BROKEN WINDOW THEORY AND LITTERING BEHAVIOR: A STUDY OF SPATIAL-BEHAVIORAL RELATIONSHIP IN MEDIUM-SIZED CITIES OF SRI LANKA

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Abstract: The study focuses on studying the applicability of the Broken Window theory to understand spatial-behavioral relationships, focusing on littering behavior in medium-sized cities in Sri Lanka. Recognizing littering as a multifaceted urban issue, the research review prior studies conducted on the matter that focuses on social and behavioral aspects but overlooks spatial factors. With Panadura, Sri Lanka as the case study, the research identifies locations with high litter accumulation in various public spaces and identifies their spatial characters, such as signs of neglect, disorder, damages, and poor maintenance, aligning with Broken Window Theory's premise that signs of disorder can encourage further disorder. A questionnaire survey conducted with controlled visual stimuli of identified spatial characters indicate that respondents are more likely to associate littering with neglected or disorderly spaces while noting that littering can occur more in these spaces, and exhibit stronger place attachment towards well-maintained, natural, or orderly environments. The findings affirm that proper maintenance and order in public spaces will foster strong place attachment and discourage littering. Offering an effective strategy to address urban waste issue beyond conventional enforcement. The study highlights the importance of integrating spatial planning and environmental cues into waste management of urban cities to enhance their livability.

Keywords: *Broken Window theory; Place attachment; littering; spatial characters; Public spaces.*

1. Introduction

Waste management is one of the major challenges globally. With rapid population growth and urbanization, solid waste management has become a critical issue in urban contexts, raising and environmental concerns. (Delavari H et al., 2024; Muñoz et al., 2012) While household, commercial and industrial waste are major concerns, littering is also an issue that cannot be disregarded.

Littering, especially in public spaces is an issue while seems small, has major environmental, social, health, and economic impacts that can significantly degrade the quality of life. The accumulation and dispersal of litter in public spaces results in unpleasant spaces that are unappealing to people, additional costs and labor for cleaning, and contribute to environmental degradation. Furthermore, it is speculated that the presence of litter can also influence crime rates in an area as well. (Muñoz et al., 2012).

Littering is a multifaceted issue encompassing material production, consumption, socio-cultural dynamics and contextual influence. (Demel, 2021) While pinpointing a specific cause for littering is challenging, many studies have been conducted in an effort to understanding the littering behavior. The majority of existing research focuses on personal behaviors, societal norms, and social influences that influences littering. While informative, a pattern of contradictory results are noticeable among the results of these studies.

A critical gap remains in the contemporary research landscape regarding the influence of spatial perceptions on littering behavior. This underexplored spatial-behavioral relationship might explain why the issue of littering persists regardless of policies, legislations, and design strategies aimed to prevent it due to their lack of attention to the influence of environmental clues and spatial characters. It can be speculated that the contradictions in earlier findings could be due to how littering behavior is influenced by spatial characters and how they are perceived by individuals.

The relationship between spatial perception and littering behavior is an underexplored but important aspect. It could be argued that understanding and treating the root of the issue would be much more effective rather than reactionary solutions or ineffective design interventions. Highlighting the necessity of a holistic approach that includes the influence of spatial and environmental characters on individuals.

1.1. AIM OF THE STUDY

To explore how spatial characters of public spaces, particularly regarding medium-sizes cites in Sri Lanka such as Panadura, influence individuals' littering behavior, with the focus of evaluating the applicability of the Broken Window Theory.

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1.2. OBJECTIVES

The first objectives of the study is to critically review existing literature regarding Broken Window theory and other complimentary theories such as Environmental Cue theory and Place attachment theory regarding littering.

The second objective is to identify and document spatial characters of public spaces in medium-sized cities with higher litter accumulation through field observations, and to conduct surveys using images of identified spatial characters to gather data on individual perceptions and littering intentions.

The final objective is to collect and analyze survey data to evaluate the spatial-behavioral relationship and to evaluate the validity of Broken Window theory regarding littering.

1.3. EXPECTED OUTCOMES

Understanding the spatial-behavioral relationship is essential as a method of devising informed decisions in spatial planning to ensure littering will not be enabled. The results of the study will ensure a deeper understanding of spatial-behavioral relationship and help landscape architects, architects, and urban planners avoid accidental or unintended creation of such spatial characters that influence littering. Addressing the issue at root can reduce energy and cost spent on cleaning litter and enforcement of legislations to keep public spaces clean.

