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Spatial quality of renovated open space in Tokyo via the experiences of users with urban gardening

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Abstract. Since last century, megacities have been seeking measures to enhance the living condition of its urban dwellers by green infrastructures like parks or rooftop greening. Their social and environmental benefits offer considerable solutions for sustainable urban design, which is a critical concern in the era of climate change. Additionally, other concern of compact cities is to improve the quality of their neglected open space and accommodate the city lifestyle. These concerns mentioned above lead to a noticeable trend of designing renovated open space (OS) using urban gardening (UG) in recent years, intending to raise awareness of natural resource in the urban area. In Japan particularly, research proves that gardening for leisure is improving the well-being of urban citizen, especially in Tokyo metropolitan. However, the past research focus was on the impact of UG on people, the management or the technic employed but not on the spatial quality itself, like the one in the author's previous study. In the author's recent work, open space with urban gardening (OSUG) was examined firstly through the user's eyes to reveal their experience in space. Then seven scenarios were identified to determine the quality of urban space in OSUG, as characterized by the variation of three factors: Usage, Space Affordance, and Image of Identity. In this study, space itself will be analysed in connection with the design concept to understand the user's experience linked to Space Affordance (SA). The finding will reveal the impact of SA in the relation of design concept and the user's experience. Based on that a method for the future design of urban green space for compact cities can be defined.

1. Introduction

Climate change has been an issue of global concerns in which city residents are vulnerable. The latest report of the Intergovernmental Panel on Climate Change has found that green infrastructure like community parks and green roofs are valid solutions for sustainable development. Besides, in the urban situation, many projects are adopting these green solutions to revitalize the neglected open space (OS) by creating practice like events, markets and urban gardening (UG). In Asia where UG plays a critical role in promotion rural area, Japan and especially Tokyo mainly focuses on improving urban dweller's well-being. As a result, the renovation project of OS in the mix-used building are focusing on the leisure UG and are offering benefits on the physical outdoor, the connection with nature and the social integration through gathering activities. This type of urban recreation space is defined, in this research, as renovated open space with urban gardening (OSUG). From the author's previous study, OSUG presents well-adapted scenarios for the city lifestyle. These scenarios are identified by a combination of



three quality factors as Usage, Space Affordance and Image of Identity. However, the results in the previous study only showed the importance of understanding the role of users in OSUG but left aside the question related to the effect of the spatial structure and its relation to the planning intention. Hence, the current study aims to investigate the characteristics of Space Affordance (SA) to understand its impact on the scenarios of OSUG and the relationship to the design concept.

As for the literature review, researches on gardening space did not study directly on urban leisure gardening. For this reason, it is adequate to find the relevant researches on user behavior in public open space from different fields. At first, Baker in the field of behavior setting acknowledged that users behave according to what affords by the environment. Suzuki rejoined this idea by observing people as their position in space, it emphasizes the Zone they belong to and the Boundary it set to others. Secondly, Gehl in the making of cities for people confirmed that good quality space shows a significant rate of pass-by and pass-time activity, in other terms crossing and staying. For crossing, Bastoro found which factors affect people route and for staying, Whyte observed which factors influence people to stay. These studies confirmed that the same physical environment could afford different Route for users. And at last, in the user-participation research field, Thiel mentioned that the user adopts their unique approach to understand and act within the environment. This concept defines a user's Path, which is a combination of several elements related to the user's position in space. These above researches propose a study method starts with an observation on how the user moves within the Zone and Boundaries of OSUG. Next, a structural analysis aims to understand the patterns of Route and Path, by using the framework developed by Ashihara based on parameters like height or texture. Then, by arranging these parameters according to the emerged patterns, the scenarios of OSUG will be illustrated following the order of SA. From the previous study, the illustrated scenarios represent most of the situation existing in OSUG, intended or not by the design concept. Therefore, in this study, the objective is to continue this discussion on the spatial quality of OSUG via another viewpoint through affordance and design intention to understand its impact, its relationship and propose a method for the future design of OSUG.

2. Research method

By adopting the results of previous research, this current study looks into applying its framework partly and reuse the same data collected from its fieldwork. The details are explained in the sub-chapters below.

