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INTERACT

STUDYING THE ASSOCIATION BETWEEN BUILT ENVIRONMENT INTERVENTIONS, HEALTH, AND GENTRIFICATION: THE WHAT AND THE WHY

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Introduction

In 2019, our team launched *Sustainable Healthy Cities: The Interplay between Urban Interventions, Gentrification, and Population Health,* a research project aimed at **assessing the impacts of built environment interventions on health inequities with a focus on gentrification**. The purpose of this document is to provide clarity on the built environment interventions we are studying in Montreal.

> Gentrification can be defined as "an area-level process in which formerly declining, under-resourced neighbourhoods experience reinvestment and in-migration of increasingly affluent new residents" [1].

Research project

This research is a Montreal-based satellite project of the INTERACT team aiming to analyse the relationship between **built environment interventions**, gentrification and health outcomes, namely, physical activity, social connectedness and well-being. This study is based on a longitudinal design with retrospective and prospective analyses. In addition to participant recruitment made through INTERACT, we will complement the recruitment by further targeting adults living in low-socio-economic status (SES) areas – those that have a potential for gentrification – in the region of Montreal. Three data collection waves are planned: 2020, 2021, and 2023.

> Built environment interventions refer to changes that affect the "the land use patterns, the distribution across space of activities and the buildings that house them; the transportation system, the physical infrastructure of roads, sidewalks, bike paths, etc., as well as the services this system provides; and urban design, the arrangement and appearance of the physical elements in the community." [2]

While we acknowledge the role of private investment in changing neighbourhood dynamics and in contributing to gentrification, we are specifically interested in the impact of **public investments** in the built environment. We consider that such investments, whether strategically aligned with sustainable development, mobility, resilience, climate, or other types of city plans, have the potential to reduce health inequities across the city and are driven by public institutions that represent the population's desires for the future, through elected representation. At the same time, we recognize that such investments can also

have unintended consequences, and lead to gentrification, and possibly, to detrimental impacts in terms of health and health equity.

In order to better understand how built environment changes relate to gentrification and health in Montreal, we are focused on studying interventions that meet the following criteria:

1) changes to the **built environment;**
2) funded by **public institutions** (such as the City of Montreal, municipalities); and
3) located within the realm of the **public space**.

In line with these criteria, we will study interventions that fall within one of the following four categories: **changes to the green space, implementation of cycling infrastructure, implementation of transit infrastructure, and changes to the public space** (more details below).

In fact, our interventions of interest might occur in various neighbourhoods in the city, and possibly at different intensities. Having a good variation in exposure among our sampled population is a to be able to assess effects.

It's important to note that some of built environment interventions might be very specific and localized. For example, the removal and transformation of a former highway stretch (1 km of Autoroute Bonaventure) into an urban boulevard in 2017, although falling under the 'changes to the public space', might only affect a very specific area of the city. In order to properly measure its effects on neighbouring residents, a relatively large and concentrated sample of participants living in the affected area would be needed to specifically evaluate the impact of this localized transformation (along with a reference non-exposed sample). Due to the structure of our sampling in INTERACT, with participants distributed across the Island of Montreal, Longueuil, St-Lambert, Brossard, and Laval, we do not currently have the statistical power to evaluate strictly localized interventions. Such important urban transformations that only affect 'one neighbourhood at a time', will be controlled for, but not the focus of our work. This brings us to other 'urban investments' that are not the focus of our work.

What We Aren't Studying

Our focus is on built environment interventions occurring in the public space that are led by public institutions. As such, this project will not study:

1) **Social programs** (such as the *Revitalisation urbaine intégrée* program to revitalize under-resourced neighbourhoods through social initiatives);
2) **Changes in housing typologies** and/or development (such as new condos on private land);
3) **Changes in business types**.

These neighbourhood changes might be controlled for in our modelling but won't be considered as primary determinants or pathways. While they may play an important role in health, they are outside of our research focus.

Social programs do not tangibly alter the built environment. Housing investments are predominantly driven by private interests, although public institutions also have a say on certain developments through social housing regulations (e.g., minimum number of social housing within new private developments) and are also leading some developments themselves (Public social housing, *Office Municipal d'Habitation de Montréal*). Similarly, changes in business composition are not part of our focus, as these are mainly linked to private activities. While all these changes are external to our study, we aim to measure and control for such transformations in our models. As mentioned earlier, this will also be the case for major projects that are very localized, such as the Autoroute Bonaventure. If partners show an interest in evaluating such localized investments, it would be possible to add specific recruitment in a targeted area with complementary funding. For now, our analyses will control for living in proximity to the following major projects that are deemed of interest by stakeholders and/or are deemed to have a major impact on the city, but are very localized: the Autoroute Bonaventure transformation, the Campus MIL, a new University of Montréal campus in the middle of the city, and the McGill University Health Center (CUSM), a new 1400-bed hospital located in the southwest of the city.

Changes to Green Space

Green space can include parks or forests, as well as playgrounds, gardens, arboretums, or plantings along streets [3]. Changes to the green space are often related to sustainability objectives (e.g., reducing urban heat islands, improving water or air quality) and with the objective of improving residents' quality of life [4].

