safe/very safe in their neighborhoods, and a positive moderation effect on its association with life satisfaction.

PSG related variables were also generally positively associated with neighborhood perception; out of eight, only two variables were negatively associated with neighborhood perception.

On the other hand, PSG presence on the street had only positive associations with neighborhood perception, as participants were 3 times more likely to feel safer, at least 2.5 times more likely to perceive locals' relationships and neighborhood belonging pride as better, and 5 times more likely to enjoy their promenades on the street with PSG compared to the street with no PSG. These results suggest that encouraging PSG ownership might be a useful tool in the destigmatization of disadvantaged communities in dense neighborhoods.

PSG ownership negative association with locals' perceived safety might be related to its nature as private property, permanently present on unsafe public grounds, inducing insecurity feeling for owners. In contrast, its positive association with outsiders' feeling of safety might come from its nature as a green element.

PSG ownership significant association with prosocial behavior was generally positive, as it was associated (directly or by moderation effect) with increased responsibility to clean the neighborhood, and a higher diffusion of areas to clean.

PSG ownership' association with areas to protect was mixed, with a buffering effect on its association with life satisfaction and an enhancing effect on its association with perceived safety.

PSG related variables were mainly negatively associated with neighborhood attachment and prosocial behaviors, as out of five significant correlations, only two were positive. These results suggest that PSG might provide a venue for socializing activities important enough to induce altruistic and prosocial behaviors, which might explain the apparent cleanliness of front yards with PSG compared with those without PSG. However, this association did not extend to behaviors that may represent a significant risk for their safety, like protection from potential offenders, as PSG owners felt responsible for protecting areas "not belonging to them" only when safety was assured. Curiously, PSG ownership was not associated with neighborhood attachment. These results suggest that PSG ownership might be a useful tool to improve neighborhood cleanliness.

Concerning health variables, analysis results revealed a negative association, direct and moderated between PSG ownership on one side and physical activity and Depression level on the other side. PSG owners had 0.37 higher depression scores than nonowners. These findings cannot be explained by PSG nature as a green element as both necessary (cleaning watering), and recreational activities (chatting, eating, etc.) conducted next to PSG were associated with better mental health and more physical activity. PSG nature as a private property might be the cause behind its negative association with health, which suggests exerting caution before encouraging PSG ownership in dense disadvantaged neighborhoods as it might be amplifying the impact of negative neighborhood characteristics on owners.

Therefore, further research is needed to ascertain these results and study PSG association with health, but in light of these last results, experimental designs would not be ethically appropriate. The negative associations between PSG ownership on one side and perceived safety and health variables, on the other hand, deserves special attention and need to be investigated to assess its validity thoroughly.

3. Implications

The findings of this study revealed that PSGs have a significant potential as an alternative to UGS in dense disadvantaged neighborhoods. However, at this stage, due to the scarcity of similar investigations in different contexts, the generalization of our results is not yet possible. Our findings might be valid only in this specific context.

Our results revealed also that encouraging PSG ownership might have both positive and negative effects on its owner's wellbeing.

In addition, our case study suggest that urban policy might affect communities' choice to start a PSG when the appropriate tools are used.

More academic and official attention must be accorded to PSG and other informal forms of green space as their impact on health, behavior, and urban environment perception might potentially be as important as formal green space impact and may lead to a redefinition of its role in the city.

4. Strength and uniqueness of the study

The present research comes at a timely period where for the first time in human history the world's urban population exceeded the rural one, with the great majority of these urban citizens living in underdeveloped countries where UGS is not priority. Similar studies are essential in order to find realistic and low-cost solutions for UGS shortage.

The methodology used in the study helps us understand the invisible and complex correlations between a large number of variables measured in a realistic setting, form two point of local's and outsiders' points of view, which allows us to understand how PSG association with our population works. In turn, understanding these association patterns allow us to inform urban policy and urban design.

To our knowledge, this research is the first to study PSG ownership moderated and direct association with neighborhood perception, prosocial behavior, and human health, and the first ever to study UGS in Morocco.

Furthermore, conducting the research in our study area, was a unique opportunity to investigate the impact of the indirect intervention of the state to promote PSG ownership. Our findings will be used to orient and correct future interventions.

The study's findings, confirmed that there is indeed a strong correlation between PSG ownership and variable that play a significant role in defining urban populations wellbeing, which represents an important breakthrough for the future UGS related research and will reorient similar investigation towards inspecting similar associations with other informal forms of UGS.

5. Limitations

Several limitations need to be considered for our research. First, to our knowledge this research is the first to specifically focus on PSG relationship with neighborhood perception and human health and behavior, therefore, there is no similar research to compare our findings with. It is difficult to know if our results are reliable and can be generalized or if they are specific to our study area.

