

The framing of active school travel in Ontario, Canada as a health and built environment issue

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Abstract

This is the abstract.

It consists of two paragraphs.

Background:

Methods:

Results: Conclusions:

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1. Introduction

Rates of walking and bicycling to school, commonly known as active school travel (AST), have been declining in Canada and the United States for decades (Rothman et al., 2018), with levels much lower than other developed countries like The Netherlands (van Goeverden and de Boer, 2013), Denmark (Jensen, 2008), and Japan (Waygood and Taniguchi, 2020). However, the appetite for AST may be high in many Canadian communities. For instance, 40% of children in a study conducted in Toronto, Ontario who are driven to school would like to travel by bicycle instead (Larouche et al., 2016). But the study reported that less than 3% actually do, despite the vast majority having access to a bicycle and living within a short and bikeable distance to school. Another study based in London, Ontario reported similar findings with respect to children’s preference for active travel (Larsen et al., 2012). From a public health perspective, this represents a huge opportunity to improve health and wellbeing if more children could use active modes to school.

In response to this trend, the Government of Ontario, in Canada, created a fund in 2017 to support communities across the province in developing AST initiatives. Green Communities Canada runs the program, called *Ontario Active School Travel*, and determines the projects that will be funded with their support (Canada, 2020a). As of December 2021, OAST has awarded over 2 million Canadian dollars and provided resources to over 25 projects across Ontario. Many communities implemented school travel planning (STP), along with encouragement activities like walking school buses or developed resources for schools and parents, among other actions (see Canada, 2020b). In this context, STP is a popular “school-specific” intervention led by a facilitator that brings together a committee of stakeholders from diverse sectors including education, planning, transportation, and public health to develop action plans (Buliung et al., 2011; Mammen, M. R. Stone, Ron Buliung, et al., 2014). The five-step process involves identifying barriers to AST based on the local context and implementing approaches or activities following the 5 E’s that alleviate concerns about AST and make AST safer and more convenient (Buliung et al., 2011; Lang et al., 2011).

How AST is framed by STP stakeholders to a target audience, like parents or the general public, may raise awareness about the issue and influence how walking and bicycling to school are perceived. Gamson and Modigliani (1987) define a frame as a “central organizing idea or story line that provides meaning” to a particular phenomenon. A frame can enable individuals “to locate, perceive, identify, and label” information pertaining to various dimensions of an issue (Goffman, 1974). Therefore, stakeholder groups involved in STP efforts can play a role in shaping public perception about AST in such a way that it attracts greater attention and becomes a “problem” that needs to be addressed through behaviour change or by new policies. We also contend that the ways in which the AST issue is framed can affect the policy process, as outlined in Kingdon’s (1984) Multiple Streams Framework (MSF), through all three streams (i.e., problem, policy, and politics). This framing can ultimately impact financial contributions

and potential solutions to address the decline of AST in Canada.

After significant investment of human and financial resources to boost rates of AST in Ontario over the past few years, we ask the following questions: How is AST framed? What benefits of AST are communicated to the public? What solutions are proposed to increase rates of AST? Do proposed solutions focus primarily on the intrapersonal and interpersonal factors, meaning that behaviour change must ultimately result from the individual or household making different travel decisions? Or is AST framed as an issue that must be addressed through changes in the built environment or at the policy level?

In this paper, we use natural language processing to examine how three STP stakeholder groups in Ontario (i.e., municipalities, school boards, and transportation consortia) frame the issue of AST. We assembled a corpus of texts from webpages that can be considered an important source of information for the general public or parents who are interested in AST. We examine word frequency, bigrams, and concordances in these selected documents, and also identify key topics presented by each stakeholder group. We then compare the findings from these documents to a selection of studies on AST and explore the extent to which there is concordance between the literature on AST and materials shared with the public.

2. Literature Review

2.1. Benefits of active school travel

The benefits of AST are valuable information to communicate to the public in order to convey the importance of this issue. The desire to increase AST in Canada is certainly warranted - there is compelling evidence that children who actively commute to school earn physical and mental health benefits. Faulkner et al. (2009) concluded from their systematic review that children who travel on foot or by bicycle to school generally have higher levels of physical activity than their peers who are driven to school. However, Schoeppe et al. (2015) reported no association between AST and physical activity. This relationship could be dose-dependent, meaning that children would have to travel longer distances to accumulate physical activity. A walking distance of 1000-1600 metres to school has been found to contribute to overall levels of physical activity for boys (Faulkner et al., 2013). The daily routine of travelling to school can be a good opportunity for children to regularly build physical activity into their schedule (Mitra, 2013). Research has also shown that using active modes to school contributes to improvements in cardiovascular fitness (Børrestad et al., 2012).

More recently, there has been literature exploring the link between transport and children’s wellbeing (Waygood et al., 2020), with relevant applications to the study of travel satisfaction (van den Berg et al., 2020; Westman, Olsson, et al., 2017). Being driven to school reduces community interactions for children which may impact their social wellbeing (Waygood and Friman, 2015), whereas walking and bicycling give children opportunities to socialize with friends or

siblings (Michail et al., 2021). This is something that children highly value about travel (Zwerts et al., 2010) and indicates that social connections through travel are important for their wellbeing. AST also provides opportunities for children to engage with the natural environment (Fusco et al., 2012; Romero, 2015) which can improve their mental or emotional wellbeing.

2.2. Factors that influence active school travel and mode choice

Factors that influence AST have been presented and organized using a socio-ecological model (SEM) (Mitra, 2013) or systems model (Badland et al., 2016) whereby children’s travel behaviour is understood within the context of their household, social, neighbourhood, and policy environments. Individual characteristics of the child are also determinants. The SEM comes from the field of public health and is a useful framework for understanding complex health behaviours, including travel habits such as walking or bicycling to school, because it identifies multiple determinants that need to be addressed by interventions to facilitate behaviour change. The consensus in the literature is that various factors are interrelated and that interventions should target multiple levels in order to increase levels of healthy and physically active modes of travel to school (Mitra, 2013). Rather than describing an extensive list of factors that influence AST and mode choice in Canada (e.g., Mammen et al., 2012; Mitra, 2013; Rothman et al., 2018; Wilson et al., 2018), we discuss a few potentially modifiable determinants that may be targeted for change through STP.