2.1. Framework

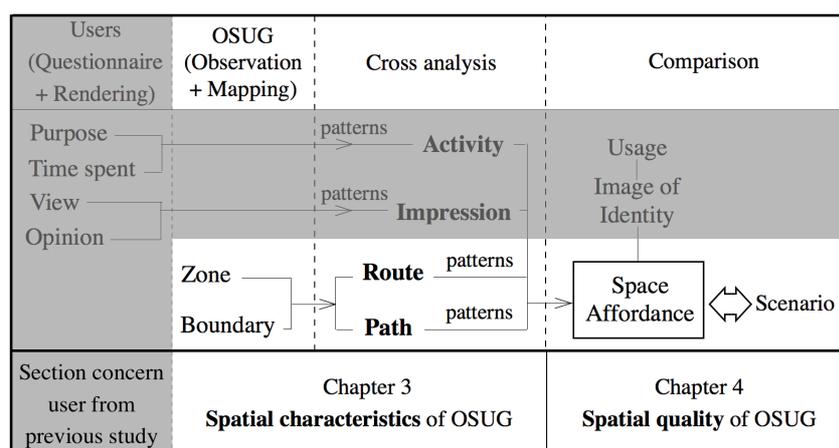


Figure 1. Framework

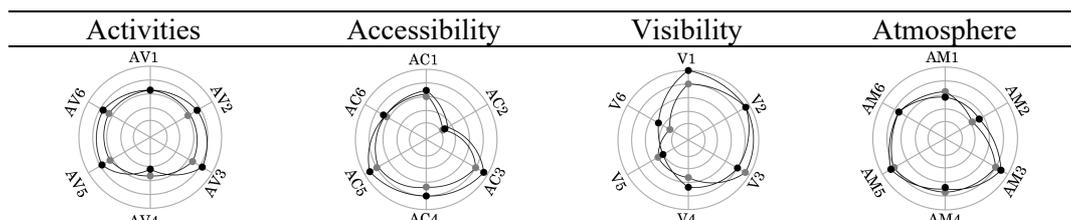
The adopted framework of the previous study is shown in Figure 1; the grey part is the portion related to the user and will not be mentioned in this study. The study part is structured in two chapters. The first chapter focuses on the process to identify the affordance of OSUG and the second chapter look into understanding its relationship with the scenarios in OSUG. In the first chapter, information collected through observation and mapping is grouped by Zone and Boundary. Then, after classification, the

patterns of Route and Path will emerge as Spatial Characteristics of OSUG. In the second part, these patterns are identified within the scenarios. Then, by revealing the SA of the scenarios in relation to the design planning, the relationship of SA and design concept will emerge as Spatial Quality of OSUG.

2.2. Case studies

The cases studies are two different urban situations located in Tokyo metropolitan. At a starting point, these case studies share common characteristics as a renovated project by integrating UG to a neglected OS and by transforming a mono-used building to a mix-used building. Case 01 Ebisu (E) is from an inaccessible rooftop turning to an accessible roof garden; the OSUG is designed with the initiative to be part of the Green Building Program to combat heat island effect in Tokyo at the beginning of 21 century. Case 02 Zama (Z) is from neglected parking between two blocks turning to a communal garden; the OSUG is designed to change the image of the community housing and promoting the neighborhood, this project also being part of the recent effort to renovate the building stock of Tokyo metropolitan. Hence, the primary purpose of enhancing the environment and social aspect by the quest of creating new urban quality by the new design of OSUG is considered suitable for this research. Besides, by looking closely, E and Z present a considerable similarity and singularity characteristics between them, which produce a diverse data collection for research. Details of case studies are shown in below tables.

Table 1. Similarity between case studies



^a The preliminary survey of June 2017, the responders rated the criteria on a Libert scale of 5 points:
 AV1~6: Evaluation of Activities: work, play, rest, do garden, eat and sleep, meet and talk
 AC1~6: Evaluation of Accessibility: walk, bicycle, car, train/bus, by wheelchair, using the stroller
 V1~6: Evaluation of Visibility: sky, building, landscape, farm, floor, surroundings
 AM1~6: Evaluation of Atmosphere: lively, natural, comfortable, spacious, child-friendly, clean

Table 2. Singularities of each case study

Case	Location	Management	Program	Service	Photos
Ebisu (Built in 1997, renovated in 2009)	-Ebisu station -Atre West rooftop -Ebisu Green Garden	-Owner JR East -Design Ekipara -Manager Toho Leo	Integrated in the rooftop of 3132m ² OS of 1134m ² green landscape, wooden deck and a UG (613m ² – 19.6%)	Everyday 10:00-18:00, UG support staff always present	
Besides	-Zama station -Hoshinotani Danchi -OS between building 3&4	- Owner Odakyu -Designer Blue Studio -Manager AgriMedia	Integrated in the OS of 4533m ² s between building 3&4 a garden, café, child care center, UG (525m ² - 11.5%)	Everyday 11:00-16:00, UG staff come 3 times/ week	