Access and exposure to green space has been related to lower stress and anxiety levels and increased life satisfaction [4-7]. Green spaces may also play a role in promoting physical activity and reducing risks of obesity [8-10]. While these benefits are well documented, interventions aimed at increasing access to green space may contribute to gentrification processes, also called 'green gentrification' [11]. A recent literature review suggests that green gentrification may displace, re-segregate, alienate, and exclude socially and economically vulnerable residents [11]. While there is a perception among citizens that greening is a contributor to environmental gentrification [12], primary research points to an association only under specific circumstances. For instance, areas closer to the 'old town' in Barcelona [13] or 'downtown' in US cities [14] were more likely to gentrify as they became greener. Other research finds that neighbourhood parks may be anchors for gentrification processes rather than being causes alone, as was suggested in a survey and spatial analysis conducted in Philadelphia [15]. When new public green space was created, neighbourhoods close to already gentrified areas were more likely to gentrify themselves than neighbourhoods farther away from existing gentrification [15]. In Barcelona, formerly

industrialized, older, and low-income areas may also gentrify as they become greener [13]. A longitudinal study of new parks created across 10 major US cities found that green gentrification was associated with parks built between 2008–2015, but did not find an association between park size and gentrification [14].

The City of Montréal has taken on many greening projects in recent years. For instance, the city has been working on the transformation of a landfill into a major park (Parc Frédérick-Back) now comparable in size to Parc du Mont-Royal. Another project in the works is the Grand Parc de l'Ouest, planned to be Canada's largest municipal park, which will be completed in 2030. Our focus is on greening initiatives at different scales, both city investments in new parks and citywide changes in sidewalk-level greening. It's worth noting that reductions in greenspace are also happening in certain areas. For example, the emerald ash borer has led to significant tree cuts in the last 10 years, with some areas more affected than others. Relevant measures of change in greenness may include continuous remote sensing measures (i.e., satellite-derived Normalized Differential Vegetation Index or LiDAR data for canopy assessment), park and green space implementation as documented through land use maps, but also more specifically cutting and planting of trees on streets or other public areas, partially available through Montreal's open data portal.

Table 1: Specific types of greening interventions considered in our study.

Inclusions	Exclusions
Changes in park area	Green alleys will be studied as placemaking measure
New trees (and loss of trees)	Greening on private property
Public gardens	
Greenways	
Changes to the presence of greenness (canopy coverage)	
Blue space (i.e. new access to waterfront)	

Cycling Infrastructure

Cycling infrastructure refers to all road infrastructure for cyclists (bike paths, painted bike lanes, protected bike lanes) and amenities such as bike racks and traffic signs and signals.

Cycling has been promoted as a population health strategy globally [17, 18]. As physical activity, cycling reduces the risk for many chronic diseases: heart disease, stroke, diabetes, dementia, certain cancers, and depression [18]. However, residents across US cities fear cycling infrastructure may lead to gentrification [18,19] and racism and inequality [19,20]. Primary research conducted in the US demonstrates that marginalized communities do not

attract as much investment for cycling infrastructure development [21] and that areas with higher SES often have more cycling infrastructure [22]. Gentrification may modify this pattern [22]; as a gradual process, gentrification may create pockets of advantage within otherwise disadvantaged neighbourhoods, and in this process areas with lower SES residents may also receive cycling infrastructure (by virtue of connections) [22]. One study conducted in the US on how the associations between bike lanes and cycling are moderated by sociodemographic factors suggests that bike lane investment could in actuality widen sociodemographic disparities in cycling if non-infrastructure barriers (such as individual, environmental, social and institutional barriers) to cycling are not also addressed [22]. According to another study, cycling infrastructure is not a form of gentrification, but a part of greater change that caters to potential gentrifiers [23]. A separate US study posits that gentrification and cycling infrastructure development are likely processes that occur alongside one another [21]. Locally, there is evidence from a study in Montréal that home sale prices increased in areas where bicycle sharing stations are more accessible [24].

Montreal's current mayor Valérie Plante, has promised to make of Montreal a more cyclist-friendly city. Montreal's Sustainability Plan 2016-2020 had targets to "increase the modal share of travel on foot, by bicycle or by public transport." As of 2020, the City has added 270 km of new bike lanes since 2018 [25], including through first phases of implementation of *the Réseau Express Vélo* (REV), a major 'cycling highway' initiative. Data layers of interest to document changes in cycling infrastructure may be pulled from different sources, including the Montreal open data portal, but also possibly from cycling organisations like Vélo Québec, or other research groups that have structured a historical dataset of cycling infrastructure in the region [26].

Table 2: Specific cycling interventions we will include in the study.

Inclusions	Exclusions
Cycling infrastructure network (including types of paths)	Bike parking on private property
Bike share program/station	Employer initiatives to promote cycling to work (i.e. providing showers, etc.)
Bike racks	
Bike parking	

Public Transit Infrastructure

Public transit infrastructure changes of interest include the rehabilitation of public transit systems and future system improvements and expansions [27].