Second the directionality of PSG relationship with the studied variables. Cross-sectional studies do not assume causality between the studied variables. For instance, it is equally possible that PSG ownership is causing higher depression levels, or that people with higher depression levels are predisposed to have PSG as a coping mechanism for their depression symptoms.

Third the results of the field experiment might have been affected by extraneous variables that might bias the results. Extraneous variables are the variables that are proper to the field experiment area and are difficult to control for. We tried to rule out this possibility by choosing two similar streets and conducting the experiment at the same time of the day in small groups of four, but these effects cannot be ruled out completely.

In addition, there could be self-selection bias caused by the potential difference between the studied population who agreed to participate vs those who refused to take part. Another limitation is that the observed associations could be caused by the non-normal distribution of the data and the selection bias. We aimed to eliminate selection bias by using a systematic random sampling and controlling for demographic characteristics of the population; however, there were limited opportunities to interview women (only 30% of our sample) due to cultural and safety reasons (no female interviewers, neighborhood high crime rate) and thus the social effects of selection cannot be ruled out completely.

Lastly, we couldn't collect data related to income the study did not control for household income because none of the pilot study participants agreed to share this information as it is considered a sensitive issue In addition, we tried to compensate by controlling for house and car ownership but the impact on the missing data cannot be ignored.

6. Recommendations

6.1. Research recommendations

This research produced interesting results, and its limitations present new opportunities for research. Therefore, we recommend conducting experimental and longitudinal PSG' related studies, using bigger sample sizes, especially in developing countries where the need for low-cost UGS alternative is urgent.

Furthermore, it would be interesting to conduct experiments assessing locals and outsider's perception of a defined neighborhood before and after the introduction of PSG, and collect data in different points in time and space to investigate the distance decay, using larger sample size, to follow the progressive change in neighborhood cleanliness, safety, noise annoyance, social relations between neighbors and mental and physical health, and other variables.

We also recommend, investigating further, PSG physical characteristics and its environment, type of plant, type of container, street width, patterns of PSG positioning on the street, and its association with neighborhood perception, behavior, and mental and physical health as it could lead to very interesting results explaining some of our findings.

However, it is imperative to conduct more cross-sectional studies with bigger sample sizes to deeply investigate PSG ownership association with mental and physical health before encouraging PSG ownership as an alternative to UGS in dense neighborhoods.

Finally, the methodology used in this research revealed an invisible relation between PSG ownership and variables that are of the highest importance for urban life in dense neighborhoods. Similar connections between semifixed objects and neighborhood perception, human behavior and health can be unveiled using the methodology developed in this study.

6.2. Urban policy recommendations

We recommend according PSG the appropriate attention it deserves as a serious alternative to formal UGS by the governments, and as an investment with clear benefits, through the formulation of adaptive non-intrusive urban policy proper to the typology of each neighborhood and each street.

However, it is imperative for urban policy to not interfere with the informal character of PSG, as PSG represent an expression of individuality, adaptability and the urban genius of its owners and of the community in general. This ingenuity must be encouraged, and the state intervention must be kept quasi-invisible, through the organization of neighborhood beaty competitions, locally and nationally, the founding of NGOs encouraging PSG, organizing gardening trainings days, and providing gardening tools and fertilizers.

6.3. Urban design recommendations

In some neighborhoods, like in our study area, it is already too late for the creation of new formal GS, with the high population density, and the lack of empty land. Consequently, the GS shortage must be addressed creatively, using PSG in addition to other UGS forms to green these neighborhoods. So instead of the creation of GS like gardens or parks, we recommend the redevelopment of these neighborhoods into green spaces, by the design of waterproof integrated ground level planters. Placed on public space back to back with houses mimicking PSGs. elevated planters were found in some neighborhoods, but a large number was destroyed by its owners because of capillary action damage to buildings. These planters are impossible to steal so they will reduce owners feeling of unsafety, and may be combined with PSG, as in japan, and as PSG, will serve to delimit boundaries between semi-private and public space.

In addition, it will serve as a protection against street noise, provide children and adults alike with more opportunities to practice gardening in more space, and increase interaction with green space.

PSG age negative association with our variables can be mitigated by encouraging blooming and short-lived plants that change with seasons, and the plantation of more diverse colored plants.

Before the corona virus pandemic, we were talking with NGOs in Agadir, a city in the south of Morocco, to discuss with local municipalities the application of some of these recommendations, that will allow us to collect experimental data before and after the implementation of PSG.

Figure 6-2 3D visualization and section of the street level planters.

Research Activities

Peer reviewed papers

- Afrad A, Kawazoe Y, Can interaction with informal urban green space reduce depression levels? an analysis of potted street gardens in Tangier, Morocco, Public Health, https://doi.org/10.1016/j.puhe.2020.06.034

Papers not peer reviewed (in review process)

- Can interaction with informal green space increase physical activity? An analysis of potted street gardens' association with moderate physical activity duration in a dense Moroccan neighborhood.