At the individual level, older child age is often associated with AST (Mammen et al., 2012; Stark et al., 2018; Wilson et al., 2018) as parents typically escort younger children. There is evidence that gender is a determinant of AST, with boys being more likely to travel using active modes than girls, although this is not a strong or consistent finding (Rothman et al., 2018; Schoeppe et al., 2015). Children’s mode choice to school is strongly influenced by their parents’ travel behaviours and the complexity of their household’s travel needs (Buliung et al., 2021), which indicates that shifting parental perceptions and habits is important. Convenience and inclement weather have been cited by parents as barriers to AST (Buliung et al., 2011). Parental perceptions of the built or school environment (De Meester et al., 2014; Panter et al., 2010) and their children’s skills (Mammen et al., 2012) also influence whether they allow their children to walk or bicycle to school.

Distance between home and school is most strongly associated with AST (Ikeda et al., 2018; Mammen et al., 2012; Pont et al., 2009; Rothman et al., 2018) with less AST reported among children who have to travel farther to school. Many studies have also found that the quality of the built environment along the route to school and around the school site (Ikeda et al., 2018; Rothman et al., 2021) and provision of active travel infrastructure (Chen et al., 2018; Pont et al., 2009) facilitate AST. Canadian youth report that they feel most safe bicycling on streets in their neighbourhood or that have low volumes of traffic (???). Finally, concerns about traffic and strangers have been reported by parents who drive their children to school (Mammen et al., 2012), which highlights that the volume and speed of cars can be a concern or deterrent for AST.

2.3. School travel planning in Canada

School travel planning (STP) has been implemented in Canada since at least the late 2000s. Within the STP process, facilitators generally establish multi-sector committees who intervene at the participating school through a range of activities related to the 5E's such as *education* strategies, *encouragement* through in-person events or programs, *engineering* improvements to or around the school site, and *enforcement* of traffic speeds around schools (Lang et al., 2011; Mammen, M. R. Stone, G. Faulkner, et al., 2014). The first large-scale evaluation of STP as an intervention in Canada took place at twelve schools across the country, including four in Ontario, using parental surveys to measure changes in travel behaviour and perceptions (Buliung et al., 2011). Since then, there have been other assessments of both the efficacy of STP (Buttazzoni et al., 2019; Mammen, M. R. Stone, G. Faulkner, et al., 2014) and the process of implementing such programs in Ontario (Buttazzoni et al., 2018; Mammen et al., 2015). STP facilitators have recommended that additional time and resources are needed to improve the efficacy of STP (Mammen et al., 2015), which highlights that long-term and sustained efforts driven at the policy level are required to address declining rates of AST.

The ways in which AST is framed seem particularly important to shift parental attitudes and perceptions given their reported influence on children's travel mode to school. STP activities heavily focus on education or encouragement (Buliung et al., 2011; Buttazzoni et al., 2018; Mammen, M. R. Stone, G. Faulkner, et al., 2014), but parents may not always be receptive to the goals of STP and may be resistant to behaviour change (see Buttazzoni et al., 2018). Parents have been found to express different understandings, language, and perceptions than planners of the built environment determinants that influence school travel (Buliung et al., 2021). This is also true when it comes to other factors like convenience of different modes to school (Lang et al., 2011). STP stakeholder groups must pay special attention to parents' understanding of the decline of AST as a problem, which may affect their receptivity to proposed solutions.

The "central organizing idea or story line" of AST, to apply the definition from Gamson and Modigliani (1987), could also affect broader support in the community. Municipal representatives are perceived to be instrumental but the involvement of other stakeholder groups (e.g., busing consortium representatives and local residents) can be lacking (Buttazzoni et al., 2018). In Ontario, it would be reasonable to say that AST has become a policy issue on the education and public health agendas over this time as evidenced by the financial contribution from the provincial government. The support from a range of municipal representatives (see Buttazzoni et al., 2018; Mammen et al., 2015) demonstrates that the "policy stream" (see Kingdon, 1984) has been well engaged. However, it is unknown to what degree the general public (i.e., local residents) has been exposed to messaging about AST, or how they view the AST issue, which could affect their participation in the STP process as desired by STP facilitators (Buttazzoni et al., 2018).

The success of STP interventions would likely depend on parental judgments of factors that are related to school travel, as well as support from key policy

makers. For example, parents have been found to view mixed land use as conducive for driving, despite transport planners viewing neighbourhoods with mixed uses as key for encouraging more active travel (Buliung et al., 2021). Therefore, stakeholder groups involved in STP must make important choices about the proposed solutions and potential benefits of AST that ought to be communicated to parents and the general public to convey its importance as a policy issue and to facilitate adoption of AST. Publicly available content about AST, therefore, needs to effectively engage multiple audiences on this policy issue including parents, children, politicians, and school representatives. This information should reflect current knowledge from research on school travel, plus content specific to local factors that influence AST, so that the challenges of AST are adequately defined and the opportunities or solutions to address the problems are clear. However, it is unknown to what degree STP materials presented to the general public reflect the scope of evidence from the literature on AST.

3. Data

3.1. Data retrieval

3.1.1. Policy documents

We assembled a collection of publicly available documents that were sourced online from the main stakeholder groups involved in STP initiatives in Ontario: i) school boards (public or Catholic and English-speaking only); ii) municipal governments; and iii) transportation consortia. The latter are a unique group of entities sanctioned by Ontario’s Ministry of Education in Ontario 2006. Each consortium involves a collaboration between regions and school boards; the consortium’s objective is to deliver more efficient and timely transportation services to schools in each region. Non-profit organizations, police services, and advocacy groups are other stakeholders who often play a role in supporting AST and/or STP, but this study does not include any documents from these groups because they are not consistently participating in all initiatives across Ontario.

The search was guided first by a list of all English public and Catholic school boards across Ontario. The websites of each school board were manually searched for pages related to school transport or travel. Any pages relevant to these topics were manually downloaded. Next, we collected documents by searching municipal government and transportation consortia websites. These were identified based on geographic area (i.e., the municipalities and/or transportation consortia that are in the same geographic area of each school board). Webpages related to active transport or school travel were manually downloaded.

Webpages from STP stakeholder groups were included in our analysis if they were easy to find. This primary criterion was important since our analysis pertains to how such issues are framed to the general public. Thus, we included only webpages that were readily accessible, which we defined as requiring no more than 2-4 separate links from the initial Google search.

Table 1: Search results from the main STP stakeholder groups.

Stakeholder	Total	Included
School boards	62	32
Municipalities	62	28
Transportation consortia	39	9

The initial corpus of documents from STP stakeholder groups included 69 relevant webpages (i.e., one page or more) from all STP stakeholder groups. We refer to these as policy documents throughout the paper. It is important to note that school boards, municipalities, and transportation consortia may or may not publish information about their involvement in AST and STP efforts on their respective websites or in policy documents. Search results are summarized in Table 1.