As shown in the survey of Table 1 for similarity, there is an equal level of activities, accessibility, visibility and atmosphere in both sites. As for singularity shown in Table 2, E and Z differ from each other in ownership, size, the period of construction and program. Case E was a pioneer model of OSUG aims to enhance the central environment aspect by the direct connection to Ebisu station and the commercial building of Atre West Ebisu. This commercial building is well deserved for locals. Its main

constraint is the technic employed to integrate greening and trees on the rooftop of the existing building. Case Z is a recent project of community housing, being part of a revitalization project around the central station of Zama. The renovation is not only the OSUG but also the housing unit of Hoshinotani danchi by adding more functions such as cafe and child care center, the project focus on enhancing the social aspect of the bed-town city. Its main constraint is on the budget and schedule of different phases of an urban project. Both cases studies also share an economic interest in bringing more visitors to the site by the creation of play zone for physical activities and shaded zone for resting area..

2.3. Fieldwork

Concerning the fieldwork, 102 collected samples of users from the previous survey were used due to its relation to defined scenarios and design intention of OSUG. Even though observation could cover much more samples on these sites, but these available data are considered suitable due to its variety in age, gender, activity, companion (Figure 2) representing the general situation of users of E and Z. During the previous survey, a team of two members visited the sites and conducted an online questionnaire at the same time with observation. As for user, while answering the questionnaire, their localization is recorded on the map along with photographs which define their position compare to physical elements presented on site. The photograph in Figure 3 below explained in details the information collected.

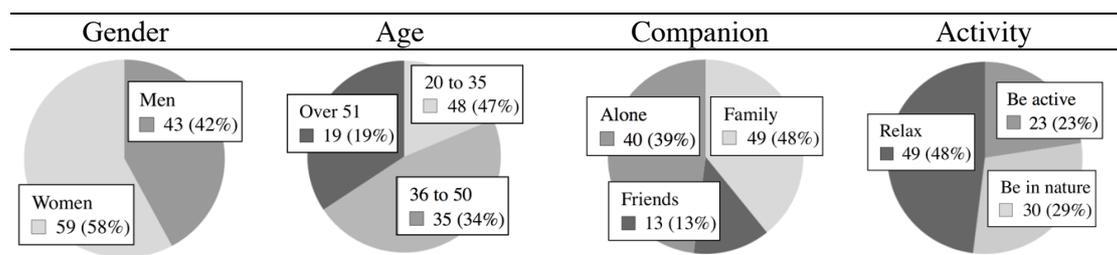


Figure 2. Distribution of Gender, Age, Companion and Activity in both case studies

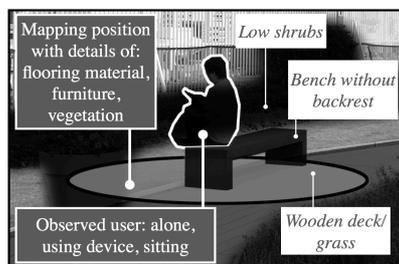


Figure 3. This photograph captured a data sample of the user which show his position and related spatial elements found around his position. This observation was carried on during the period of July-August 2017 alternatively between two case studies. For the schedule, the team visited each site on six different days, during two periods on weekend and weekday, from 12:00 to 14:00 and from 15:00 to 17:00s.

3. Spatial characteristics of OSUG

Data collected is analyzed through three steps: mapping, delimitation by Zone-Boundary and classification by patterns of Route-Path. These steps correspond to each of the following sub-chapter.

3.1. Mapping

Belong to a mix-used building, OSUG presents a wide range of area for the users. Figure 4 below shows firstly the public zone with an outdoor area as an open garden and a semi-outdoor area separated by a glass wall as a resting area. Besides, there is the lawn area as the public playground and the UG as the non-public area. The UG can be seen from the OS and is located along the sidewalk. Here, areas are differentiated by flooring material such as grass, wooden deck, concrete or soil. The separation between each area is also materialized as fences, stairs, high or low vegetations, benches with or without backrest, concrete blocks, counters or indication boards. For the fieldwork, the on-site observation consists of mapping the position of users in each area of OSUG and checks if the users were coming alone or with a company. Other data belong to users are captured by photography to verify their movement as sitting, standing or passing between area. Details of the movement are then classifying in the following chapter.

