

# TRANSPORT PLANNING TOOLS FOR CHILD-FRIENDLY CITIES

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Transport is an integral part of people's lives, and children are no exception. However, transport and urban planning in many Western countries typically focus on adult travel patterns resulting in transport systems that create a situation of dependency. This project aims to develop tools that support child-friendly city planning. The two main tools being developed are: 1) a tool to estimate road danger; 2) a tool to estimate the accessibility to local child-relevant destinations. The first tool aims to estimate the level of traffic danger based on street characteristics as children's independent travel is often limited by traffic danger. The second tool will determine important destinations for children and measure how many are accessible given the level of traffic danger. In such an approach, some links of the transport network will be excluded from the accessibility analysis as they are too dangerous. The types of destinations will be considered with respect to children's psychological, cognitive, physical, and social wellbeing.

**Key Words :** *children's independent mobility, child-friendly cities, accessibility, child wellbeing*

## 1. INTRODUCCION

Children's wellbeing is considerably impacted by transport (1), yet they are typically not taken into consideration in transport planning. Transport planning often focused on moving motorized vehicles quickly and in large numbers which creates extreme danger for children resulting in their freedom to travel being

severely restricted. Further, vehicle traffic is associated with various other externalities such as air pollution and noise that have health impacts such as asthma, cancer, and sleep problems.

Transport planning (at in Anglo-Saxon countries) typically assumes that if adult mobility is considered, then children will have access (2; 3). This has likely

contributed significantly to the situation where children in Anglo-Saxon countries are very dependent on their parents (4).

A critical problem in transport planning is using mobility rather than accessibility (5). Mobility is essentially just movement and can be thought of as the ability to move, often measured by speed. Accessibility is the ability to reach a location and requires mobility and proximity, it might be measure by the time to reach a destination. With respect to children's accessibility, child-relevant destinations must first exist and then child-appropriate infrastructure that would allow them to reach such locations independently.

This research aims to develop tools to address those problems. One will examine the level of traffic danger based on infrastructure design. The second will consider how that limits children's ability to travel (their mobility) and measure accessibility to child-relevant destinations that exist within a reasonable distance.

## 2. METHODOLOGY

Various steps are required to build these tools. An overview of the approach taken is given here.

### (1) Measuring traffic danger

Much research on traffic danger focuses on crashes (6). However, in order for a child-pedestrian crash to exist, a child must be travelling. In cases where the danger is extreme or distances are too large, children may not be travelling, so crashes would not exist. This could lead to an inaccurate prediction of traffic danger.

Another approach is to use human judgement to estimate traffic danger of a street. A literature review was conducted to examine infrasture and built environment characteristics as they relate to traffic danger and perceptions of traffic danger by parents and children (7). These do not always match. As parents and children are the ones who judge whether a street is dangerous or not, it is important to understand how they make those judgements. At the same time, it is important to use expert opinion built on research. This research will develop three models based on experts', parents', and children's judgements using the MACBETH method for Multicriteria Decision Aiding (MCDA).

An initial "proof of concept" was conducted using the expert judgement of our project team which further includes psychologists, urbanists, and child-advocacy members. Using Likert-scales from "ideal/very safe" to "avoid/too dangerous" each characteristic was judged by the team members independently. Then, the members had to assign a value

from 1 to 100 for the respective weighting of the component. The sum of the weights could not exceed 100. The values for each component were multiplied by their respective weights and summed to give a score. This approach however will be refined in the future with an more advanced MCDA approach.

### (2) Measuring accessibility

This part requires a few substeps. One is to identify child-relevant destinations. Another is to use the traffic danger as a measure of child-friendly infrastructure. Those two components are combined to measure accessibility. Finally, the child-relevant destinations will be judged with respect to how they relate to children's diverse needs through a wellbeing perspective (1).

A literature review of children's non-school destinations was conducted to develop a list of child-relevant destinations (8). A survey will be used to examine actual and desired frequency of visiting those destinations.

