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EXPLORING THE ACOUSTIC ENVIRONMENTS OF BARCELONA'S SUPERBLOCKS: PERCEPTIONS FROM SOUNDWALKS

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ABSTRACT

The Superblock proposal in Barcelona is a strategy for urban intervention that aims to promote lower traffic density, increased green spaces and quiet areas, thereby improving the health and well-being of citizens. Consequently, it can serve as a valuable case study for testing tools for soundscape assessment, as it provides a unique acoustic environment. To evaluate it, soundwalks were conducted in the Poblenou, Sant Gervasi, and Sant Antoni Superblocks. This study examined the similarities among these three locations in terms of how people perceive the quietness and sounds in each area. Subjective data were obtained through questionnaires with a 5-point Likert scale and multiple-choice questions. The results showed that Sant Gervasi and Sant Antoni Superblocks were not considered quiet areas by the participants, although birds and vegetation contributed positively to the sense of quietness in the first location. In Poblenou, the quietest point is related to the promotion of social interaction. The findings of this study can be used to plan new superblocks and analyze their effectiveness in promoting a better acoustic environment in the city.

Keywords: *urban soundscape, environmental noise perception, citizen science, urban planning*

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1. INTRODUCTION

Proposals to rethink urban environments based on enhancing proximity relations have been extensively discussed across various fields of study. Notably, global cities such as Paris, Milan, and Barcelona are striving to place citizens at the center of urban planning [1]. Furthermore, it not only aims to alleviate the negative impacts of urban congestion but also seeks to foster a healthier environment for residents.

These cities are promoting active mobility and reducing reliance on private vehicles through measures aimed at mitigating air and noise pollution. This approach aligns with the implementation of the “proximity city” concept, which seeks to create more accessible and sustainable urban spaces put all citizens at the centre [2].

In Barcelona, the Superblock proposal represents a comprehensive urban intervention strategy designed to reduce traffic density, enhance green spaces, and create quieter zones [3, 4]. The superblock is a spatial unit consisting of nine blocks, forming a square of (400x400) m, delineated by a network of primary roads that connect various origins and destinations throughout the city. When this unit is replicated within the urban framework, its dimensions are adapted to accommodate the morphological and functional characteristics of the existing city [5].

This approach maximizes the availability of public space, which is currently dominated by vehicular traffic, while simultaneously ensuring the system's functionality and organization. By prioritizing pedestrian accessibility and promoting active forms of mobility, the Superblock approach encourages community engagement and social



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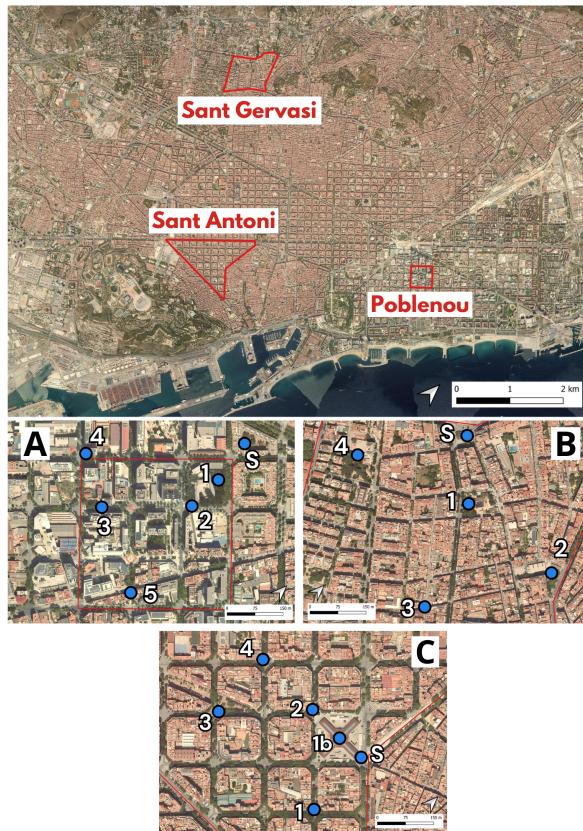


Figure 1. Three Superblocks analyzed (above) and the three soundwalks stops: A) Poblenou B) Sant Gervasi C) Sant Antoni.

interaction [3, 4]. The boundaries of the Superblock are defined by the primary roads, where through and connecting traffic is permitted to travel at a maximum speed of 50 km/h. In contrast, the interior roads (intervias) of the superblock form a local network with speed limits of 10 or 20 km/h, facilitating shared urban uses [4, 5].