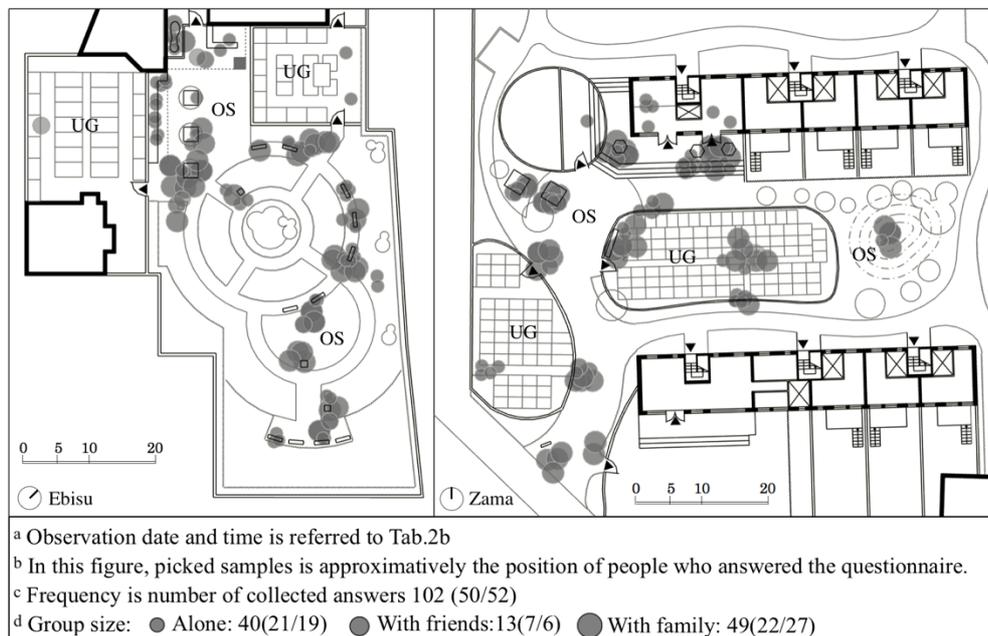


Figure 4. Observation in OSUG

3.2. Classification of Zone and Boundaries

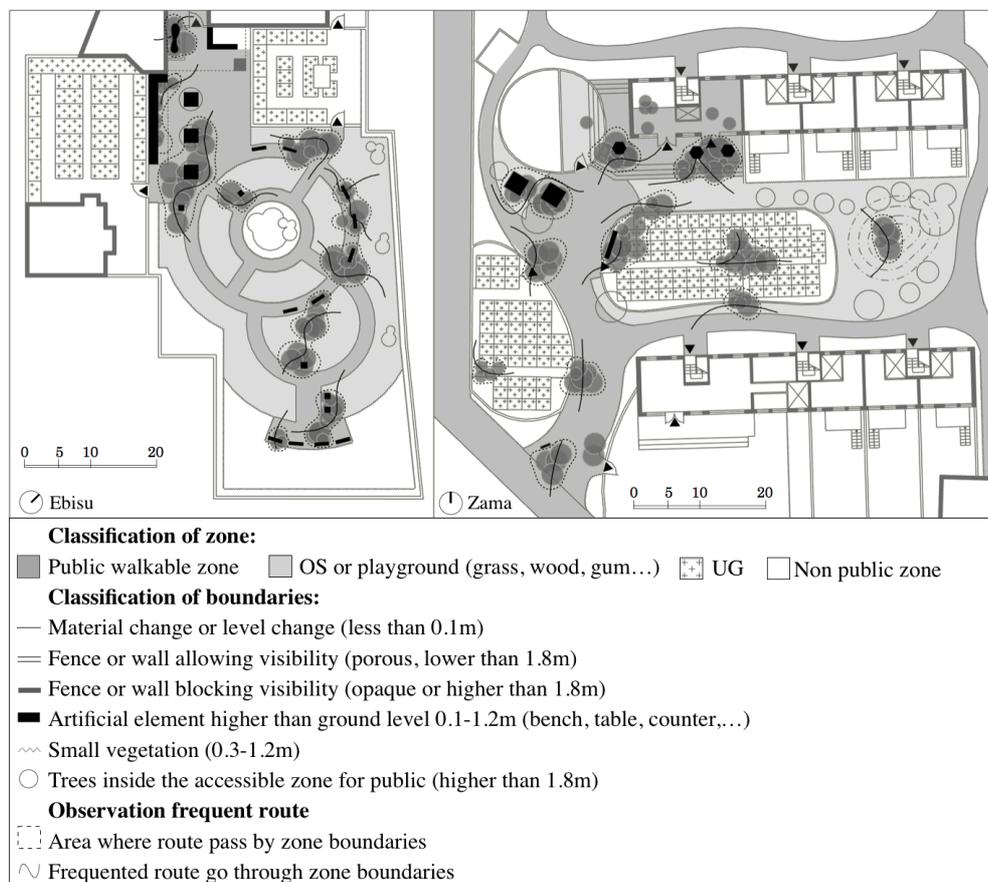


Figure 5. Zone and boundaries in OSUG

According to the classification of Zone and Boundary, each area represents a different degree of publicity. Zones is categorized as a walkable zone for the public, zone for the playground, zone not open for public and zone for UG. The separation between each zone is identified as a boundary between zone. These boundaries are classified to follow their physical features such as height, texture and being artificial or natural elements. As shown in the illustration of Figure 5 above, the planning and planting of each case study are related strongly to the site constraints. For instance, the renovation in E of an existing rooftop causes technical concern on load limitation, drainage and windproof. The design consisted of preserving the corner zone for UG, planting trees and abundant green, while the OS has a lightweight soil suitable for grass and low height vegetations and the seated area have protection for strong wind. Differently, since Z is a housing which concerns on the limit between private and public, the design of public zone is restricted on the area between two buildings by maximizing UG for community use and a narrow area for OS delimited by trees and typology. Besides, observation on the frequented route by combining all user's position is illustrated. In the map of figure 5, all the positions are where the observation found a high frequentation of users (more