3.1.2. Academic papers

To be completed by Dr. Paez

3.2. Data cleaning

A multi-step process was conducted to ensure that the analysis captured as much text as possible from both the policy documents ($n = 64$) and academic papers ($n = 233$). To begin, the webpages, which were manually downloaded in portable document format (PDF), were trimmed so that pages that only consisted of tables, figures, or references were removed. Many academic papers were in a two-column format, which is not ideal for conversion to `txt`. We adapted a procedure (<https://stackoverflow.com/questions/42541849/extract-text-from-two-column-pdf-with-r>) to read the two-column PDF documents so that they would be converted correctly. Four academic papers did not join sufficiently and were taken out of the corpus due to the substantial time required to manually correct their inconsistencies.

Next, we converted the trimmed PDF documents into `txt` files so that they could be imported in R for analysis. We then proceeded to a manual cleaning phase where we removed any remaining tables, figures, references, headers/footings, and captions that could not be trimmed. Manual corrections were also required for certain pages in academic papers that remained in two-column format after the conversion process. This typically occurred on pages that had a table or figure which disrupted the text. Finally, we reviewed all of the documents to remove hyphenation by line breaks and to keep hyphenated words together on the same line. Any ligatures (e.g., combinations of characters or letters that were not properly detected during the conversion process) were

fixed by replacing the unicode sequence of character by inserting the missing sequence of characters.

We also manually removed any extraneous material in the academic papers that did not pertain to AST specifically. This included footnotes, references, acknowledgments, and conflict of interest statements in the academic papers. We removed all phone numbers, inserted links to other webpages, personal names, and content not specific to AST from the policy documents that were retrieved from the websites of school boards, municipalities, and transportation consortia.

In the final step, we removed all blank spaces, punctuation, capitalization, and numbers. English stop words, which are common words such as *and* or *the* as identified in a predetermined list by Lewis et al. (???) and other frequent terms in the documents like “school” and specific location names, were removed from the corpora.

4. Methods

4.1. Framing analysis

Issues that pertain to public health or wellbeing are often presented to the public through particular frames to influence perceptions or behaviours. As previously mentioned, a frame is a “central organizing idea or story line that provides meaning” to a public issue or phenomenon (Gamson and Modigliani, 1987). Scholars in the field of political communications have proposed that communicators, such as the media or an institution, construct the narrative of a frame for policy positions or public issues in order to activate or restrict a particular response in the intended audience (Pan and Kosicki, 1993). Organized groups of stakeholders can employ similar methods to attract attention to particular issues. Framing can be used to position existing solutions as suitable to address particular issues (Mah et al., 2014), which may prevent the public from being aware of other policy approaches that challenge the status quo. The way policy issues are framed is ultimately important to understand because it plays a role in either altering or preserving the existing social perceptions. This, in turn, can affect whether issues are put on the agenda of policy makers and can determine which solutions are proposed to address the problem (Kingdon, 1984).

Framing of issues is an important step in developing health policy. An obvious example over the past decade is the framing of climate change as a public health issue (e.g., Depoux et al., 2017; Maibach et al., 2010; Weathers and Kendall, 2016) to increase public engagement and awareness of the issue. This framing has slowly advanced this issue on public policy agendas as public attention puts pressure on the policy stream to adopt frameworks for action. For example, transport planners also use different frames to guide the extent to which transport policies can be adapted to address climate change. In a recent paper (Reynard et al., 2021), framing analysis was applied to review the representation of issues such as mobility and social exclusion in municipal policies from four western Canadian cities under the current circumstances of climate change. The

authors found four primary frames: “The Growing City”, “If You Build It, They Will Come”, “Better City for All”, and a “the Resilient City” (Reynard et al., 2021). Each frame presented the nature, opportunities, and challenges of climate change in different ways which set the stage for the types of mitigation and adaptation strategies that cities were proposing to address this issue.

In a similar way, we hypothesize that STP stakeholder groups in Ontario have framed AST in particular ways to effectively engage multiple audiences on this policy issue including parents, local residents, school representatives, and municipal representatives. These groups are likely identifying points of intervention and potential opportunities to build support for and encourage AST.

4.2. Topic modelling

We use topic modelling in R to conduct the framing analysis. Topic modelling is a machine learning technique that can identify what language and concepts are being communicated by analyzing text. This method is more practical for researchers working with large amounts of text because it replaces the manual coding of topics that would normally take place to analyze or summarize textual data (Jacobi et al., 2016). In the data pre-processing phase, we tokenize the text in the documents and create a document-term matrix so that it is in the correct format for analysis. We primarily use the following packages: `tidytext` (???), `topicmodels` (???), `word2vec` (???), and `wordcloud` (???) to examine text in the documents that were sourced for this project. These packages have functions for determining the frequency of specific words in each document or relationships (e.g., pairs of adjacent terms called bigrams) and correlations between words. These methods can reveal what language and concepts are being communicated to the general public. Topic modelling is a popular method for analyzing text from social media platforms (Albalawi et al., 2020) or news articles (Jacobi et al., 2016). We estimate latent Dirichlet allocation (LDA) models to classify both the STP and documents according to the topics that are contained within them. This method “treats each document as a mixture of topics, and each topic as a mixture of words” (Silge and Robinson, 2021). The model’s output is “a set of topics consisting of clusters of words that co-occur in these documents according to certain patterns” (Jacobi et al., 2016). Researchers must then interpret the identified topics, as done after other methods of manual coding. We also compare the topics between the policy documents and the academic papers, and use our interpretation to answer the questions outlined above that guide this paper. This methodology is not familiar to many, so we describe in more detail below how we used specific functions and code in R to produce our results.

4.3. Reproducibility

This paper is an example of open and reproducible research that uses only open software. All data were obtained from publicly available sources and organized in the form of a data package. Following best practices in spatial data science (???), the code and data needed to reproduce or conduct a similar analysis for other regions in North America or elsewhere are available for download.

Table 2: Top 25 terms identified in each corpora. Document frequencies are also indicated.