Research Grants

- Obayashi Foundation Research Grant 2018.

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APPENDIX 1

Survey About the Impact of the Spontaneous Decoration of Tangier's Residential Streets with Street Potted Gardens on Human Behavior and Health,

Thank you for accepting to take part in this survey.

This questionnaire is a part of a PhD research conducted at the University of Tokyo, Japan, Kawazoe Lab.

The principal objective of the survey is to study the effect of the spontaneous decoration of Tangier's residential streets with potted gardens, on human behavior.

This study is the first of its kind in Morocco. Similar studies were done before in cities like Tokyo, New York and Copenhagen, the collected data is used to improve the quality of life in these cities.

We value your opinion and we are very grateful for your participation in this research.

The questionnaire is anonymous and all data collected will be used only for academic purposes.

This survey takes less than 10 minutes to complete.

Thank you for your cooperation.

Part one: About your potted garden (if you have no pots please go to question 10)

1. **Since when there are potted plants in front of your house?**
   _____ years_____ months

2. **How many pots are in your garden?**
   _____Pots

3. **How many times a week do you take care of these plants (watering or cleaning for example)**
   ○Never ○ 1 time ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 times

4. **How much time do you spend taking care of your garden daily?**
   _____ hours _____minutes

5. **What kind of activities do you next to your pots?** Tick all that apply
   ☐ Nothing   ☐ Sitting or standing   ☐ Eating
   ☐ Chatting   ☐ Smoking   ☐ Other: _____

6. **On average, how many times a week do you have activities next to your pots?**
   ○ Never ○ 1 time ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 times

7. **Do you think that your potted garden is public or private?** (choose only one answer)
   ○ Public   ○ Private   ○ Both

8. **Do you think that your garden is making your neighborhood better?**

○ Yes   ○ No

9.   How much time does it take to go to the nearest park to your house <u>by walk</u>?
_____ hours _____minutes

Part two: about your relation with your neighborhood

10.   Since when do you live in this neighborhood?
Since _____

11.   Do you OWN or RENT your residence?
   ○ Rent   ○ Own

12.   Overall, how satisfied or dissatisfied are you with the life quality in your neighborhood?
(choose only one answer)
  ○ Not satisfied at   ○ Not satisfied   ○ Average   ○ Satisfied   ○ Very satisfied
  all
13.   How proud or not proud are you to live in this neighborhood? (choose only one answer)
  ○ Not proud at all   ○ Not Proud   ○ Average   ○ Proud   ○ Very proud

14.   Would you like to move to another neighborhood if you had the possibility?
  ○ Yes   ○ No   ○ Other
15.   How many times in a typical week do you have a promenade in your neighborhood?
  ○ Never   ○ 1 time   ○ 2   ○ 3   ○ 4   ○ 5   ○ 6   ○ 7 times

16.   How much time does every promenade last?
   _____ hours _____minutes

17.   What do you like the MOST about your neighborhood? Tick all that apply
☐ Neighbors   ☐ Situation   ☐ Calm
☐ Safe   ☐ Clean   ☐ Other: _____

18.   What do you like the LEAST about your neighborhood? Tick all that apply
☐ Neighbors   ☐ Situation   ☐ Noisy
☐ Unsafe   ☐ Dirty   ☐ Other: _____

19.   How would you describe the relationship between neighbors in your neighborhood? (choose
only one answer)
   ○ Very bad   ○ Bad   ○ Neutral   ○ Good   ○ Very good

20.   How many of your neighbors do you know? (choose only one answer)
   ○ None of them   ○ A few of them   ○ half of them   ○ Most of them   ○ All of them

21.   How annoyed or not annoyed are you with your street 'noises (children playing or people
shouting)? (choose only one answer)
   ○ Not Annoyed at all   ○ Not annoyed   ○ Neutral   ○ Annoyed   ○ Very annoyed

22.   How clean or not clean are the streets in your neighborhood? (choose only one answer)

○ Not clean at all   ○ Not clean   ○ Neutral   ○ Clean   ○ Very clean

23.   Do you believe that it is your responsibility to keep your neighborhood clean?
○ Yes   ○ No

24.   If you answered by yes in 23, which area you think (or areas) is YOUR responsibility? (Choose only one answer)

○ In front of your house	○ Front of yours and your neighbors' house	○ All your street	○ All the neighborhood

25.   How would you rate your neighborhood safety (for people and their belongings)**?** (Choose only one answer)
○ Very safe   ○ Moderately safe   ○ Average   ○ Moderately unsafe   ○ Very unsafe

26.   Do you believe that it is your responsibility to keep your neighborhood safe?
○ Yes   ○ No

27.   If you answered by yes in 26, which area (or areas) you think is YOUR responsibility? (Choose only one answer)

○ In front of your house	○ Front of yours and your neighbors' house	○ All your street	○ All the neighborhood