than four times during six visits on each site). And all recorded positions are grouped with the nearby boundaries to find out the patterns of Route and the configuration of Path, by examination in details the features of boundaries of each zone.

3.3. Patterns Route and Path configuration

Table 3. Route patterns according to relevant zone

Route Patterns	Zone where observed sample are found	Movement observed in this zone	Sample (102 – E/Z)
R00	Resting area or area for UG	Stay	20 (8/12)
R01	Zone around UG	Approach	22 (4/18)
R02	Zone around the resting area	Cross	29 (15/14)
R03	Zone around the playground or OS	Cross	25 (18/7)
R04	Playground or OS	Cross	6 (5/1)

According to the grouping of Figure 5, boundaries of each zone appear to either guide users to stay in a specific zone of resting area, UG and playground or allows them to approach or cross between zone. Consequently, Route patterns presenting in Table 3 shows an equal number of Route for crossing and non-crossing in both cases. The highest quantity found in R01, R02, R03 where users of OSUG tends to move between areas. The reason for this pattern is to analyze in the next figures which defined the characteristics related to the movement as boundaries which blocks or affords cross and approach. The order of parameters configuring this boundary is defined such as height, texture opaque/porous, and if the connected floor under is presenting a change in level or a change in material.

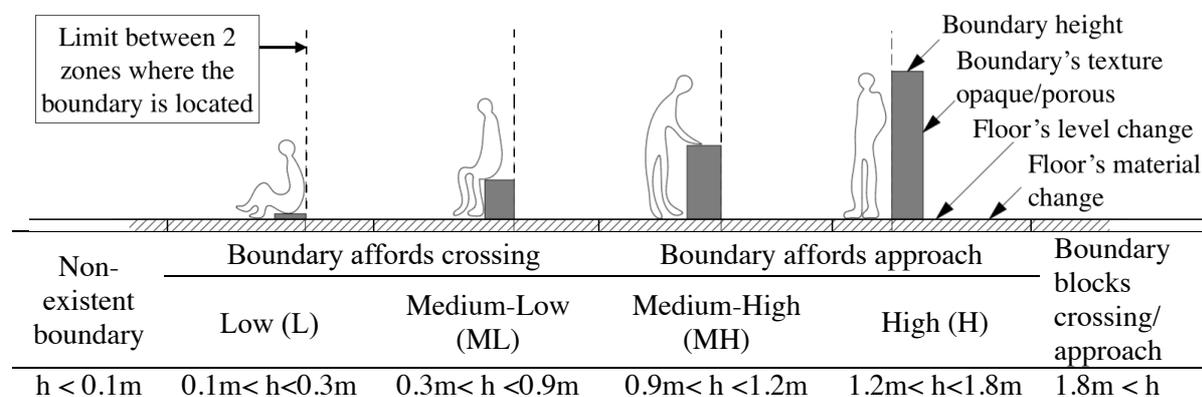
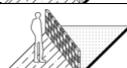
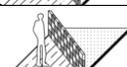