Municipalities			School Boards			Transportation Consortia			Academic Papers		
Term	Count (n)	Documents (n)	Term	Count (n)	Documents (n)	Term	Count (n)	Documents (n)	Term	Count (n)	Documents (n)
active	248	26	active	124	13	active	67	7	walking	5059	220
travel	126	20	bus	120	20	walking	55	8	parents	3927	209
walking	90	25	travel	103	11	walk	49	8	distance	3252	203
bike	87	15	information	65	21	travel	41	8	students	2956	171
cycling	78	22	walking	57	17	students	39	9	cycling	2739	170
safety	71	21	walk	53	13	safety	32	6	environment	2585	200
health	65	21	weather	40	11	help	29	9	traffic	2334	206
physical	63	18	safety	40	19	schools	25	9	choice	2295	167
traffic	59	20	safe	39	19	children	25	6	activity	2265	207
road	56	13	services	37	17	community	24	7	physical	2238	213
activity	55	14	planning	37	7	bus	18	4	trips	2164	168
schools	52	14	parents	32	17	route	17	5	car	2140	193
children	47	15	sustainable	31	8	zone	16	6	safety	2111	202
plan	45	16	children	31	14	resources	16	6	time	2091	216
students	44	14	child	31	12	day	16	4	factors	2083	214
walk	43	18	day	29	13	safe	15	5	child	2060	185
public	39	15	routes	28	14	planning	15	4	walk	1985	198
community	37	19	physical	28	11	physical	15	7	public	1973	206
safe	34	16	health	28	11	healthy	14	6	age	1774	209
benefits	32	17	incident	25	11	traffic	13	6	urban	1749	198
play	31	2	eligibility	24	11	support	13	6	different	1695	213
resources	30	13	consortium	24	9	families	13	5	home	1691	197
healthy	29	16	region	23	10	way	12	5	social	1672	189
routes	27	13	service	22	11	student	12	5	significant	1644	206
lanes	26	3		21	1	region	12	4	mobility	1634	136

Note:

^a Count (n) refers to the total number of times the term is found in the corpora

^b Documents (n) refers to the total number of documents that feature the term

5. Results

5.1. Word and document frequency

We analyzed word and document frequency for each set of documents (i.e., corpus). Table 2 shows the most frequent terms found in the municipal, transportation consortia, school board, and academic documents. As expected, policy documents and academic papers reference *active travel*, *walking*, *biking* or *cycling*, and *students* more than other terms. Each corpus also has *safety* and *traffic* as common words which suggests congruence on these key factors between the research literature and how AST is framed to the public. The word *physical* is present in each corpus, but it’s not clear what this refers to (e.g, *physical activity*, *physical health*, or the *physical environment*). Furthermore, documents from STP stakeholder groups discuss *resources*, *information*, and *services* about school travel. In the section below, the context in which these terms are discussed is explored further.

Unlike the academic papers, policy documents include the words *route* or *routes* as frequent terms. This could reflect the role of STP stakeholder groups in identifying safe routes to school to share with parents or families, as well as the STP emphasis on making the physical environment safer for AST. The academic corpus differs from the policy documents in that *parents* and *distance* are the second and third most common terms. In addition, *time*, *factors*, *environment*, and *age* are also identified in the academic papers. These words are absent from the list of common words in policy documents. Table 2 indicates that the academic corpus discusses a broader range of determinants of AST than the policy documents. The number of references for each term in the academic papers is also significantly higher due to the inclusion of more documents.

5.2. Bigrams and concordances

Bigrams refer to a pair of consecutive words. We use the `unnest_tokens` function from the *tidytext* package to determine the bigrams. Figures 1, 2, and 3 show the bigrams that occur more than 5 times for each set of policy documents. These figures help to make further sense of the word frequencies reported above, and highlight the main ideas that are presented to the public in each of the policy corpora. Municipalities primarily discuss *physical activity* (n = 53) and *public health* (n = 19) in the context of AST. In addition, *travel planning* (n = 19), *bike lanes* (n = 16), and *safe routes* (n = 14) are also identified, conceivably as either proposed solutions or built environment factors that support AST. Key issues related to transport such as *traffic safety* (n = 10), *air quality* (n = 9), and *greenhouse gases* (n = 9) are conveyed to the public through these policy documents. It is not surprising to find this focus given that municipalities in Ontario are concerned about climate change and have increasingly looked to active modes of travel to offset transport-related emissions in urban areas.

Similar word bigrams are found in school board documents: *travel planning* (n = 33), *safe routes* (n = 15), *physical activity* (n = 10), and *public health* (n = 10) are among the most common bigrams. Both municipalities and school boards in Ontario seem to emphasize what can be or has been done to improve AST (i.e., policy or planning changes), while outlining some of the benefits of AST at the individual- or community-level to potentially encourage behaviour change (i.e., physical activity for children or improved air quality). Unlike other STP stakeholders, school boards also consider *inclement weather* (n = 24) and *bus cancellations* (n = 13). This is likely because many students in Ontario travel to school by bus and this information is presented alongside AST options. Finally, transportation consortia documents highlight topics such as *physical activity* (n = 10), *pedestrian safety* (n = 8), *crossing guards* (n = 6), *travel planning* (n = 6), and *walk zones* (n = 6). Biking or cycling is notably absent from transportation consortia documents. Overall, the policy documents There appears convey an emphasis on the built environment, rather than household decision-making.

We then combine all municipality, school board, and transportation consortia documents into one “policy” corpus. This enabled us to examine and visualize the most common bigrams found across all of the material in Ontario that was collected for this study. Figure 4 shows all of the bigrams that occur more than 10 times in the policy corpus. In addition to the bigrams already identified above, we also found *mental health*, *walk day*, and *green communities* as common pairs of consecutive words. The latter terms represent the significant involvement of the non-profit organization in supporting AST initiatives through the Ontario Active School Travel program. Overall, the policy documents from STP stakeholder groups seem to focus on four key areas: i) benefits or impacts of AST; ii) mechanisms of intervention; iii) concerns or considerations; and iv) supports for AST. This interpretation indicates that the general public accessing information about AST in Ontario is informed about an adequate range of content related to this issue.

Next, we analyze bigrams in the academic corpus separately to make comparisons with the policy corpus. Figure 5 indicates that academic papers include

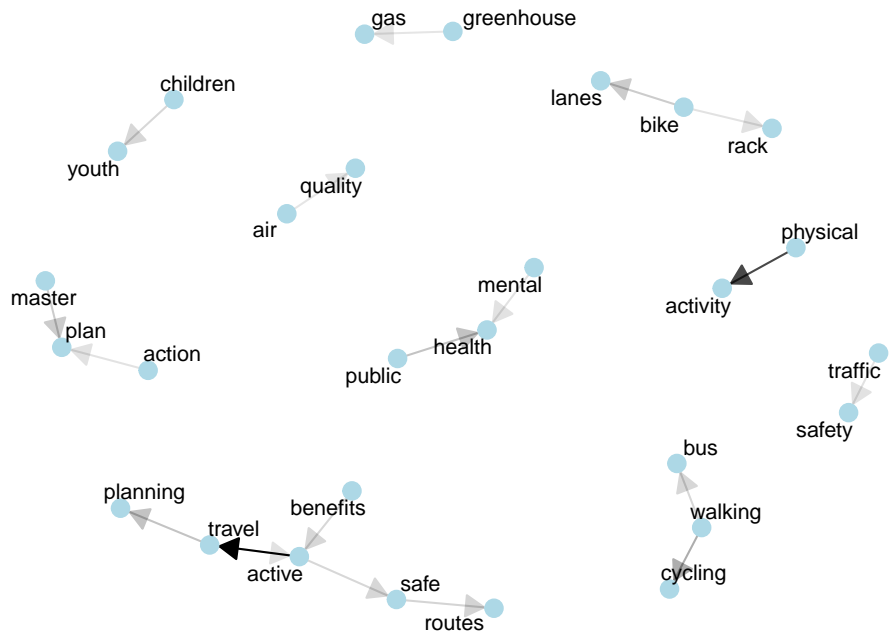


Figure 1: Most common bigrams found in the municipal or regional government documents.