2. Literature review- Broken Window theory

Broken Window theory originated as a criminological theory. According to Wilson and Kelling, (1982) "physical and social disorders exert a causal effect on criminal behavior" (Lanfeer et al., 2019) the theory brings forth the idea that signs of disorder can invite more disorder. While this has not been proven as fact, it does offer an interesting perspective that the spatial characters can influence the behavioral responses of an individual.

Recent studies further affirms the argument that visible signs of disorder such as litter or graffiti tends to increase more antisocial behaviors including littering itself. Controlled experiments conducted in urban context have illustrated that individuals are more likely to litter when environmental disorder cues are present, supporting the idea that disorder showcases weakness or lack of social norms and enforcement. (Keizer et al., 2008; Volker, 2017) this further solidifies the core premise of Broken Window theory that signs of neglect can be a catalyst for further disorderly behaviors.

It should be noted that the application of the Broken Window theory should be critically analyzed. A major argument against the theory is that it can confuse correlation and causation. Especially because crimes and disorders stems from deep rooted social issues such as poverty or inequality. The applicability of the theory is further affected by the cultural, economic, and contextual differences. In Sri Lankan setting, it is important to apply the theory cautiously while taking urban forms, capabilities of local governance as well as socio-cultural dynamics into consideration. Due to empirical evidence on the effectiveness of the theory being inconclusive, it should be applied consciously with complementary theories.

Even though the theory has not be proven in criminology, it has been used in various other fields as a means to understanding spatial-behavioral relationship. One of the major points noted in many research regarding the Broken Window theory is that signs of disorder can influence petty crimes as well as littering. (Volker B, 2017; Lanfeer et al., 2019; Keizer et al., 2008)

When specifically discussing about littering, while some studies explore the direct link between the Broken Window theory and littering behavior (Malomo et al., 2021) other studies highlight a connection between the quality of the physical environment and litter all the while not explicitly stating the theory itself. (Mori Y et al., 2024) Broken Window theory by itself cannot completely explain the littering behavior. Studies have identified that when spaces show signs of disorder it can undermine the attachment one feels towards the space. (Cannon et al., 2025) Which in turn can encourage individuals to litter. Hence, it can be argued that a strong place attachment can foster antilittering behavior. And to achieve that, removal of signs of disorder is needed.

Other theories complement the Broken Window theory while providing a possible explanation. Place attachment theory explains how disordered spaces can increase littering due to the reduction of emotional connection and subsequent stewardship towards a place, which can lead to neglectful behaviors. Furthermore, Environmental cue theory aligns with this theory by claiming that negative cues such as damage or neglect can diminish place attachment, reinforcing the behavioral effects proposed by Broken Windows Theory (Peters, 2016).

Broken Window theory in isolation cannot wholly justify the spatial-behavioral relationship that can influence littering. While it can explain how spatial characters can lead to increased littering, the explanation as to why can be explained by the Place Attachment theory and to some extent- the environmental cue theory.

3. Methodology

While the existing literature provides a good understanding of how spatial-behavioral relationship can lead to anti-environmental behaviors such as littering, it only gives a vague notion of the spatial characters that can be a negative environmental cue or diminish the place attachment rather than doing in-depth study. As mentioned previously the study will evaluate what specific spatial characters can be perceived in a negative manner that can lead to increased littering with reference to public spaces in medium-sized cities such as Panadura.

3.1 CASE STUDY: PANADURA CITY

Panadura is considered a medium-sized town (Second-order town) according to standard definitions. (Weeraratne, 2016; Panadura Urban Council, 2002; Abeyanayake, 1992) Panadura does not have the necessary resources or strong local governing bodies to handle the strain of waste management. Furthermore, Panadura town a city that has naturally evolved over time. The evidence of this evolution are visible in the complex and organic urban form.

The resulting lack of proper land use, haphazard development, development of buildings encroaching on drainage, road reservations, creates a complex spatial-behavioral relationship. Spatial characters were analyzed in three public spaces in Panadura with varying uses such as facility public spaces, commercial public spaces, and recreational public spaces. The spaces are the Panadura Private Bus stand, Panadura market and the Panadura beach respectively. Collectively these aspects provide a unique context to study the spatial-behavioral relationships in different public spaces.