Figure 6. Parameters configure Path

By applying the above scheme to Table 3, it explains why the amount of sample R01 is higher in the case of Z. The reason could be by the large quantity of boundary afford approach like a porous fence for UG in the case of Z compare to E. On the other hand, the pattern of Cross related to the playground is much higher in the case of E, where there are more lawn space and wooden deck with low height separation. Furthermore, the results of Table 4 below show the illustration of Path configuration and its distribution in two case studies. Each of the configurations presents a dominance in E or Z, except for the case of Pa1. This result could explain the same level of Path configuration exists in both cases for the design of a resting area and UG. On the other hand, dominance emerged in the case of Pb1, Pc1, Pd1 and Pd2 represent a tendency to design the OSUG according to the specific situation of each case studies. This finding explains the Spatial Characteristics of OSUG revealed by the patterns of Route and Path.

Table 4. Path configuration according to boundary's features

Route patterns	Boundary's features								Path configuration	Total sample 102 (E/Z)	
	Height				Texture		Floor				
	L	ML	MH	H	Opaque	Porous	Level change	Material change			
Stay (R00)		•			•					Pa1	16 (7/9)
			•		•			•		Pa2	4 (3/1)
Approach (R01)			•			•		•		Pb1	19 (4/15)
			•			•	•	•		Pb2	3 (0/3)
Cross (R02, R03, R04)		•			•			•		Pc1	35 (26/9)
			•		•		•	•		Pc2	5 (4/1)
		•			•		•			Pd1	12 (0/12)
		•			•			•		Pd2	8 (8/0)

4. Spatial quality of OSUG

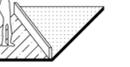
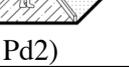
From the previous research, SA is the combination of Route and Path in each scenarios OSUG to compose the quality of OSUG. This chapter purpose of identifying the SA in each scenario and compare SA in scenarios E and Z with their initial design concept to reveal the effect of SA on the Spatial Quality.

4.1. Scenarios and space affordance

Through collection data of preliminary survey, the intended scenarios of integrating UG to the mix-used building are understood as a tool to attract new user by the bias of providing a resting place, an outdoor leisure place for exercising and a gathering place for the community. This initial intention corresponds to the finding of seven scenarios currently happening in the renovated OSUG illustrated in Table 5. There are resting scenarios like in S1, S2 or S5, while physically action scenarios occur in S3, S4 or S5 and gathering situations like in S6 and S7. As an overview, a similar quantity happens in most of the scenarios in both sites of Z and E (S1 to S6). However, only scenario S7 is happening in Zama case. The

renovation's purpose could explain this phenomenon in Zama which focus on community gardening and it justifies the central location of UG in OSUG and also the majority of Approach SA (Pb1). Another scenario which has a monotype of SA (Pa1) is S5 where users are observed doing a single action for a long time like a long rest (sleep, read, relax) or gardening. It often happens in an area away from the frequented public zone and during a less frequented time. Otherwise, for other scenarios, the variation on the combination of each SA leads to an alteration in the scenario's core and corresponds to a change in the user's activity. In general, when there are more varieties of affordance, the scenario tends to belong to users of the group with children, and the movement and activity of scenario are more diverse.

Table 5. Route patterns according to relevant zone

Scenarios	Description	Sample 102 (E/Z)	Photos	Space affordance
S1-OS for short rest	User eating and resting after lunch	16 (9/7)		  Stay in R00 (Pa1), Cross in R02 (Pc1)
S2- Area to pastime	User walking and using device while waiting	16 (12/4)		   Stay in R00(Pa1), Cross in R02, R03 (Pc1,Pc2)
S3-Natural playground	User playing, exercising or walking alone/group	12 (4/8)		  Cross in R02, R03, R04 (Pd1, Pd2)
S4- Compact urban park	User enjoy garden alone or in group	19 (12/7)		   Approach in R01(Pb1, Pb2),Cross in R03(Pc1)
S5-Privacy in public space	User resting or doing garden alone	14 (4/10)		 Stay in R00 (Pa1)
S6-Mix used building exterior	User in group eating, resting playing after shopping	12 (9/3)		     Stay in R00 (Pa1) Cross in R02, R03, R04 (Pc1, Pd1, Pd2)
S7-Garden foster community	User watch others gardening	13 (0/13)		 Approach in R01 (Pb1)