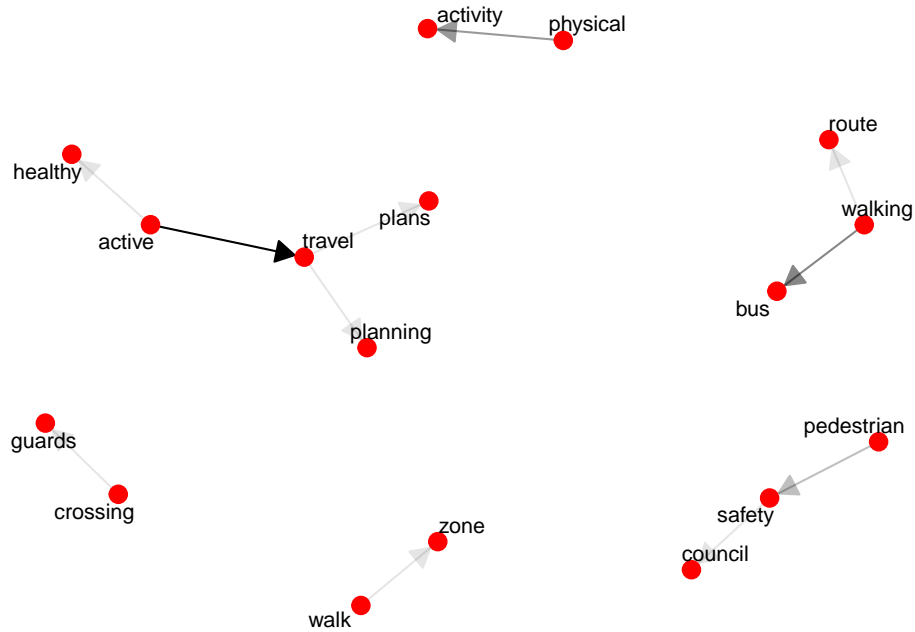


Figure 2: Most common bigrams found in the transportation consortia documents.

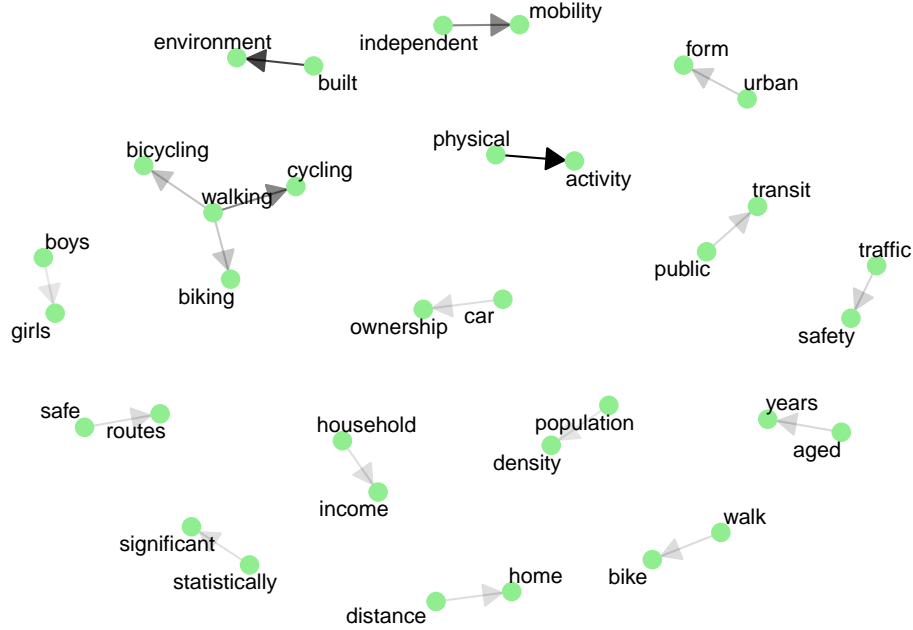


Figure 5: Most common bigrams found in the academic papers.

several common bigrams that were also found in the policy documents including *physical activity* ($n = 1566$), which is the top bigram, *traffic safety* ($n = 308$), and *safe routes* ($n = 268$). However, many other factors are identified in the research literature that are not presented to the general public through policy documents. After *physical activity*, *built environment* ($n = 1175$), *independent mobility* ($n = 774$), and *urban form* ($n = 352$) are the most frequent pairs of consecutive words. Academic papers also often discuss *distance home* ($n = 258$), *car ownership* ($n = 254$), *household income* ($n = 254$), and *population density* ($n = 205$), which are factors that have been found to influence AST. It is evident that many papers investigate gender differences in AST given that *boys girls* ($n = 211$) is another common bigram. Finally, the presence of *statistically significant* among the top bigrams underscores that some researchers aim to identify determinants using statistical measures. We find that the academic corpus focuses on a greater range of topics than found in the policy documents.

We interpret the most common bigrams from the policy corpus (see Figure 4), which includes all documents from municipalities, transportation consortia, and school boards, as the main ideas that STP stakeholder groups are focusing on and communicating to the public about AST. We then use the `kwic` function from the *quanteda* package to better understand the context of these key ideas. Table 3 presents some examples of the context that was extracted from select policy documents to demonstrate how the most common bigrams are communicated to the public.

Table 3: The context of key terms that were identified as common bigrams.