The initial three superblocks were implemented between 2016 and 2019 in the neighbourhoods of Poblenou, Sant Antoni, and Horta. These interventions yielded benefits such as improved opportunities for rest, reduced noise levels, and decreased air pollution [4]. Consequently, these areas became quieter, fostering enhanced interactions among residents [3]. Over the years, other superblocks have been implemented in neighborhoods such as Sant Gervasi, Hostafrancs and Sagrada Familia [4]. This strategy is intended to enhance the overall well-being of citizens, contributing to health benefits [3,6] and a more sustainable and livable urban landscape [7].

In this context, the proposal of superblocks aligns with the necessity to enhance soundscapes through an understanding of the perceived acoustic environment. The purpose of quiet areas is to safeguard human health against noise annoyance and sleep disturbances—psychological factors that cannot be quantified using physical measuring instruments [8]. Only an assessment of how people perceive a quiet area can provide these insights. Considering that, superblocks may be a valuable source of information for the assessment of the sound environment, as they foster a distinct acoustic setting within the city.

For this purpose, were performed soundwalks, a conventional method for data collection in soundscape research, which offers a qualitative overview of typical methodological approaches in this field [9]. Therefore, the aim of this study is to examine the similarities among Poblenou, Sant Gervasi and Sant Antoni Superblocks in





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Figure 2. Three Soundwalks (from left to right): A) Poblenou - participants listening to the soundwalk instructions at Ada Byron Square (point S); B) Sant Gervasi - acoustic measurements being taken at *Jardins de Vil·la Florida* (point 1); C) Sant Antoni - intersection of Parlament and Comte Borrell Streets, both pedestrianized (point 1).

terms of how people perceive the quietness and sounds in each area.

2. METHODOLOGY

To evaluate each location, one soundwalk was conducted in each Superblock: Poblenou, Sant Gervasi and Sant Antoni (Figures 1 and 2). The structure of the soundwalks was detailed in each starting point (S), with an introduction to the activity in the field and a description of its purpose. Each soundwalk was designed to cover a length of 1.3 to 1.7 km. Each route was predefined incorporating 4 to 5 quiet areas. Participants were guided along the designated route, making stops at the identified quiet areas. At these locations, they were encouraged to engage in active listening to the surrounding environment for a duration of 1 to 3 minutes in silence. After listening, the soundwalk participants were requested to assess their experiences using a questionnaire that included open entry, multiple choice and 5-point Likert scale questions, to measure different aspects of the acoustic environment.

In total, a sample of 21 participants voluntarily participated in three soundwalks: 12 at Poblenou, 7 at Sant Gervasi and 2 at Sant Antoni. The participants were asked to evaluate the soundscape and express their perceptions using Hush City App [10]. Respondents answered questions concerning about what people were doing around, and evaluated the overall quality, cleanliness, maintenance, security and accessibility of each point. Related to acoustic environment, respondents answered the questions shown in Table 1 and L_{eq} values were collected at each stop via smartphone through the App. The subjective data col-

lected were analyzed through descriptive statistical analyzes and qualitative data analyzes.

2.1 Poblenou Superblock

The first soundwalk was conducted in the Poblenou neighborhood, which has undergone significant transformation in recent decades, evolving from an industrial zone into a residential and commercial district, while still retaining several areas of undeveloped land [11]. In September 2016, the Poblenou Superblock was established within the perimeter formed by Badajoz, Pallars, Llacuna, and Tanger streets [4]. The soundwalk was conducted in the fall of 2019 (27 September) at 3:00 pm.

The proposal involves a guided walk through the Poblenou Superblock, with stops at five listening points, beginning at Ada Byron Square (point S), a quiet area situated near the first street of the Superblock.