A "proof of concept" was conducted on how to translate the traffic danger estimation to eliminate or constrain the children's mobility along dangerous links. Focus groups will be used to determine how traffic danger limits children's independent and active mobility. For example, what level of traffic danger is acceptable to allow young children to travel independently? What level of traffic danger would allow children to travel by bicycle if accompanied by an adult?

A survey will be used to determine how different destinations relate to children's wellbeing. Destinations will be scored based on how they support psychological, physical, social, and cognitive wellbeing. For example, a local store or restaurant might support social wellbeing by providing connections to the community, but limited physical wellbeing. A library might provide cognitive wellbeing, but limited social and physical wellbeing. Schools might provide high cognitive, social, and physical wellbeing. A natural environment might provide high psychological wellbeing.

## 3. RESULTS

### (1) Estimating traffic danger

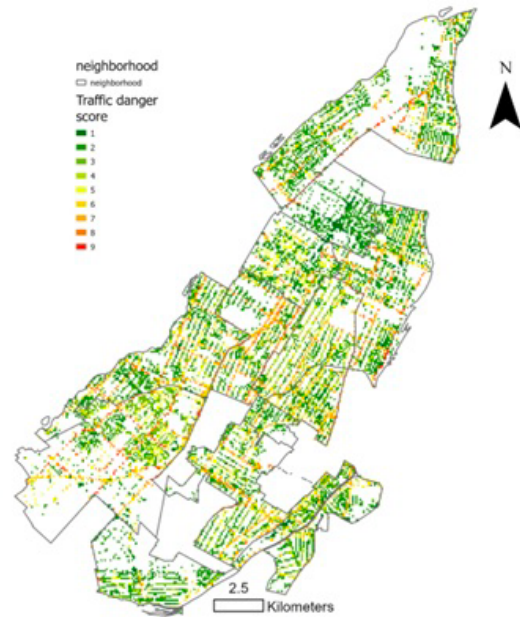
This work is preliminary and has not applied appropriate MCDA methodology. However, it provides an idea of how dangerous most transpopt infrastructure in Montreal is. The Likert-scale average responses are shown for the indicators and their categories in Table 1 where 1 is considered *ideal/very safe* and 9 is *avoid/too dangerous*. Traffic volume was an indicator identified in the literature review,

however at the time of study, traffic volumes for all streets in Montreal were not available. Road classification was used as a proxy.

**Table 1** Respective danger values for the different categories of the indicators.

Indicators	Category	Value
Speed limit	Less than 30 Km/h	1
	30 Km/h	2
	40 km/h	3
	50 km/h	7
	60 km/h	7
	70 km/h	9
	More than 70 km/h	9
Road classification	Main arterial road	9
	Secondary arterial road	7
	Collector	5
	Local road	3
	Back lane	2
	Pedestrian street	1
Direction	The street is one-way	3
	The street is two-way	3
Traffic control	Stop signs	5
	Traffic lights	3
	Traffic lights w/o pedestrian light	7

The average weight (range) for the indicators are as follows: speed limit, 43 (20-74); traffic control, 22 (10-40); road classification, 21 (7-40); and finally, traffic direction, 14 (5-25). The weighted sums were calculated for all streets in Montreal with the necessary data available. The largest value was used as the designated intersection value. The results were then separated into nine categories based on natural splits. The results are presented on a GIS map (Figure 1).