3.2 DATA COLLECTION AND IDENTIFICATION OF SPATIAL CHARACTERS

A preliminary site observation was conducted to identify the basic layout of the selected areas and to identify litter accumulation hotspots. Four major hotspots for each public space were identified with the aid of a modified Clean Coast Index. Subsequently, few more visits were done to confirm that the identified locations are indeed hotspots for litter accumulation and not a one-time littered space.

Built spaces with predominantly geometric forms, high visual clutter and stimuli as well as visible signs neglect and damage were identified as common characters of the spaces with higher amount of litter accumulation. This partially aligns with the premise of the Broken Window Theory.

Figure 1: Selected Public Spaces in Panadura (*Compiled by Author*)

Figure 2: Litter Hotspots (*Compiled by Author*)

3.3. SURVEY DESIGN

To conduct the survey, images taken within Panadura were utilized to represent the medium-sized city type. The photographs were carefully selected to showcase identified spatial characters individually. If the photograph contained too many variables they were digitally altered to isolate the specific character. This was done to reduce overlapping variables and for clarity of the character. Along with these images, another set of images are also selected to represent the opposing state of each character. These images will help create a controlled visual stimuli and can enhance the validity of the responses.

The survey will focus on hard landscape and soft landscape of a space and how their conditions such as state of negligence vs. maintenance, disorder vs. order as well as spatial composition can influence place attachment and littering as a behavioral response. The survey questionnaire consists of the images, simple choice questions regarding the images along with open ended questions giving the opportunity for the respondents to explain their choices. The questionnaire was distributed online to get a random sampling of respondents regardless of their age, gender, and social background. Furthermore this would allow to get responses from people that are not familiar with Panadura, reducing the possible bias that could occur.

Figure 3: Images representing built and natural environment *(compiled by author)*

Figure 4: Neglected vegetation and maintained vegetation *(compiled by author)*

Figure 5: disorderly and orderly spaces (*Compiled by Author*)

4. Findings

The survey was distributed via online platforms for a two week period. A total of 123 responses were recorded. Majority of respondents (99.2%) acknowledge that littering is a prominent environmental issue. 95.9% of the respondents stated that they associate littered spaces with negative emotions such as annoyance, disgust, and disappointment. This finding highlights a general environmental consciousness among respondents that increases the reliability of their perception-focused responses.

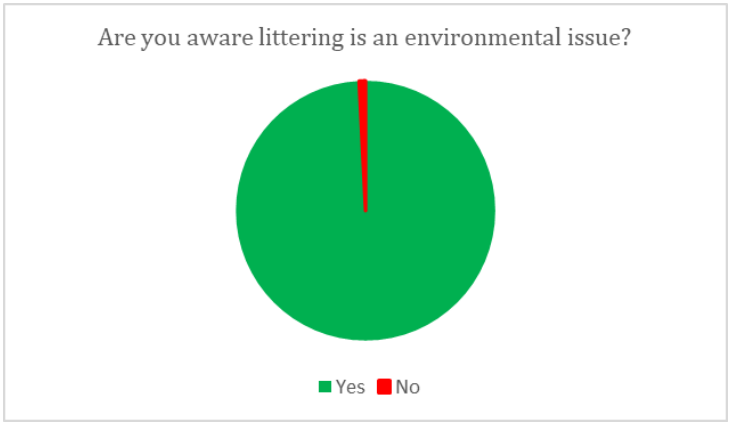

Figure 6: Responses on environmental awareness of respondents (*Compiled by Author)*

4.1 PERCEPTION OF SPATIAL CHARACTERS AND PLACE ATTACHEMENT

Survey respondents evaluated the given sets of images (Figures 3 through 5) depicting different spatial characters of public spaces in Panadura. The responses were then thematically coded. Several key themes were identified according to the perceived appeal and tendency to litter which are associated with specific spatial characters.