Part three: Questions about your health

28.   Over the last 2 weeks, how often have you been bothered by any of the following problems? (use "✓" to indicate your answer)

	Not at all	Several days	More than half the days	Nearly every day
Little interest or pleasure in doing things	○	○	○	○
Feeling down, depressed, or hopeless	○	○	○	○
Trouble falling or staying asleep, or sleeping too much	○	○	○	○
Feeling tired or having little energy	○	○	○	○
Poor appetite or overeating	○	○	○	○
Feeling bad about yourself—or that you are a failure or have let yourself or your family down	○	○	○	○
Trouble concentrating on things, such as reading the newspaper or watching television	○	○	○	○
Moving or speaking so slowly that other people could have noticed. Or the opposite—being so fidgety or restless that you have been moving around a lot more than usual	○	○	○	○
Thoughts that you would be better off dead, or of hurting yourself in some way	○	○	○	○

29. **If you checked off any problems, how difficult have these problems made it for you to do your work, take care of things at home, or get along with other people?** (Chose only one answer)

○ Not difficult at all ○ Somewhat difficult ○ Very difficult ○ Extremely difficult

Part four: Some *Information about you*

30. **How old are you?** (Choose only one answer)

○ Less than 18 ○ 18 to 35 ○ 36 to 50 ○ 51 to 65 ○ More than 65

31. **Gender**

○ Male ○ Female

32. **Marital Status:** (Chose only one answer)

○ Single ○ Married ○ Widowed ○ Divorced

33. **What is your occupation?** (Chose only one answer)

○ Student ○ University student ○ Self employed ○ Employee
○ Retired ○ Housewife ○ Unemployed ○ Other: _____

34. **Education**: **What is the highest degree or level of school you have completed?** (Chose only one answer)

○ Less than high school ○ Professional education ○ High school ○ Bachelor
○ Masters ○ PhD ○ Other: _____

35. **Does your family have a car?**

○ Yes ○ No

36. **Including yourself, how many people currently live in your household?**
_____ People

Thank you very much

東京大学

THE UNIVERSITY OF TOKYO

استبيان حول تأثير التزيين العفوي بالمحابق للأحياء في طنجة على سلوك وصحة السكان
بحث لنيل شهادة الدكتوراه في الهندسة المعمارية بجامعة طوكيو في اليابان

السلام عليكم ورحمة الله تعالى وبركاته،

يندرج هذا الاستبيان ضمن بحث لنيل شهادة الدكتوراه في مجال الهندسة المعمارية، بمختبر الاستاذ كوازوي بجامعة طوكيو في اليابان(UTokyo) ، والذي يهدف إلى دراسة تأثير التزيين العفوي للأحياء والأزقة بالنباتات بمدينة طنجة بالمغرب، ومدى تأثيره على سلوك ساكنيها ومعرفة انطباعهم وآراءهم بعد التغيير الذي عرفه حيهم.

تعتبر هذه الدراسة الأولى من نوعها في المغرب، بعد ما أجريت في عدد من المدن العالمية كطوكيو، نيويورك وكبنهاكن، والتي تم استعمال نتائجها من أجل تحسين مستوى عيش سكان هذه المدن.

من أجل ذلك فإننا نرجو منكم المساهمة الجادة لإنجاح هذه الدراسة وذلك بالإجابة بكل موضوعية على كافة الأسئلة، علما بأن هذه المعلومات ستبقى سرية وستستخدم لغرض البحث العلمي فقط.

تتطلب الإجابة على هذا الاستبيان أقل من 10 دقائق.

نشكر لكم مقدما جهودكم وحسن تعاونكم.

الجزء الأول: حول المحابق الموضوعة أمام المنازل (إذا لم تكن لديك محابق فالمرجو الانتقال إلى السؤال رقم 10)

1- منذ متى والمحابق موجودة أمام منزلك ؟

_____سنة و_____شهرا

2- كم عدد هذه المحابق؟

_____محبقا

3- كم مرة في الاسبوع تقوم فيها أنت بالعناية بالمحابق (عن طريق سقيها أو تنظيفها) ؟ (اختر إجابة واحدة)

○ ولا مرة   ○ مرة   ○ مرتان   ○ 3 مرات   ○ 4 مرات   ○ 5 مرات   ○ 6 مرات   ○ 7 مرات

4- كم من الوقت تقريبا تقضيه في العناية بمحابقك كل يوم؟

_____ساعة   _____دقيقة

5- ما هي الأعمال الروتينية التي تقوم بها قرب محابقك؟ (يمكن اختيار اكتر من جواب واحد)