**Fig. 1** Estimated traffic danger score (preliminary findings) for intersections in Montreal, Canada.

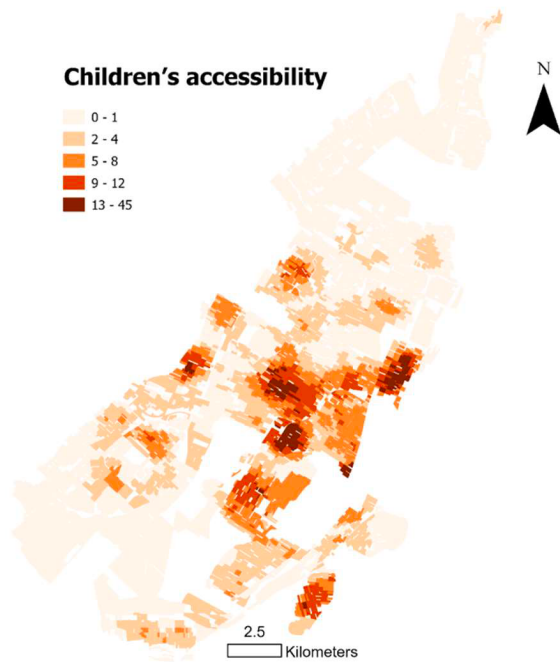
## (2) Children's destinations

Many parents and planners may only think of schools and parks when they think of children. However, public gathering points such as convenience stores and shopping streets are important social destinations for children as well. The important destinations identified in the literature review (8) were: sports facilities, shops/retail, friends' or family members' homes, public transport, and green spaces other than parks/playgrounds.

A key gap here is that children will gather and use informal places that are not often considered "destinations" from an adult perspective. As such, this information is not currently available in GIS data and cannot therefore be incorporated.

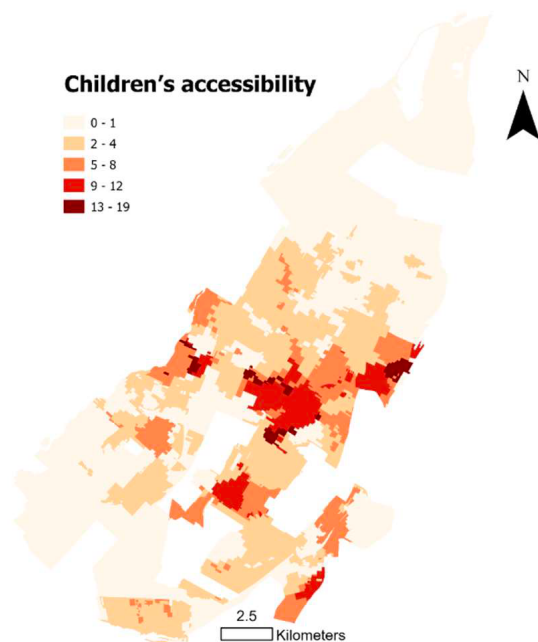
## (3) Impact of traffic danger on accessibility

From the list of important places, accessibility was estimated to the available destinations using Montreal Open Source data. A sum of the total destinations within a reasonable walking distance using the sidewalk network was estimated. One kilometer was used as a reasonable walking distance based on previous research in this region of Canada (4; 9). Central neighborhoods had 10 or more destinations, but 38 % of neighborhoods, principally suburban ones, had only 1 destination within this distance. The maximum was 45 (Figure 2).



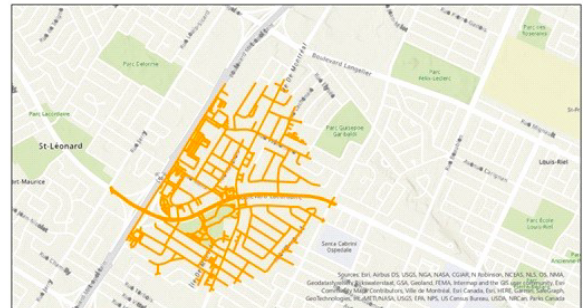
**Fig. 2** Accessibility to child-relevant destinations in Montréal when traffic barriers are excluded.

The next calculation estimated accessibility when the intersections with the two most dangerous ratings (8, 9) are excluded from the network (Figure 3). As can be seen, the maximum drops to 19 and many areas have lower scores.