The aim of this particular question was to get a general consensus on how people think a specific spatial character can encourage litter accumulation. This would be influenced by the respondents' experience and their understanding of the spatial-behavioral relationship. Focusing mainly on what they think others would do. Next, the respondents were asked what location would they chose If they were forced to litter to understand how people would explain their own perception of the place and their own behavioral responses. The results were as shown. (Table 1)

Table 1: Percentages of responses

Image	Finds appealing %	Probability of litter being present %	Choice if forced to litter %
1A	7.3	87.4	88
1B	92.7	12.6	12
2A	4.5	93.6	94.9
2B	95.5	6.4	5.1
3A	6.4	97.2	92.7
3B	93.6	2.8	7.3

Among the first set of images (Figure 3), responded preferred the image with natural elements citing cleanliness, calmness, and visual appeal as the reasons. The less appealing image was noted to be associated with litter, damage, and chaotic stimuli as well as lack of authority presence, which could lead to a high likelihood of littering. Furthermore, the aversion to littering in natural environments was linked to environmental responsibility of an individual and guilt, consistent with earlier research that states on reduced litter cognition in natural settings (De Veer et al., 2022).

Although people tend to be attached to spaces with greenery, the condition of the greenery also affect their perception especially regarding greenery in built environments. Considering the second set of images (Figure 4), respondents preferred orderly, visually appealing, and well maintained soft landscapes over neglected and overgrown vegetation. The neglected soft landscape was noted to promote perceptions of litter being present, influencing littering behavior. These spatial cues significantly influence place attachment and the sense of responsibility to keep the place litter-free.

Similarly, among the third set of images (Figure 5) clean and orderly hard landscapes were favored due to the perception that these spaces are safe and well-maintained. The damaged surfaces and clutter were associated with insecurity, existing disorder and litter, which further encourage littering. These "broken window" cues being present tends to diminish place attachment, resulting in increased littering. Furthermore, old and neglected appearance and clutter would make the litter less noticeable and acts as a cue to litter. Additionally it was noted that when the place looks clean, well-maintained or visually appealing, it makes the respondents feel guilty about littering, making them reconsider or make an effort to properly dispose of their waste instead of littering

4.2 SPATIAL CUES AND BEHAVIORAL RESPONSES

Among all image sets, spatial conditions that signal neglect or disorder tended to diminish place attachment and sense of responsibility towards the place, which promoted littering. Well-maintained environments fostered feelings of responsibility and guilt toward littering, often deterring such anti-environmental behavior. These findings affirm the Broken Window theory's relevance in environmental behavior.

5. Conclusion

During the field observations it was notable that litter accumulation hotspots tended to be visually abandoned, neglected or showed signs of disorder in the form of damaged surfaces, excessive posters and signs of discolorations. Which corroborate the broken window theory. Although field observations alone could not confirm that the litter accumulation occurred specifically due to the spatial characters.

The visual questionnaire survey was conducted as a method of affirming the observations through large sample as to increase the credibility of the findings. Results showed that majority of respondents (93.4%) finds natural environments and feel attached to them. It was also noted that they would not litter in natural environments due to sense of responsibility and the guilt they would feel. In this regard being environmentally conscious increased the place attachment respondents feel towards natural environments along with the calm and comfortable atmosphere they provide. Though littering in built area is also an environmental issue, respondents cannot easily identify it due to the reduced litter cognition, as discussed previously.

When focusing on built environments, the place attachment is greatly influenced by the spatial characters of a place. When a space depict a "broken window" scenario, people find it less appealing, reducing the place attachment. The uncared-for environments give the cue that 'this place is abandoned, this place is unimportant' which also dissuade users from feeling attached. Both the soft and hard landscaping of a place being well-maintained and care for can vastly increase its appeal to users. Which in turn would enhance place attachment and create a fostering user base that would prevent from engaging in littering.

In this study, the broken window theory is affirmed both during the field observations and questionnaire surveys. The results indicate that if proper maintenance, cleanliness, and appearance of a place is upheld, it would make a significant impact on littering behavior. With proper maintenance schedule and infrastructure development littering can be reduced by fostering place attachment, rather than rigorous enforcement. Which would be highly beneficial in Sri Lanka, especially due to the concerning lack of legislation enforcement regarding littering. Furthermore with place attachment fostered towards public spaces, the strain of litter management on the local governing bodies, especially medium and small- sized cities, will be decreased. Overall, well-cared for public spaces will encourage socioeconomic growth of cities while enhancing the quality of living of the citizens.

6. Limitations and further research

The study would benefit from a larger sample of respondents to increase the credibility of the findings. The research only covers the state of hard and soft landscape of a space. The other aspects such as visibility, enclosure, user intensity, land use,

etc. was not factored in to the identification of spatial characteristics. Further research could be conducted on these aspects as well as on the relationship between the Broken Window theory and the Environmental cue theory.

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