Point 1 is located within the Superblock, in a green space between the Can Framis Museum and a roadway. Point 2 is positioned between this museum and the Flor de Maig School. This street has been pedestrianized, converting it into a public space for community use.

Point 3 is situated in an office area where enhancements have been made, including resurfacing the ground and installing benches and tables, attracting office workers during lunch breaks. Point 4 is found in the border of the Superblock, adjacent to a busy road where traffic noise dominates the soundscape. Finally, point 5 is near one of the access points to the Superblock, where road traffic noise remains a significant presence.





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Table 1. Variables and questions used in this research.

Variables	Questions
Participant emotional status	What prompted you to record this sound?
Quietness of the soundscape	Rate how quiet the soundscape is in this location
Sense of quietness	Sounds that contribute positively to your sense of quietness
Social interaction	Do the sounds promote social interaction?
Conversations	Do the sounds encourage you to have conversations here?

2.2 Sant Gervasi Superblock

Sant Gervasi is a residential neighborhood known for its green spaces, such as *Parc de la Tamarita* and *Jardins de Vil·la Florida*. The soundwalk was conducted in the spring of 2021 (29 April) at 4:00 pm. The starting point (S) is located at the center of Bonanova Square, where Sant Gervasi de Cassoles Street begins, characterized as a semi-pedestrianized thoroughfare. Point 1 is situated in the park between Muntaner Street and Sant Gervasi de Cassoles Street, known as *Jardins de Vil·la Florida*.

Point 2 is positioned at the center of the square adjacent to the Mercat de Sant Gervasi, specifically in Frederic Soler Square. Point 3 is located at the intersection of Sant Marius Street (semi-pedestrianized) and Muntaner Street.

The path to point 4 extends outside the Superblock, traversing primarily through usual streets, such as Mandri Street. Point 4 is found in a highly regarded tranquil area of the neighborhood, known as Can Altimira Gardens.

2.3 Sant Antoni Superblock

Sant Antoni is a neighborhood of the Eixample district, close to the old city centre, and famous for its market which has recently been renovated [5]. The work carried out in this Superblock is the result of a dialogue process with local residents, merchants, and community organizations that began in February 2017 [4]. The soundwalk was conducted in the fall, on 17 November 2020 at 4:30 pm.

The starting point (S) is located in the final section of Ronda Sant Antoni, near the Sant Antoni Market, one of the largest markets in the city. Point 1 is situated at the intersection of Parlament Street (pedestrianized) and Comte Borrell Street (also pedestrianized). Point 1b is inside of Sant Antoni Market.

Point 2 is positioned in the center of the Superblock, at the crossing of Tamarit St. and Comte Borrell St. Point 3 is in a pedestrianized area, yet close to a road with traffic,

located at the intersection of Tamarit St. and Calabria St., marking one of the borders of the Superblock.

The route to point 4 extends outside the Superblock, passing through “normal” streets; however, point 4 is back within the Superblock, at the intersection of Viladomat Street and Floridablanca Street.

3. RESULTS

3.1 Poblenou Superblock

Participants were asked what activities the other people present at the location were doing, with the majority of responses indicating “passing through” or “talking”, and, in point 1, “relaxing” was highlighted.

In Poblenou Superblock (PB), when asked what prompted them to record the sound (Table 2), points 1, 2, and 3 were primarily characterized by the participants as associated with “comfort”, “calm” and “interest”. In contrast, point 4 was predominantly characterized by “disgust”, “irritation”, and “distraction”, while point 5 was identified with “distraction”, “disgust” and “interest”.

Therefore, points 1 and 2, identified as the quietest, were more closely associated with promoting social interaction and encouraging conversations (Figure 3). Conversely, points 4 and 5, which were less quiet, showed a weaker correlation with these factors.

Regarding sounds that positively contribute to a sense of quietness (Figure 4), “bird songs” at point 2, “leaves moved by wind” at points 1, 3, and 5, and “speech” at points 4 and 5 were particularly notable, although the latter were considered the least quiet among them.