4.2. The flexible but tangible quality of space affordance

Space affordances (SA) in this study represents the effect of the boundary on users frequented routes and their paths as stay, approach or cross between zones. It also conditions the interchangeable relationship between the pattern of SA within different scenarios of OSUG. As illustrated in Figure 7, scenarios of both case study could be changed from one to another depends on the flexibility of SA. For example, a simple change of floor's material, floor's level or boundary height of affordance in S1 can change the scenario from pattern of Stay (Pa) in a rest area to the pattern of Cross (Pc, Pd) in the playground of S3. Then the affordance of S3 which is a low height and a change in the floor's material could be multiplied, to create stairs in the S6 of Zama or to duplicate the flooring of S6 of Ebisu. Consequently, S2 is created by the combination of affordance in S1 and S3. Simultaneously, by the

transition of texture to porous of S5 to S7, the patterns of Stay (Pa) also transform to the pattern of Approach (Pb). This flexibility creates a diverse spatial characteristic for the OS or UG in both E and Z and also explain why the scenario of S7 which focus on community happen only in Zama. On the other hand, by order of SA from the according to the degree of movement, there is the same order of interchangeable relationship of each scenario happen in both cases studies. The more flexible SA result in the more complex relationship of scenario, in other word SA have an important impact on the planning of these projects. This result demonstrates that the design concept of renovated OSUG did not only favorize the flexible quality of space affordance but the result is tangible and in general corresponds to the intention of the design. Furthermore, the different purpose of renovation concept reflecting in the singularity of design planning also affects the user behavior in OSUG. This finding emphasizes the importance of understanding the relationship between SA toward the user's experience or expected scenario right from the design concept of the renovated OSUG project.