☐ لا شيء   ☐ الجلوس أو الوقوف   ☐ التكلم مع الجيران والأصدقاء
☐ الأكل   ☐ التدخين   ☐ عمل آخر : _____

6- كم عدد المرات التي تقوم فيها بهذه الأعمال في الأسبوع؟ (اختر إجابة واحدة)

○ ولا مرة   ○ مرة   ○ مرتان   ○ 3 مرات   ○ 4 مرات   ○ 5 مرات   ○ 6 مرات   ○ 7 مرات

7- هل تعتبر محابقك ملكية عامة أم خاصة؟ (اختر إجابة واحدة)

○ عامة   ○ خاصة   ○ الاثنان معا

8- هل تظن أن هذه المحابق تجعل حيك أفضل؟ (اختر إجابة واحدة)

نعم ○   لا ○

9- كم، تقريبا، تبعد عنك أقرب حديقة عمومية أو منتزه عمومي <u>مشيا على الأقدام</u>؟

دقيقة_____ ساعة_____

الجزء الثاني: حول علاقتك مع حيك

10- منذ متى وأنت تقطن بهذا الحي؟

منذ سنة_____

11- هل أنت مكتري أم مالك؟ (اختر إجابة واحدة)

مالك ○   مكتري ○

12- ما مدى رضاك عن جودة الحياة في حيك؟ (اختر إجابة واحدة)

راضي تماما ○   راضي نوعا ○   محايد ○   غير راضي ○   غير راضي أبدا ○
ما

13- ما مدى فخرك بانتمائك لهذا الحي؟ (اختر إجابة واحدة)

فخور تماما ○   فخور نوعا ما ○   محايد ○   غير فخور ○   غير فخور أبدا ○

14- هل تود الانتقال من هذا الحي إذا سنحت الفرصة في ذلك؟ (اختر إجابة واحدة)

نعم ○   لا ○   آخر : ○_____

15- كم مرة في الأسبوع تذهب في نزهة مشيا بحيك؟ (اختر إجابة واحدة)

ولا مرة ○   مرة ○   مرتان ○   3 ○   4 ○   5 ○   6 ○   7 مرات ○
مرات   مرات   مرات   مرات

16- كم من الوقت تدوم كل نزهة تقريبا؟

دقيقة_____ ساعة_____

17- ما هو أكتر شيء أو أشياء تحبها في هذا الحي؟ (يمكن اختيار اكتر من جواب واحد)

الجيران ☐   الموقع ☐   النظافة ☐
الأمن ☐   الهدوء ☐   أشياء أخرى ☐
_____ :

18- ما هو أكتر شيء أو أشياء لا تحبها في هذا الحي؟ (يمكن اختيار اكتر من جواب واحد)

الجيران ☐   الموقع ☐   الحي غير نظيف ☐
غياب الأمن ☐   الضوضاء ☐   أشياء أخرى ☐
_____ :

19- كيف يمكنك وصف العلاقة بين الجيران في هذا الحي؟ (اختر إجابة واحدة)

جيدة جدا ○   جيدة نوعا ما ○   محايدة ○   سيئة نوعا ما ○   سيئة جدا ○

20- كم عدد الجيران اللذين تعرفهم تقريبا؟ (اختر إجابة واحدة)

كلهم ○   معظمهم ○   نصفهم ○   القليل منهم ○   لا أحد ○

21- **ما مدى انزعاجك من الأصوات الآتية من زنقتك (لعب الأطفال أو صياح المارة مثلا)؟** (اختر إجابة واحدة)

○ لا تزعجني أبدا ○ لا تزعجني ○ محايد ○ تزعجني نوعا ما ○ تزعجني جدا

22- **ما مدى نظافة حيك؟** (اختر إجابة واحدة)

○ غير نظيف ابدا ○ غير نظيف ○ محايد ○ نظيف نوعا ما ○ نظيف جدا

23- **هل تعتقد أن الحفاظ على نظافة حيك هو من مسؤوليتك؟** (اختر إجابة واحدة)

○ لا ○ نعم

24- **إذا كانت إجابتك نعم على السؤال 23، فما هو المكان أو الأماكن التي تعتقد أنها تدخل في نطاق مسؤوليتك؟**
(يمكن اختيار اكتر من جواب واحد)

○ كل الحي ○ كل زنقتك ○ أمام منزلك ومنازل جيرانك ○ أمام منزلك فقط

25- **ما هو تقييمك لمستوى الأمن بهذا الحي** (فرص وقوع سرقات أو اعتداءات على الناس أو الممتلكات)؟
(اختر إجابة واحدة)

○ غير آمن ابدا ○ غير آمن نوعا ما ○ محايد ○ آمن نوعا ما ○ آمن جدا

26- **هل تعتقد أن الحفاظ على أمن حيك وسكانه من مسؤوليتك** (عن طريق تحذيرهم أو التبليغ عن الأشخاص المشتبه بهم للشرطة مثلا)؟ (اختر إجابة واحدة)