Furthermore, participants evaluated how quiet each point was on a scale from 1 to 5, where 5 represents “very quiet”. It was observed that points 1 and 2 exhibited the highest average scores (3.5 and 4.2, respectively), whereas point 4 was the least quiet, with an average score of 2, as confirmed by L_{eq} smartphone measurements (Figure 5).





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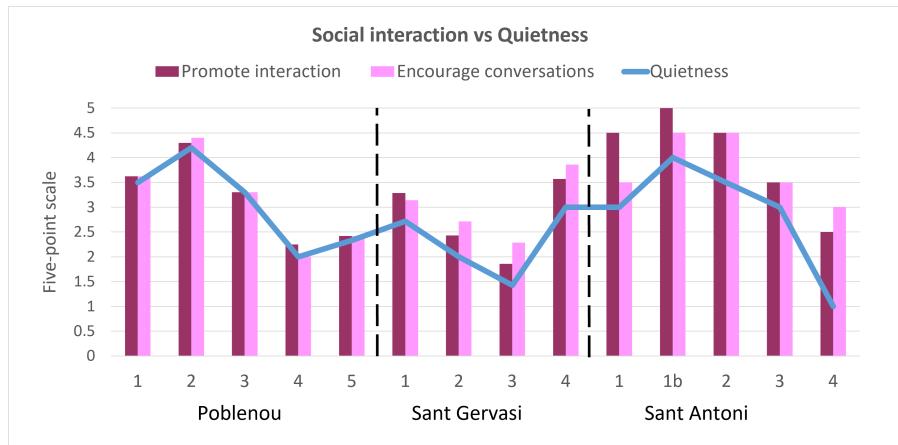


Figure 3. Answers to: To what extent do the sounds in this location promote social interaction and encourage conversations? - graph counting answer occurrence and plotted to get a 100 percentage on each bar.

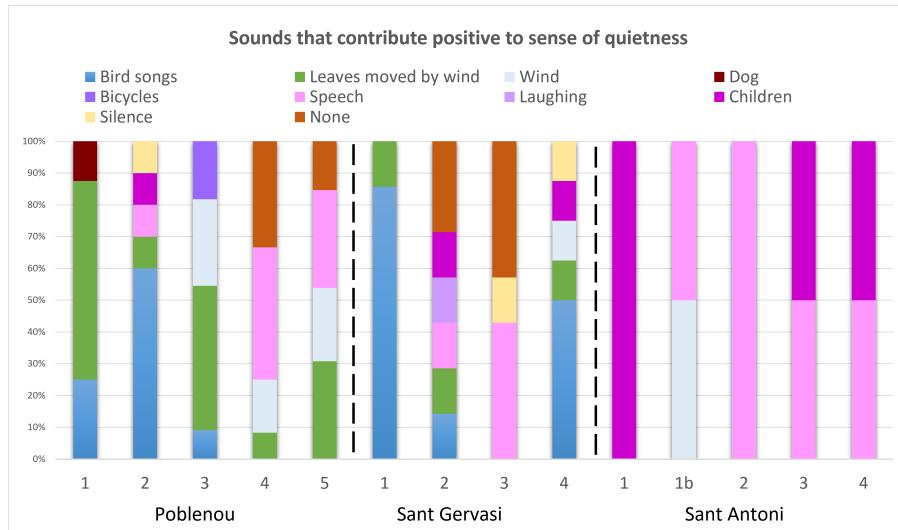


Figure 4. Answers to: Sounds that contribute positively to the sense of quietness - graph counting answer occurrence and plotted to get a 100 percentage on each bar.

Therefore, it was observed that in Poblenou Superblock, the sense of quietness is associated with green spaces (such as point 1), and pedestrianization of the street (point 2) has also contributed to a quieter environment, encouraging social interaction. However, points 4 and 5, characterized by higher traffic noise, caused feelings of irritation and disgust among the participants.

