RELATIONSHIP BETWEEN COMMUNITY COMPLAINTS AND NOISE LEVEL DURING THE CONSTRUCTION OF A LARGE ROAD INFRASTRUCTURE IN MONTRÉAL

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1 Introduction

Noise has been considered as one of the most important challenges to the quality of life in the last decade by to the World Health Organization [?]. While some studies have previously investigated the links between noise annoyance and community complaints related to road and airport transport [?], the relationship between construction noise and complaints has been little explored. However, reviewing complaint data could help better understand community annoyance to noise and help plan future major construction work.

The relationship between complaints and noise levels does not seem straightforward. While some researchers have found an association between noise levels and the amount of complaints lodged in a community [?], other studies have not found such a clear correlation [?, ?]. Previous work from our research team has found that construction noise level explain only a fraction of annoyance levels (i.e., less than 1%), while psycho-social and contextual factors explained the majority of construction noise annoyance levels (i.e., up to 70%) [?].

Therefore, the aim of this study was to investigate the relationship between community complaints to noise and noise levels measured around a large construction worksite. The rehabilitation work of the Turcot interchange, located in Montreal, provided an opportunity to study community annoyance to construction noise.

2 Method

2.1 Complaints

This study was approved by the Ethics Committee of the Centre for Interdisciplinary Research in Rehabilitation of Greater Montreal (CRIR-1236-0317). A total of 1,325 complaints were collected through the complaint management system set up by the Ministère des Transports du Québec (MTQ) between January 6, 2017, and January 11, 2021. Of these, 31 complaints were excluded from the study because they did not concern the rehabilitation work of Turcot (n = 22), were duplicates (n = 5) or no information regarding the nature of the complaint was provided (n = 4). The analyses were conducted on the 1,294 remaining complaints.

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2.2 Noise levels

Eighteen independent noise stations, consistent with the ISO 1996-1 (2016) standard [?], were installed by the MTQ within 50 m of the Turcot complex. They allowed the measurement of multiple noise indicators (i.e., $L_{Aeq.24h}, L_{day}, L_{Evening}, L_{Night}, L_{10}, L_{90}, L_{Max}$) based on $L_{Aeq.1s}$ in 30-minute time averaging. Additional information regarding the localization of noise stations in the study area and the measurement of noise indicators can be found in other publications from our research team [?, ?].

2.3 Statistical analyses

Correlations between noise levels and number of noise complaints were investigated using Pearson's R (SPSS Statistics, 26.0.0.0 version) with a significance level of 5%. Note that a complaint can relate to several sources of noise (i.e., described here has complaint units) and in this case, they were considered independently.

Two approaches were taken to attribute a specific daily noise level to each complaint unit in the correlations. First, the logarithmic average of the sound levels of all active noise stations on the day the complaint was lodged. Second, the noise level at the station with the highest noise level on the day the complaint was lodged. These calculations were applied to all noise indicators.

3 Results

3.1 Noise complaints

Between 2017 and 2021, out of the 1,294 complaints, 457 were related to noise (about 35%). These were the most frequent in 2017 (n = 112), 2018 (n = 187), and 2019 (n = 124). Fewer noise complaints were lodged in 2020 (n = 34), period when most rehabilitation work was completed.

3.2 Correlations between noise complaints and noise levels

Person's correlations between the number of noise complaints units and noise levels were carried for the period between January 2017 and December 2019. Since few noise complaints were lodged in 2020, these were excluded from the analyses.

When using the first approach to attribute a noise level to each complaint unit (i.e., an average of noise levels across all stations on the same day of the complaint), significant correlations between complaint units and noise levels were observed (Table 1): $L_{10}(r(354) = .226, p < .001), L_{Aeq.24h}(r(354) = .192, p < .001)$, and $L_{Max}(r(354) = .158, p = .003)$ for 2017; $L_{10}(r(355) = .160, p = .002)$ for 2018; and $L_{10}(r(331) = .323, p < .001), L_{90}(r(331) = .282, p < .001), L_{Aeq.24}(r(331) = .343, p < .001)$, and $L_{Max}(r(331) = .283, p < .001)$ in 2019.

Table 1: Pearson correlation coefficients between the daily number of complaint units and the daily averaged noise levels across all stations.

	L_{10}	L_{90}	$L_{Aeq.24h}$	L_{Max}
2017	.226***	.074	.192***	.158**
2018	.160**	-.012	.089	-.041
2019	.323***	.282***	.343***	.283***

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

When using the second approach, the highest level obtained at a given station on the same day of the complaint, similar results were obtained (Table 2): $L_{10}(r(350) = .193, p < .001), L_{90}(r(350) = .123, p = .022)$, and $L_{Max}(r(354) = .158, p = .001)$ in 2017; and $L_{10}(r(330) = .310, p < .001), L_{90}(r(331) = .213, p < .001), L_{Aeq.24}(r(331) = .268, p < .001)$, and $L_{Max}(r(331) = .282, p < .001)$ in 2019.

Table 2: Pearson correlation coefficients between the daily number of complaint units and the highest daily noise level obtained at a station.

	L_{10}	L_{90}	$L_{Aeq.24h}$	L_{Max}
2017	.193***	.123*	.064	.178**
2018	.040	.034	.008	-.010
2019	.310***	.213***	.268***	.282***

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

4 Discussion

In our study, most construction-related complaints regarded noise. We observed that the number of noise complaints were relatively constant over the period of the rehabilitation work, indicating that noise is a major nuisance from the start of construction work until the end.

To better understand the relationship between noise complaints units and noise levels, correlations were computed . Significant correlations were obtained for most noise indicators in 2017 and 2019. However, most of these were poor. It should also be noted that most correlations in 2018 were not significant. This can be explained by the reduced number of active noise stations during that year because construction work was concentrated in two of the five residential areas neighbouring the Turcot structures. Therefore, the noise levels used for the correlations in 2018 might not have been representative of the actual noise levels across the entire worksite. Overall, our results suggest that indeed, the number of complaints lodged during the construction of a large infrastructure can be, in part, associated with noise levels.

Interestingly, the strongest correlations were obtained with the L_{10} noise indicator. The L_{10} is more representative of intermittent sources of noise that can emerge from the ambient noise. These could be more easily perceptible in neighbouring residential areas, which might explain their stronger association with complaints. Intermittent construction noise has also previously been associated with higher levels of construction noise annoyance [**?**].

Our findings are important for government agencies concerned about construction noise. They suggest that, in part, the number of complaints lodged by citizens can be associated with noise levels. Therefore, the use of noise indicators such as the L_{10} to monitor the soundscape and limit annoyance and complaints is supported by our results. However, since correlations between complaints and noise levels were weak, we believe that noise levels alone cannot fully explain why a specific individual decides to file a noise complaint.

5 Conclusions

In our study, we analyzed 1,294 community complaints lodged between 2017 and 2021, in the context of the rehabilitation work of the Turcot interchange in Montreal. Noise remained the nuisance causing the most important number of complaints. Complaint numbers were significantly correlated with various noise indicators, especially those integrating sound levels that emerge from the ambient noise (e.g., L_{10}). Our findings can help guide authorities in managing annoyance to noise and complaints in the community in the context of the construction of a large infrastructure.

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