○ لا ○ نعم

27- **إذا كانت إجابتك نعم على السؤال 26، فما هو المكان أو الأماكن التي تعتقد أنها تدخل في نطاق مسؤوليتك؟**
(اختر إجابة واحدة)

○ كل الحي ○ كل زنقتك ○ أمام منزلك ومنازل جيرانك ○ أمام منزلك فقط

الجزء الثالث: حول صحتك (المعلومات ستبقى سرية و ستستخدم لغرض البحث العلمي فقط)

28- **خلال الأسبوعين الماضيين، كم مرة عانيت من أي من المشاكل التالية؟** (ضع علامة ' ✓ ' للإشارة لجوابك)

	تقريبا كل يوم	أكثر من نصف الأيام	عدة أيام	ولا يوم
قلة الاهتمام أو الاستمتاع بممارسة أي عمل	○	○	○	○
الشعور بالحزن أو ضيق الصدر أو اليأس	○	○	○	○
صعوبة في النوم أو نوم متقطع أو النوم أكتر من المعتاد	○	○	○	○
الشعور بالتعب أو بامتلاك القليل جداً من الطاقة	○	○	○	○
قلة الشهية أو الافراط في تناول الطعام اكثر من المعتاد	○	○	○	○
الشعور بعدم الرضا عن النفس أو الشعور بأنك قد خذلت نفسك أو عائلتك	○	○	○	○

○	○	○	○	صعوبة في التركيز مثلاً أثناء قراءة الصحف أو مشاهدة التلفزيون
○	○	○	○	بطء في الحركة أو بطء في التحدث أكثر من المعتاد لدرجة ملحوظة من الآخرين / أو على العكس من ذلك التحدث بسرعة والحركة أكثر من المعتاد
○	○	○	○	راودتك أفكار بأنه من الأفضل لو أنك ميت أو أفكار بأن تقوم بإيذاء نفسك

29- إذا أشرت إلى أية من المشاكل أعلاه، فإلى أية درجة صعّبت عليك هذه المشاكل القيام بعملك، الاعتناء بالأمور المنزلية، أو الانسجام مع أشخاص آخرين؟ (اختر إجابة واحدة)

○ هناك صعوبات بالغة التعقيد   ○ هناك صعوبات شديدة التعقيد   ○ هناك بعض الصعوبة   ○ ليست هناك أي صعوبة

الجزء الرابع: معلومات شخصية

30- كم عمرك؟ (اختر إجابة واحدة)
○ أكبر من 65   ○ من 51 الى 65   ○ من 36 الى 50   ○ من 18 الى 35   ○ اقل من 18

31- أنت:
○ أنثى   ○ ذكر

32- الحالة العائلية (اختر إجابة واحدة)
○ آخر:_   ○ أرمل (ة)   ○ مطلق (ة)   ○ متزوج (ة)   ○ أعزب (عزباء)

33- ما هي مهنتك؟
○ موظف (ة)   ○ أعمل لحسابي الخاص   ○ طالب (ة)   ○ تلميذ (ة)
○آخر: ـــــــــــــــــــــ   ○ بدون عمل   ○ ربة بيت   ○ متقاعد (ة)

34- المستوى الدراسي (اختر إجابة واحدة)
○الإجازة   ○ الثانوي   ○التكوين المهني   ○أقل من الثانوي
    ○ آخر: ○الدكتوراه   ○الماستر

35- هل تملك عائلتك سيارة؟ (اختر إجابة واحدة)
○ لا   ○ نعم

36- كم عدد أفراد عائلتك الذين يسكنون معك في نفس البيت (بما فيهم أنت) ؟
ـــــــــ فردا

شكرا جزيلا وجزاكم الله خيرا على مساعدتكم

APPENDIX 2

Thank you very much for accepting to take part in this survey.

This questionnaire is a part of a PhD research conducted at the University of Tokyo, Japan.

This study is the first of its kind in Morocco. Similar studies were done before in cities like Tokyo, New York and Copenhagen, the collected data was used to improve the quality of life in these cities.

Please fill each part of this questionnaire **after the end of each promenade and based solely on YOUR observations.** There are no right or wrong answers.

All data collected will remain anonymous, and will be used only for academic purposes.

Thank you for your cooperation.