It has been shown that introducing new public transit options can contribute to increasing physical activity levels, by encouraging commuters to walk to and from public transit stops,

potentially improving health on a population scale [28]. Yet transit infrastructure development can also lead to gentrification. In US neighbourhoods who received transit investments, displacement of long-term residents was more prevalent in areas with higher racial integration, compared to neighbourhoods with a majority of White residents [29], and "Walk and Ride" station implementation also led to gentrification [30]. In a systematic review, there was some evidence of associations between gentrification and transit-oriented development, but the authors of the study warn that methodological challenges limited this work [31]. The authors suggested that gentrification may be more closely associated with existing local dynamics, including the policy context and other built environment attributes, rather than with transit-oriented development itself [31].

Many transit projects are planned in Montreal, the largest being the *Réseau Express Métropolitain* (REM). Its first phase is planned to be inaugurated in 2022 and be fully operational by 2026. A major completed addition to the transit system happened with the extension of the orange line towards Laval in 2007. For the purpose of this study, our focus is on the Bus Rapid Transit Pie IX, which is set to open in 2021 and will be completed by 2023. The BRT will be integrated into the current transit network and will increase the frequency, capacity, and quality of much of the north-south public transit linkage in the eastern portion of the city. Finally, announcements for future implementation of new tramway lines in the South shore have been made. The timeline remains uncertain, but it is important to be aware of such possible investments. Data layers on major transit investments including the BRT are generally available at the Montreal City Open data portal, although the *Agence Métropolitaine Regionale de Transport* (ARTM) may also be a data source of interest.

Table 3: Transit interventions we will include and exclude from the study.

Inclusions	Exclusions
Additions in routes to bus lines: BRT Pie IX	Changes in frequency of passage of current transit lines
Subway line extensions and possible new tramway lines	Changes to nature of metro or bus fleet (i.e. electrification of bus fleet, etc.)

Changes to Public Space

As per the City of Montreal's Master Plan, "[*p]ublic spaces convey the collective sense of belonging to the City. Since, by definition, a City is a gathering place, all sites accessible to the public - parks, plazas and streets - represent its most valuable asset. Coherent design of the public realm means that streets, sidewalks, parks, plazas and squares must be designed to be comfortable, safe and pleasant areas to visit in every season, especially for pedestrians."* [32].

This inclusive definition of public space leads us to be interested in any built environment change that affect the 'design of the public realm', which were not covered by one of the previous categories.

Traffic calming measures are physical changes to the built environment (such as speed bumps, curb extensions, etc.) and related strategies to facilitate their implementation (such as 30 km/h speed limits, reduction in the number of lanes). Traffic calming measures aim to reduce the speed and/or volumes of motorized traffic to achieve different goals and objectives (such as increasing safety for pedestrians) [33].

While there is evolving evidence on the link between public space features and health, some research suggests a potential pathway through the new opportunities they provide. These include new resources and locations for physical activity and social integration, all associated with positive health outcomes [34]. Interventions such as walkability improvements have been linked to increased access to resources (e.g., health) and opportunities [35], while improving perceptions of safety [36]. An ethnography conducted in Denver suggests that changes to the public space often accommodate gentrifier norms and attenuate cultural practices of long-time residents [37]. To avoid displacement of long-time residents due to gentrification, one study conducted in Barcelona recommended taking measures to protect social housing and promote home ownership [38].

Traffic calming measures have been shown to positively impact health but could also lead to gentrification. A literature review on the impact of traffic calming on health indicated positive impacts on four health determinants: reduction in the number and severity of collisions, improvement in air quality, reduction in environmental noise, and increase in active transportation [32]. Traffic calming is a desirable neighbourhood change, but it may also increase property values and contribute to displace long-time residents [39].

In the INTERACT study, we will be looking at changes in public spaces in Montreal such as the creation of 15 *rues piétonnes et partagées* since 2015, as well as all new green alleys across the city. We include a diversity of investments, such as the implementation of plazettas, '*placottoirs'*, and other urban furniture, as well as transformation of streets into pedestrian areas. We will also be looking at traffic calming measures such as curb extension implementation. Previous research in Montreal has demonstrated the validity of city-based data sources to document the implementation of curb extensions and speed bumps in four Montreal boroughs between 2008 and 2014, using Google Street View's time machine function [40].

Table 4: Public space and traffic calming interventions considered in this study.

Inclusions	Exclusions
Curb extensions	Festivals
Reduced speed limit	Outdoor events

Urban furniture	Social activities
Long term and seasonal pedestrianized area/street (i.e. *rues piétonnes et partagées*)	Pop up farmer's market next to metros to improve food security
Placottoirs – *placette*/plazettas	Pop up events
Public Terraces (patios)	Temporary (a few days) closed streets
Street lighting	RUI (mainly social programs)
Ruelles vertes – Green alleys	Participatory budgets (*projets de budgets participatifs*)
Playgrounds in public non-green spaces	Street art, murals

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