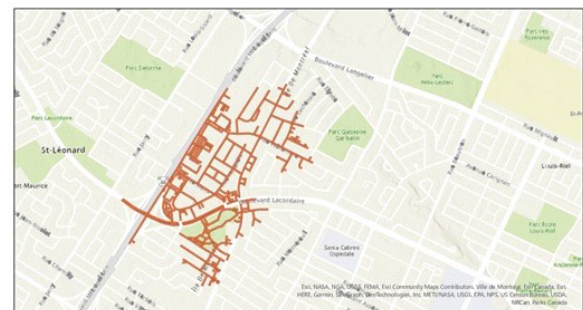


**Fig. 3** Accessibility to child-relevant destinations in Montréal when too-dangerous intersections are excluded.

An example of the change in the network is shown in Figure 4. As can be seen in the example, the child-friendly network is considerable smaller. The network size of Fig. 4a is 29 KMs, whereas as in Fig. 4b it is 19 KMs, a reduction of 32%. The reductions in Montreal ranged from 4 to 45 KMs.



a) Network size without considering dangerous intersections.



b) Network size when too-dangerous intersections are excluded.

**Fig. 4** Differences in transport network size when traffic danger is considered.

Finally, to better identify neighborhoods where the impact of dangerous intersections is greater, a map displaying the reduction in accessibility was developed (Figure 5).

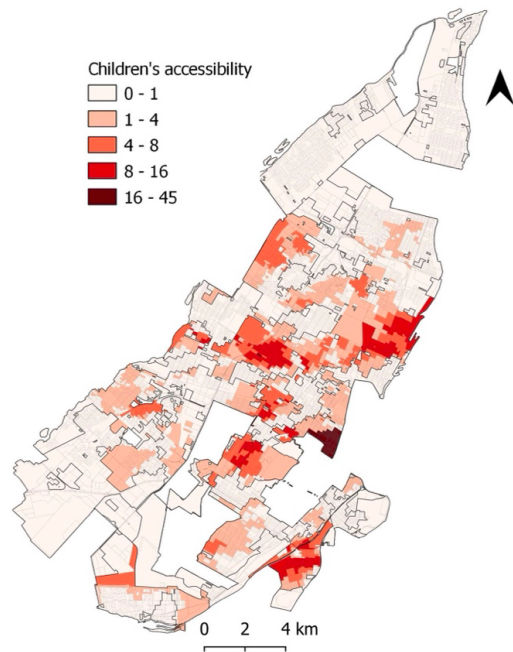


Fig. 5 Change in children's accessibility for Montreal when dangerous intersections are considered.

## 5. DISCUSSION

### (1) Estimating traffic danger

The current estimations are preliminary and are intended to demonstrate a proof of concept. The current approach was limited to estimating danger at intersections, though the intention is to estimate danger for links and nodes (intersections). As can be seen, most intersections are judged to be quite dangerous. In the context of North America, this is not a surprise as narrow roads that limit traffic are limited. Montreal is an exception to most NA cities as it has recently changed all residential streets to 30 km/h. However, the posted speed limit has only some impact on actual speeds and road design that limits traffic speeds would be an important consideration in next steps.

The next steps of the project will aim to use appropriate MCDA methods to develop transparent values based on the inputs of experts, parents, and children. Those results will be compared to identify where opinion differs. This will likely be useful in identifying the conflict between perceived and objective danger as these do not always match (7).

### (2) Child-relevant accessibility

This research used available GIS destination data which was not developed with children in mind. As such, some child-relevant destinations are not included. However, with the existing data, it could be shown that accessibility varied significantly and that areas where many children live (the suburbs) often have very low levels of accessibility.

Once extremely dangerous intersections were excluded from the network, the child-friendly accessibility was shown to reduce significantly (roughly 10 % to 90 % reductions).

Not all children-relevant destinations were included. Many children in NA play at their home or a friend's home, but such destinations were not included. Using census data on the density of children in an area might be one way to overcome this.

Next steps include determining acceptable levels of danger by consulting parents and children. As well, how to create a "hinderance" (i.e., the street *could* be used but a certain penalty applied) versus a barrier (as applied here). Another step is to develop typologies of accessibility related to the different domains of children's wellbeing.

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