Part I: Neighborhood 1

After the end of your promenade in the first neighborhood, and based on your observations

1. **How clean or not clean are the streets in this neighborhood?** (Choose one answer)
   ○ Not clean at all   ○ Not clean   ○ Neutral   ○ Clean   ○ Very clean

2. **How calm is this neighborhood?** (Choose one answer)
   ○ Not calm at all   ○ Not calm   ○ Neutral   ○ calm   ○ Very calm

3. **How safe did you feel is this neighborhood?** (Choose one answer)
   ○ Very unsafe   ○ Moderately unsafe   ○ Average   ○ Moderately safe   ○ Very safe

4. **Did you feel observed in this neighborhood?** (Choose one answer)
   ○ Not at all   ○ Not really   ○ Maybe   ○ I felt observed   ○ I was surely observed

5. **How pleasant or unpleasant did you find this neighborhood?** (Choose one answer)
   ○ Not Pleasant at all   ○ Not Pleasant   ○ Neutral   ○ Pleasant   ○ Very Pleasant

6. **How proud do you think people in this neighborhood are of their neighborhood?** (Choose one answer)
   ○ Not proud at all   ○ Not Proud   ○ Average   ○ Proud   ○ Very proud

7. **How do you think the neighbors' relationship is in this neighborhood?** (Choose one answer)
   ○ Very bad   ○ Bad   ○ Neutral   ○ Good   ○ Very good

Part II: Neighborhood 2

After the end of your promenade in the second neighborhood, and based on your observations

8. **How clean are the streets in this neighborhood?** (Choose one answer)
   ○ Not clean at all   ○ Not clean   ○ Neutral   ○ Clean   ○ Very clean

9. **How calm is this neighborhood?** (Choose one answer)
   ○ Not calm at all   ○ Not calm   ○ Neutral   ○ calm   ○ Very calm

10. **How safe did you feel is this neighborhood?** (Choose one answer)

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○ Very unsafe   ○ Moderately unsafe   ○ Average   ○ Moderately safe ○ Very safe

11. Did you feel observed in this neighborhood? (Choose one answer)
○ Not at all   ○ Not really   ○ Neutral   ○ I felt observed   ○ I was surely observed

12. How enjoyable was your promenade in this neighborhood? (Choose one answer)
○ Not enjoyable at all   ○ Not enjoyable   ○ Neutral   ○ enjoyable   ○ Very enjoyable

13. How proud do you think people in this neighborhood are of their neighborhood? (Choose one answer)
○ Not proud at all   ○ Not Proud   ○ Average   ○ Proud   ○ Very proud

14. How do you think neighbors' relationship quality is in this neighborhood? (Choose one answer)
○ Very bad   ○ Bad   ○ Neutral   ○ Good   ○ Very good

Part III: Questions about yourself

1. How old are you? (choose one answer)

○ Less than 18   ○ 18 to 35   ○ 36 to 50   ○ 51 to 65   ○ More than 65

2. Gender

○ Male   ○ Female

3. Marital Status: (choose only one answer)

○ Single   ○ Married   ○ Widowed   ○ Divorced

4. What is your occupation? (choose only one answer)

○ Student   ○ University student ○ Self employed   ○ Employee

○ Retired   ○ Housewife   ○ Unemployed   ○ Other: _____

5. Education: **What is the highest degree or level of school you have completed?** (choose only one answer)

○ Less than high school   ○ Professional education   ○ High school   ○ Bachelor

○ Masters   ○ PhD   ○ Other: _____

1. Does your family have a car?
○ Yes   ○ No

2. Including yourself, how many people currently live in your household?
_____ People

Thank you very much

東京大学
THE UNIVERSITY OF TOKYO

استبيـان

الـسلام عليكم ورحمة الله تعالى وبـركاتـه ،

شكرا جزيلا لمـوافقتكم على المـشاركة في هذه الـدراسة ، التي تنـدرج ضمن بحث لـنيل شهادة الـدكتوراه في مجال الهندسة المعمارية ، بجامعة طوكيو في اليابان. تـعتبر هذه الـدراسة الأولى من نوعها في المغرب، بعد مـا أجريت في عدد من المـدن كطوكيو ، نيويورك وكبنهاكن، والـتي تهدف إلى تحسين مستوى عيش سكان الاحياء المدروسة.

من أجل ذلك فإنا نرجو منكم الاجابة على الأسئلة بكل صراحة و عفوية **بعد انتهاء نزهتك في كل الـحي، و انطلاقا من ملاحظتك أنت.** في هذا الاستبيان لا توجد أجوبة صحيحة أو خاطئة ، و المعلومات المحصل عليها ستبقى سرية وستستخدم لغرض الـبحث العلمي فقط.

شكرا جزيلا على حسن تعاونكم.