Terms	Stakeholder	Context
Air Quality Benefit	School Board Municipality	Active transportation [...] improves air quality. Stronger bones and muscles, improved self-esteem and sense of well-being while reducing stress and risk of chronic disease all benefit those who use active transportation.
Walking School Bus	School Board	While taking part in a walking school bus, your child will enjoy seeing friends on the way to school. They will be active more often. This is also a great opportunity for your child to socialize with school friends in a monitored and safe way where they can practice social distancing, modelled by a leader.
Community	School Board	Help your students get started on the right foot - encourage them to walk or bike to school when possible. Even leaving the car a block or two and walking the rest of the way helps. It's good for the environment and your health, and teaches your child independence and community awareness.
Emissions	Consortia	An active school commute also reduces congestion in school zones and contributes to reducing greenhouse gas emissions – it's a win-win for everyone!
Health	Municipality	Active School Travel allows school-aged children the chance to participate in moderate to intense physical activity. This is linked with lower body mass index and improved cardiovascular health.
Lanes	Municipality	We are continuing to build on the cycling and pedestrian network by adding more bike lanes, building multi-use paths and encouraging developments to provide better pedestrian/cycling environments.
Mental Health	Municipality	ASST not only improves physical and mental health but contributes to a healthier environment and safer streets.
Physical Health	Municipality	Encouraging Active Transportation promotes personal health and recreation, helps manage congestion, reduces emissions and supports municipal objectives for efficient land use.

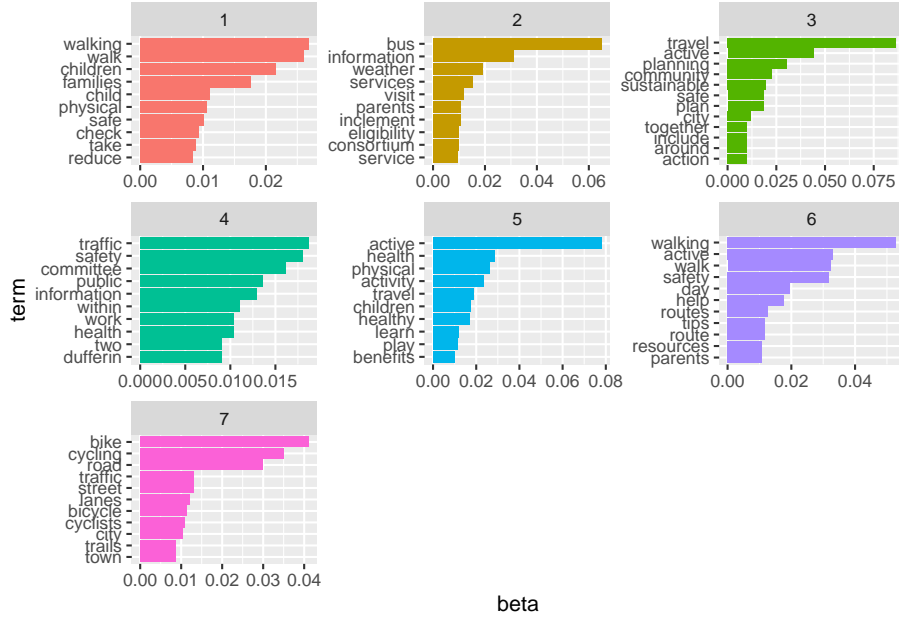


Figure 6: Topics identified in the policy corpus according to clusters of words.

5.3. Topic modelling

Finally, we conduct topic modelling to examine the different topics found in the policy and academic corpora. We focus on the policy corpus, instead of individually assessing the municipal, school, and consortia documents, so that we could report on the various frames used across all documents put out by STP stakeholder groups in Ontario. To determine the number of discrete topics in each corpus, we use the *ldatuning* package. We then use the *LDA* function from the *topicmodels* package to estimate an LDA model for each group of documents. The parameters from the *ldatuning* package suggest that the policy corpus has between 7 and 9 topics and the academic corpus has between 17 and 25 topics. After running the LDA model for the academic corpus, it was too difficult to interpret a minimum of 17 topics based on the clusters of words that were identified. We experimented with the model by adjusting and evaluating the number of topics and found that there were 9 distinct topics that could be interpreted, after which there was too much overlap. Figures 6 and 7 present the main terms that are associated with the topics found in each corpus.

In the policy corpus, we interpret the following topics based on the cluster of words: (1) resources for walking; (2) walking; (3) supporting active travel; (4) bicycling and the environment; (5) benefits of active travel; (6) safety; and (7) busing information and eligibility. These topics indicate that STP stakeholder groups are sending the message that walking and bicycling to school are healthy

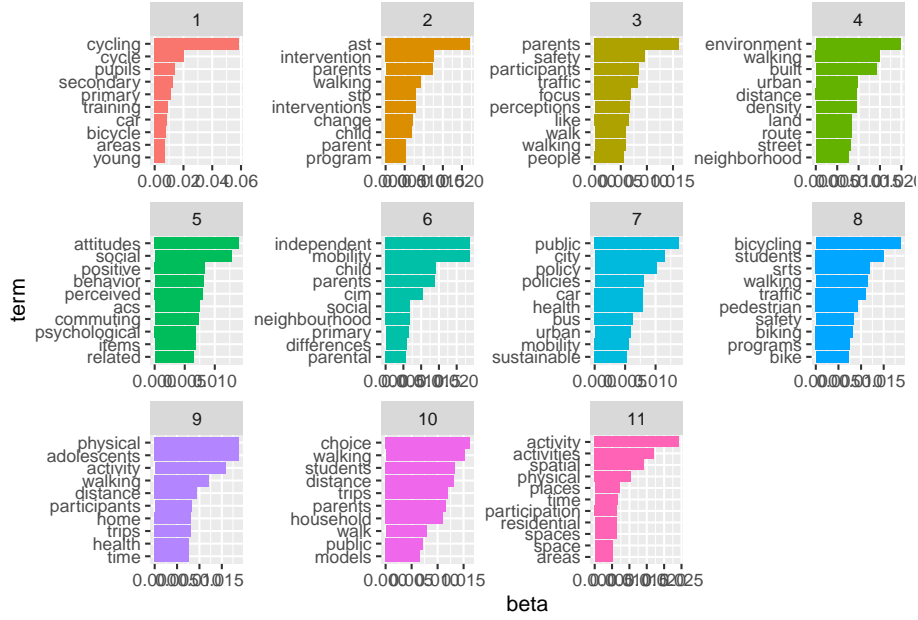


Figure 7: Topics identified in the academic corpus according to clusters of words.

travel modes for students, particularly as a means to get physical activity. We also found that there is information shared to support parents and students in using active modes to school such as the availability of cycling lanes or route tips for walking. STP stakeholder groups appear to be addressing the issue of safety.