3.2 Sant Gervasi Superblock

In Sant Gervasi (SG), responses indicated that individuals were passing through, talking, and relaxing, but other activities also emerged, such as recreation, playing, and reading. When asked what prompted them to record the sound (Table 2), point 1 was characterized by feelings of distraction, comfort, and calm. Point 1 is located in *Jardins de Vil·la Florida*, recognized as one of the more





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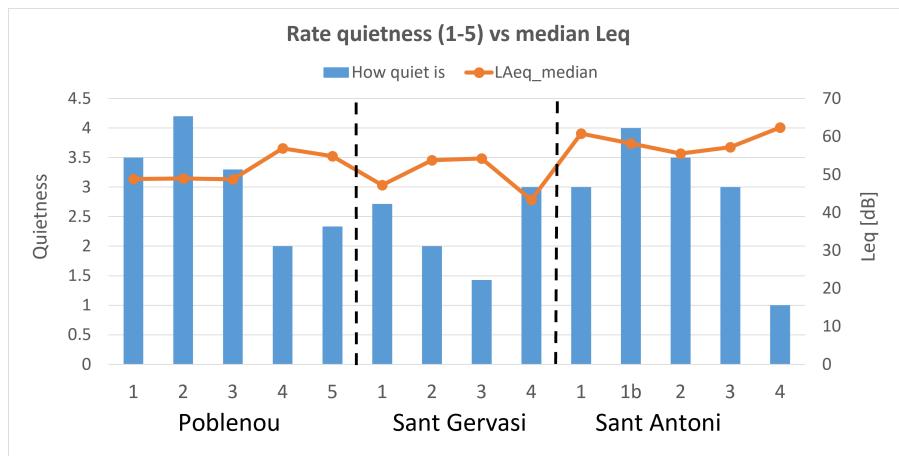


Figure 5. Answers to: mean Rate the quietness (1-5) vs median L_{eq} measured by smartphones.

tranquil areas in the neighborhood.

Point 2 also revealed distraction, along with irritation, which is interesting since this stop is located in a small square with a small park with a children's playground, adjacent to a market (Frederic Soler Square).

Point 3 was associated with irritation, anxiety, and distraction. This point marks the intersection of "quiet" area with a broader street that features ample pedestrian walkways. This segment of the Superblock has seen fewer interventions compared to others, but is home to several stores, bars, and restaurants. Point 4, a green space characterized by silence and tall trees, featuring a small bridge for crossing and recreational activities (Can Altimira Gardens), was primarily linked to distraction and enjoyment.

Participants evaluated the quietness of each point (Figure 5) on a scale from 1 to 5, with the highest score being 3 at point 4 and the lowest score of 1.43 at point 3, indicating that this area was not considered quiet by the participants.

Regarding the promotion of social interaction and encouragement of conversations (Figure 3), point 4 stood out compared to the others.

Finally, bird songs positively contributed to the sense of quietness (Figure 4) at points 1 and 4, while the sound of leaves moving in the wind was noted at points 1, 2, and 4. Speech was particularly prominent at point 3, and children were also mentioned at points 2 and 4.

Therefore, in Sant Gervasi Superblock the sense of quietness is associated with green spaces (point 1 and 4). However, points 2 and 3, characterized by closed proximity to trafficked roads caused feelings of distraction and

disgust among the participants. On the other hand, bird songs and moved vegetation produces positive sensation to people.

3.3 Sant Antoni Superblock

In Sant Antoni (SA), responses also indicated that individuals were passing through, talking, or relaxing. The Sant Antoni Superblock is situated in a highly commercial area of Barcelona (Eixample) and encompasses one of the largest markets in the city. When asked what prompted them to record the sound (Table 2), point 1 was associated with feelings of comfort, pleasure, surprise, and fun. Point 1b was characterized by calmness, nostalgia, and comfort, probably related to the market. Point 2 elicited feelings of comfort, calm, distraction, and pleasure. This area features a spacious environment adjacent to the market, while still accommodating local residents in terms of traffic flow.

Point 3 was associated with pleasure, irritation, and calm. This point is designated as a pedestrianized zone; however, it remains in close proximity to a roadway with vehicular traffic. While point 4 was primarily associated with disgust, distraction, and irritation, which involves interventions on two of the four surrounding streets to improve accessibility for pedestrians. Although Calabria Street continues to experience traffic and is not pedestrianized, this area has been adapted for urban life in a calming manner. It predominantly hosts conventional retail outlets and features a large square for public use.