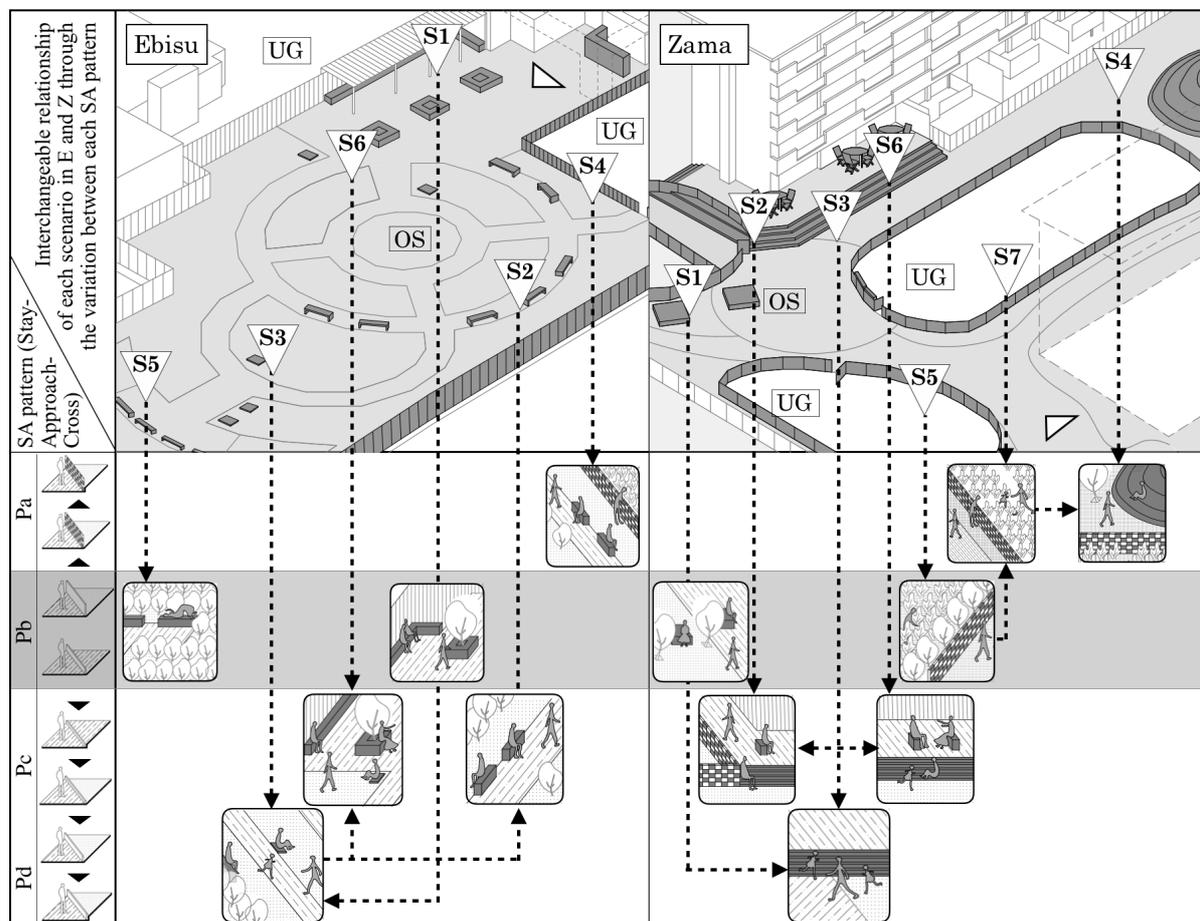


Figure 7. Relationship in terms of spatial quality between scenarios of OSUG

5. Conclusion and further discussions

By analyzing the SA of OSUG via investigation of the spatial characteristics and the spatial quality, this study suggests that the design of renovated OSUG have to pay attention to the quality created by SA. This study has investigated not only the SA of urban open space but how closely it is connected to the design concept and how important its impact on user behavior. Firstly, through observation and classification of zone and boundary, users in both case studies of Ebisu and Zama have shown a high score of crossing route between delimited zone and boundaries following a variety of path configuration. Secondly, the difference between the dominant of route patterns and path patterns in each case study also shows a relationship between existing scenarios found on OSUG and the design strategies, which

centers on the OS on Ebisu and on the UG in Zama. Finally, by comparison between affordance of Zama and Ebisu, research concludes that the flexibility induced by these SA following a specific order in relation to the initial design concept and planning. However, this flexibility is tangible and could be studied and guide the design of future renovation project of OSUG.

Besides, the research results have confirmed the role of UG in renovated OSUG. This role is related to the design intention and has some degree of variation. For instance, the scenarios existing in Zama focus primarily on the importance of UG. It explained not only by its centrality in spatial structure but also by the patterns of Approach linked to the scenarios around the UG. In Zama, despite the occasional presence of UG support staff and a delimited zone for OSUG, the role of UG is placed in the center which also shows the success in attracting the interest of the community. This effort corresponds with the initial intention of the designer to use UG as a tool for promotion to change the image of community housing and to invite visitors to enhance the neighborhood of Zama. While in Ebisu, UG is considered as an added value to the OS. It is explained not only due to the site constraints of the technical problem but could also link to the reality of gardening of Ebisu as a personal leisure activity. It is where SA is designed with the focus on the patterns of Cross on the OS and a separate pattern of Stay in the rest zone and UG, both considered as a private activity. Likewise, to compare with the trend of developing UG in other countries of Asia and Europe where UG is most likely a beneficial community practice, the case of Ebisu appears to be more related to a design of general urban recreation space. This design method in Ebisu might be considered appropriate to the situation of urban dwellers in central Tokyo, which centers on accommodating to individual well-being. However, the lack of focus to integrate community aspect in the design for UG in Ebisu has reduced the essential of promoting green and healthy physical activities in this case study. From the example of these case studies, it shows that the design on SA needs to focus on emphasizing and anticipating on the user's behavior and the scenario could happen. This finding is considered critical in the future proposal of urban design strategies.

Furthermore, in this study, spatial quality of OSUG is defined by the variety and flexibility of SA. This finding shows that measuring the effect of affordance on the intended scenario, therefore the impact on user's behavior is possible. By considering a framework to understand the implications of affordance on behavior is one solution to guaranty the quality of the new design for urban recreation space, especially in the renovation project where there is an existing social and environmental context. However, SA is not just a result of design planning or a design product; its relation with users and the environment is much more complicated. Therefore, the quest to find out the changeable character of affordance related to environments such as the weather or user perception is left open for further discussions. Finally, the scope of this study is limited to the case studies and samples collected from the previous survey. Whether this result may apply to other locations and situations under different conditions needs further investigation.

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