الحي الأول

• **بعد انتهاء نزهتك في الـحي الأول ، و انطلاقا من ملاحظتك:**

37- مـا مدى نظافة هذا الـحي؟ (اختر إجابة واحدة)

O نظيف جدا   O نظيف   O محايد   O غير نظيف   O غير نظيف ابدا نوعا ما

38- مـا مدى هدوء هذا الـحي؟ (اختر إجابة واحدة)

O هادئ جدا   O هادئ   O محايد   O غير هادئ   O غير هادئ أبدا نوعا ما

39- مـا مدى احساسك بـالأمـان أو عدم الأمـان في هذا الـحي؟ (اختر إجابة واحدة)

O آمن جدا   O آمن نوعا   O محايد   O غير آمن   O غير آمن أبدا ما

40- مـا مدى احساسك بـانك مراقب أو غير مراقب في هذا الـحي؟ (اختر إجابة واحدة)

مراقب ⭘   مراقب ⭘   محايد ⭘   غير ⭘   غير مراقب أبدا ⭘
جدا   نوعا ما   مراقب

41-   ما مدى استمتاعك بـنزهتك في هذا الـحي؟ (اختر إجابة واحدة)

استمتعت ⭘   استمتعت ⭘   ⭘   لم ⭘   لم استمتع أبدا ⭘
جدا   محايد   استمتع   نوعا ما

42-   كيف في نظرك قد يكون مدى فخر السكان بـانتماء هم لـهذا الـحي؟ (اختر
إجابة واحدة)

فخورون ⭘   فخورون ⭘   ⭘   غير ⭘   غير فخورين أبدا ⭘
جدا   محايد   نوعا ما   فخورين

43-   كيف في نظرك قد تكون جودة العلاقة بـين سكان هذا الـحي؟ (اختر إجابة
واحدة)

جيدة جدا ⭘   جيدة ⭘   محايد ⭘   سيئة ⭘   سيئة جدا ⭘
نوعا ما

الـحي الـثاني

- **بعد انتهاء نزهتك في الـحي الأول ، و انطلاقا من ملاحظتك:**

44-   ما مدى نظافة هذا الـحي؟ (اختر إجابة واحدة)

نظيف جدا ⭘   نظيف ⭘   محايد ⭘   غير نظيف ⭘   غير نظيف ابدا ⭘
نوعا ما

45-   ما مدى هدوء هذا الـحي؟ (اختر إجابة واحدة)

هادئ جدا ⭘   هادئ ⭘   محايد ⭘   غير هادئ ⭘   غير هادئ أبدا ⭘
نوعا ما

46-   ما مدى احساسك بـالأمان أو عدم الأمان في هذا الـحي؟ (اختر إجابة
واحدة)

آمن جدا ⭘   آمن نوعا ⭘   محايد ⭘   غير آمن ⭘   غير آمن أبدا ⭘
ما

47-   ما مدى احساسك بـانك مراقب أو غير مراقب في هذا الـحي؟ (اختر
إجابة واحدة)

مراقب ⭘   مراقب ⭘   محايد ⭘   غير ⭘   غير مراقب أبدا ⭘
جدا   نوعا ما   مراقب

48-   ما مدى استمتاعك بـنزهتك في هذا الـحي؟ (اختر إجابة واحدة)

استمتعت ⭘   استمتعت ⭘   محايد ⭘   لم ⭘   لم استمتع أبدا ⭘
جدا   نوعا ما   استمتع

49- كيف في نظرك قد يكون مدى فخر السكان بانتمائهم لهذا الحي؟ (اختر إجابة واحدة)

○ فخورون جدا   ○ فخورون نوعا ما   ○ محايد   ○ غير فخورين   ○ غير فخورين أبدا

50- كيف في نظرك قد تكون جودة العلاقة بين سكان هذا الحي؟ (اختر إجابة واحدة)

○ جيدة جدا   ○ جيدة نوعا ما   ○ محايد   ○ سيئة نوعا ما   ○ سيئة جدا

معلومات شخصية

1- كم عمرك؟ (اختر إجابة واحدة)

○ اقل من 18   ○ من 18 الى 35   ○ من 36 الى 50   ○ من 51 الى 65   ○ أكبر من 65

2- أنت:

○ ذكر   ○ أنثى

3- الحالة العائلية (اختر إجابة واحدة)

○ أعزب (عزباء)   ○ متزوج (ة)   ○ مطلق (ة)   ○ أرمل (ة)   ○ آخر: _____

4- ما هي مهنتك؟

○ تلميذ (ة)   ○ طالب (ة)   ○ أعمل لحسابي الخاص   ○ موظف (ة)

○ متقاعد (ة)   ○ ربة بيت   ○ بدون عمل   ○ آخر: _____

5- المستوى الدراسي (اختر إجابة واحدة)

○ أقل من الثانوي   ○ التكوين المهني   ○ الثانوي   ○ الإجازة

○ الماستر   ○ الدكتوراه   ○ آخر: _____

6- هل تملك عائلتك سيارة؟ (اختر إجابة واحدة)

○ نعم   ○ لا

7- كم عدد أفراد عائلتك الذين يسكنون معك في نفس البيت (بما فيهم أنت) ؟

_____ فردا

شكرا جزيلا وجزاكم الله خيرا على مساعدتكم

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