The participants evaluated how quiet each point was





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(Figure 5) on a scale from 1 to 5. Points 1 and 3 had an average score of 3, with point 1b recording the highest average score of 4, followed by point 2 with an average of 3.5. The lowest value was observed at point 4, with an average score of 1, indicating that the area was not quiet. Furthermore, it was observed that points 1, 1b and 2 were more closely associated with promoting social interaction, while points 1b and 2 were related to encouraging conversations (Figure 3).

Table 2. Participants' results to the question: What prompted you to record this sound?

Location	Stop	Emotional status
PB	1	Calm (5), Comfort (4), Interest (2)
PB	2	Comfort (6), Calm (6), Interest (3)
PB	3	Comfort (4), Calm (3), Interest (3), Disgust (2)
PB	4	Disgust (5), Distraction (4)
PB	5	Distraction (5), Interest (2), Disgust (2)
SG	1	Comfort (3), Distraction (3), Calm (2)
SG	2	Distraction (4), Disgust (1)
SG	3	Distraction (2), Disgust (1)
SG	4	Calm (4), Distraction (3), Comfort (2)
SA	1	Comfort (1)
SA	1b	Calm (2), Comfort (1)
SA	2	Comfort (2), Calm (1), Distraction (1)
SA	3	Calm (1)
SA	4	Disgust (2), Distraction (1)

Regarding sounds that positively contribute to a sense of quietness, children were notably present at points 1, 2, and 3, while speech (people talking) was significant at points 1b, 2, and 3 (Figure 4).

Although numerous streets are pedestrianized, the Su-

perblock does not conform to the traditional shape associated with such developments and is primarily concentrated around Comte Borrell Street and the Sant Antoni Market.

3.4 Discussion

Although the L_{eq} values are similar between the Superblocks (with Sant Antoni's being slightly higher), it is observed that Sant Gervasi was perceived as the least quiet by the participants, although birds and the sound of leaves moving in the wind contributed positively to the sense of quietness. This result was unexpected, considering that two of the four points are located in green areas, which are generally presumed to be quieter. However, this result could be partially explained by the presence of an adjoining road to the park at point 2 that may have caused "distraction" and "disgust" feelings. This relation is also evident in the fourth points of Poblenou and Sant Gervasi which are located at the edge of the Superblock and are exposed to traffic. This relation is observed in [12] where a significant relationship is reported between L_{eq} and the perceived annoyance of traffic noise.

However, there are some cases where, even if the L_{eq} values were similar to those points or slightly inferior, the soundscape of the stop was perceived as positive using adjectives such as "comfort", "calm" and "interest"; it is the case of points 1 to 3 of Poblenou, 1 in Sant Gervasi and 1 to 3 in Sant Antoni. This relation was also found by [13], underlying the differences between objective measure and people's perceptions and the role played by other sound sources (birds and leaves) and visual pleasantness.

In the case of Sant Antoni Superblock, no biophonies or geophonies were assessed as positive contributors to the sense of quietness. This may be due to the absence of parks in the area, but also to the low number of participants; for this reason, another soundwalk will take place in Sant Antoni to better assess its soundscape. It was also observed that the quieter points were more conducive to promoting social interaction and encouraging conversations. Furthermore, the presence of people talking did not negatively influence the sense of quietness.

4. CONCLUSIONS

This study examined the similarities among these three locations in terms of how people perceive the quietness and sounds in each area. The findings of this study can be used to plan new superblocks and analyze their effectiveness in promoting a better acoustic environment in the city.





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The results underscore the importance of understanding the perceptions of individuals of acoustic environments, providing essential information for planning new superblocks and promoting improved acoustic conditions within the city. Assessment while participants were still at the specific location allowed them to better express their perceptions of the acoustic environment. Furthermore, understanding citizens' perceptions of the soundscape allows for a more accurate comprehension of the acoustic environment.

As a limitation of the research, there were few participants in the soundwalk conducted in Sant Antoni Superblock, once it was a pilot study of the route. Nevertheless, the validity of the data is corroborated by the acoustic measurements collected. Further studies could reapply soundwalks in the Superblocks to conduct comparative analyzes over time.

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