The academic corpus has a higher number of topics likely due to the volume of papers that were sourced. The following topics were identified based on the clusters of words: (1) built environment (2) walking distance; (3) AST interventions; (4) parental barriers to walking; (5) behaviours and attitudes; (6) bicycling; (7) social environment; (8) children's independent mobility; (9) modeling trip choice; (10) adolescents and physical activity; and (11) safe routes to school programs. This corpus reflects a broader range of topics than the policy corpus.

We conclude that the policy corpus primarily frames AST as a health and environmental issue. Policy documents do not reflect the diversity of content found in the academic papers and instead focus on a few factors. STP stakeholder groups appear to position walking, bicycling, or rolling to school as beneficial to individual health, as an opportunity for physical activity or to improve mental health, and to the broader community through a reduction in traffic and vehicle emissions. Here, we present some examples from the policy documents to illustrate how the health and environmental frames are communicated:

If you live in a walk zone, the best way to get to school is by walking or biking. This promotes physical activity, helps the environment and minimizes traffic around schools during busy times. (City of Barrie)

Walking to school is a great way to add physical activity into your child's busy day. (Region of Haldimand-Norfolk Region)

Active school travel is a great way for children to be physically active, which is associated with improved physical and mental health, while making school zones safer, by reducing traffic volumes at and around schools.(Region of Leeds, Grenville and Lanark)

The WCDSB supports active transportation as the preferred method of transportation to school because it is a healthy choice that has proven links to greater student achievement. (Waterloo Catholic District School Board)

However by examining document frequency (see Section 5.1), we found that some terms are not present in all policy documents. This suggests that although documents pertain to the subject of active travel or school travel, some stakeholders across Ontario are not disseminating information about AST. For example, a document may discuss active travel but not to school or school travel but only by bus and not by active modes. We manually searched the policy corpus and found that 48% of documents mention AST and 16% mention STP. This confirms that many municipalities, school boards, and transportation consortia are not promoting AST through their webpages or indicating their involvement in the STP process. Instead, inclement weather and impacts to busing is a common topic addressed in school board and transportation consortia documents.

Furthermore, we found that some policy documents make direct reference to topics found in the academic papers. For example, some policy documents encourage AST programs that have been researched and evaluated in the literature, such as walking school buses, or explain how an increase in AST will reduce parent safety concerns.

_ For their health, safety, environment and community: Kids learn healthy habits and concentrate better in class; One less car (yours) reduces traffic and parking problems in school zones; Teach your kids about traffic safety; Start a walking school bus; your kids make friends in every grade, and that can prevent bullying._ (City of Guelph)

There are lots of benefits in the classroom for children that walk or cycle to school on a regular basis. Some of these benefits include improved concentration and better coping with stress. Being outside helps to prevent feelings of isolation and increases their social interactions. Walking and biking to school can also save you money and lead to fewer cars on the road. (City of Ottawa)

The secondary frame for AST in policy documents is the opportunity or prospect of behaviour change. Some cities and schools explain how children and parents can leave the car at home and make the journey to school on foot or by bike by describing efforts to make AST safer. This frame encourages the public to evaluate their own travel decisions and to access resources (e.g., walking skills checklist) that will help them make AST a first choice. Some documents emphasize the role of the parent in creating opportunities for AST in their household or neighbourhood, however few documents address the main barriers as perceived by parents (e.g., distance, travel arrangements for multiple people, or convenience). Examples of this secondary frame include:

_A way to make sure your child is safe while walking to school is with a ‘walking school bus.’ Here are some tips for a walking school bus: Invite families who live nearby to walk; Pick a route and take a test walk; Take side streets and paths that are less busy with traffic; Decide how often the group will walk together; Talk with your boss to adjust your day; Have fun! (City of Ottawa)

Help your students get started on the right foot - encourage them to walk or bike to school when possible. Even leaving the car a block or two and walking the rest of the way helps. It’s good for the environment and your health, and teaches your child independence and community awareness._ (Halton District School Board)

Want to boost your child’s mental and physical health? Ottawa Public Health, City of Ottawa, and OSTA have produced a tipsheet for parents about “active transportation” to school – fitting walking and wheeling into your daily routine. (Ottawa-Carleton District School Board)

Finally, the policy documents discuss proposed solutions to encourage AST. STP stakeholder groups seem to be communicating that AST is possible and safe as a result of improvements to the built environment and available resources for parents and children. A final focus in the policy documents is on various efforts that are underway to support AST including route planning. A few examples include:

School Travel Planning is a community-based approach that aims to increase the number of students and adults choosing active and sustainable travel to get to and from school. This approach addresses concerns about safety, physical activity, and the environment. (City of Hamilton)

Today, as more and more of our neighbourhoods are being retrofitted with new sidewalks and bike lanes, pedestrian crossovers, street lights, reduced speed limits and/or crossing guards, the walk or bike ride to and from school has never been easier, safer or healthier. (Hamilton-Wentworth District Catholic School Board)

6. Discussion

6.1. *Framing in STP documents*

Using natural language processing techniques, we analyzed how AST is framed in documents available to the general public on the websites of STP stakeholder groups in Ontario. We found that AST is primarily framed to parents as beneficial to the health and wellbeing of children and to environmental sustainability. This was confirmed by the most common bigrams identified in the policy corpus, as well as the topics identified by the LDA model. The policy documents adequately reflect the evidence that AST contributes positively to children’s physical health (see Faulkner et al., 2009; Schoeppe et al., 2015), although the statements regarding the benefits of AST to children’s school performance and cognitive development need to be studied further to produce stronger evidence (???). STP stakeholder groups also communicate that increasing AST may reduce traffic near and around schools. This presumably is communicated to alleviate parental concerns about traffic and safety (Evers et al., 2014; Mammen et al., 2012; Rothman et al., 2015; Wilson et al., 2018) or reduce the frequency of risky behaviours from drivers around schools (Rothman et al., 2017). However, the documents do not explain why declining rates of AST are a problem for the particular community or convey any urgency to this issue so that it attracts the attention of parents, the general public, or policy makers. Communicating the potential outcomes of increased AST may be persuasive arguments to motivate behaviour change, but these documents do not appear to encourage parents or the general public to view their behaviour as problematic or unhealthy for their children’s development. For example, parents who escort their children to school have reported concerns about traffic volume around schools (Mammen et al., 2012), but may not recognize that their own behaviour contributes to the problem that is perceived to prevent their child from safely walking or bicycling to school (Collins and Kearns, 2001).

The secondary frame of AST that we interpreted based on the LDA model is the opportunity or prospect of behaviour change. STP stakeholder groups identified different ways that parents could encourage or support their child(ren) to commute to school by using active modes. Some school boards and municipalities also shared resources such as walking tip sheets and guidance for starting a walking school bus. Other advice included dropping children off one or two blocks away from school so that they could walk or bike part of the trip. The general emphasis is communicating information that could change parental perceptions about the ease of their children using active modes to school, which may be seen by STP stakeholder groups as a “modifiable” factor (see Riazi et al., 2019). In turn, this could encourage parents to modify their routines and incorporate opportunities for their children to use active modes to school.

We found that interpersonal behaviour changes achieved through educational strategies and engineering changes (e.g., traffic calming measures, reduced speed limits, etc.) are communicated to the general public as potential solutions to address the decline of AST. This reflects findings from the AST literature (Panter et al., 2010), but these solutions have to sufficiently address real and perceived

barriers from parents about the household environment and the built environment (see Section 2.2). In most documents, STP stakeholder groups provide parents with resources that help them switch modes for the school commute and/or on reassure them that the built environment has become safer and friendlier to active travelers as a result of infrastructure or policy improvements. As previously noted, the documents do not appear to present a strong “call to action” that urges behaviour change for parents or the general public, which may affect the success of STP interventions. On the other hand, the emphasis on engineering changes may reflect the strong engagement of the “policy stream” (Kingdon, 1984) and the feasible options to address the problem, since engineering staff and municipal representatives are common STP stakeholders (Buttazzoni et al., 2018; Mammen et al., 2015).

Given the range of factors that influence AST in a Canadian setting (*inter alia*, see Mammen et al., 2012; Mitra, 2013; Rothman et al., 2018; Wilson et al., 2018), STP stakeholder groups must decide which points of intervention that they can reasonably have some influence towards. This would also depend on the local context to ensure that barriers to AST as perceived by parents are addressed. It could be that STP stakeholder groups perceive to have more control over micro-scale elements of the built environment, like traffic calming measures or speed limits, rather “non-modifiable” factors like street density or land use mix. It would also certainly be much more difficult for STP stakeholder groups to influence the number of trips to different destinations that households need to make or to intervene in residential location, which affects distance to school. A focus on changing parental perceptions is recommended by many scholars since parents are the “gatekeeper” for children’s mobility, but the information communicated by STP stakeholder groups in Ontario should reflect a broader range of factors that influence AST.

6.2. Implications for school travel planning

There is a noticeable lack of focus on individual and interpersonal determinants of AST in the policy documents. For example, the role of convenience and inclement weather in shaping household travel decisions (Buliung et al., 2011) or the age at which children become allowed to travel by active modes or independently (Mammen et al., 2012) were not discussed. The desire to escort children to school, which has been noted by parents as a reason to continue driving (Westman, Friman, et al., 2017), is also not adequately addressed by STP stakeholder groups. The complexity of travel arrangements that must be coordinated by households (see Buliung et al., 2021) and the dominant parenting culture to protect children from risk (???) are likewise overlooked. STP stakeholders may wish to emphasize to parents that older children have greater traffic safety and cognitive abilities to navigate their own routes to school, which could encourage parents to develop their child(ren)’s travel skills over time. Additional attention should be paid to the reasons why parents perceive driving to be more convenient.

Coming back to Kingdon’s Multiple Streams Framework (1984), we posited that STP stakeholder groups need to raise awareness about the AST issue

among parents and the general public through the problem stream. This could influence perceptions about the issue and encourage behaviour change. Based on the policy documents, it is not obvious that AST has declined significantly over the past few decades in Canada or that this issue merits urgent attention. Many municipalities, schools, and transportation consortia in Ontario use similar content in their public documents about AST. It would be worthwhile for STP stakeholder groups to frame the decline of AST as a “problem” worth addressing with information specific to each local context. STP stakeholders also need to ensure that their communication accounts for the ways in which Canadian parents perceive the built environment in different ways than planners (see Buliung et al., 2021). If there is “conceptual asymmetry” as Buliung et al. (2021) identified, the materials disseminated by STP stakeholders may not resonate or reach parents. Future research or STP activities should investigate how parents or the general public respond to messages or information that encourages the adoption of AST and evaluate how effective they are to motivate behaviour change. It would be helpful to know which frames would most encourage behaviour change or increase political support for interventions that address barriers to AST. This type of information could ensure that educational strategies and promotional materials increase buy-in for their target audience.

Although the “policy stream” appears to have been adequately engaged in Ontario communities, it could be that the decline of AST has not been sufficiently framed as “problematic” to warrant more widespread awareness or solutions. If Canadian STP stakeholder groups wish to involve more local residents in their efforts (Buttazzoni et al., 2018), it would also be worthwhile for them to produce different materials that communicate why this issue is important to the general public, regardless of whether they currently have children commuting to/from school. The “political stream” could also be further engaged by working with advocacy groups who could attract more support from a broader coalition of individuals.

Finally, Rothman et al. (2018) note that local solutions to address specific school challenges are needed, and we extend this recommendation to include local context in STP messaging about AST. Instead of generic content about AST, stakeholders involved in STP should produce more information that specifically responds to parents’ perceived barriers and challenges that were identified in that local context. For example, STP materials could explain how known concerns in a particular municipality or school area have been addressed through local solutions. This could reflect that solutions have been identified based on what was heard from the community.

6.3. Limitations

A limitation of this study is that we only analyzed texts that were easily accessible to the general public on the websites of STP stakeholder groups in Ontario. Parents likely receive information about AST directly from schools, which may contain more content that reflects the local barriers to AST.

7. Conclusion

We used natural language processing techniques to examine how different school travel planning stakeholder (STP) groups in Ontario frame the issue of AST. STP stakeholder groups frame AST as a health and environmental issue that can be addressed through household behaviour change and engineering solutions. Policy documents reveal that STP stakeholder groups are focusing on “modifiable factors” such as parental perceptions or micro-scale elements in the built environment to increase rates of AST. However, AST may not be framed sufficiently as a “problem” that requires urgent intervention, which may impact how parents respond to behaviour change initiatives and limit awareness in the general public. In their public materials about AST, STP stakeholder groups should present solutions for a broader range of factors that influence AST and emphasize why AST rates should increase in local communities.

Acknowledgments

This research was completed using open software, and the authors wish to acknowledge the developers of the following R packages: `dplyr` (???), `ggraph` (???), `ggplot2` (???), `igraph` (???), `pdftools` (???), `readr` (???), `reshape2` (???), `stringr` (???), `text2vec` (???), `textdata` (???), `tidyr` (???), `tidytext` (???), `tm` (???), `tools` (???), `topicmodels` (???), `widyr` (???), `word2vec` (???), `wordcloud` (???), `DiagrammeR` (???), and `kableextra` (???).

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