Framing active school travel in Ontario: , or how spinach is good for you

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Abstract

Active school travel (AST) is a relevant policy issue in Ontario, Canada, as reflected in provincial support for school travel planning (STP) efforts. Two pillars of school travel plans are education and encouragement. For these pillars to stand, all relevant stakeholders must be cognizant of and understand well the issues and stakes. For this reason, how AST is communicated to them is essential. In this research we adopt frame analysis to investigate the way various organizations communicate around AST to the public. A frame is a central organizing idea or story line that provides meaning to a particular phenomenon, and helps to set the parameters for conversations about policy. In the case of AST, framing can influence what policy alternatives are perceived as available by children, parents, and their wider communities. To investigate framing of AST in Ontario we use natural language processing techniques to analyze publicly available documents from Ontario stakeholders involved in school travel planning. We then compared the findings from these documents to a selection of academic studies on AST. We conclude that framing of AST in Ontario is mostly empirical-scientific in style, and largely in agreement with academic research on AST. On the other hand, it it does not appeal to moral reasons for change, and is therefore oddly soothing and lacking in urgency. Furthermore, the frames used download responsibility for change to households, which limits the scope of policy alternatives by keeping collective action out of the frame.

Keywords: active school travel, school travel planning, natural language processing, framing analysis

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1. Introduction

Walking and bicycling to school, commonly known as active school travel (AST), have declined in North America for decades (Rothman et al., 2018), but the appetite for these modes is beginning to rise in many Canadian communities. For instance, research in Toronto, Ontario found that 40% of children who were driven to school would like to travel by bicycle instead (Larouche et al., 2016). Another study in London, Ontario, reported similar findings with respect to children's preference for active travel (Larsen et al., 2012). From a public policy perspective, increasing active travel to school represents a major opportunity to improve children's health and wellbeing (Faulkner et al., 2009), to mitigate traffic and improve perceptions of safety (Rothman et al., 2015), as well as to reduce carbon and other noxious emissions (Bearman and Singleton, 2014; Goodman et al., 2019).

To promote this trend, in 2017 the Government of Ontario began to support communities develop AST initiatives through a program called *Ontario Active School Travel* (OAST). By 2021, the program, run by *Green Communities Canada* had awarded over CAD 2 million and provided resources to over 25 projects across Ontario (Canada, 2020). A popular intervention in many communities is school travel planning (STP) (see Canada, 2021). In this context, STPs are "school-specific" interventions led by a facilitator who works with a committee of stakeholders from diverse sectors including education, planning, transportation, and public health to develop action plans (Buliung et al., 2011; Mammen et al., 2014a). The five-step process involves identifying barriers to AST and implementing solutions or activities to make AST safer and more convenient: 1) setup of the program; 2) data collection and problem identification; 3) action planning; 4) implementation; 5) monitoring and evaluation (Buliung et al., 2011; Lang et al., 2011).

How AST is presented to a target audience (e.g., parents or the general public) is essential to define the parameters of what is possible policy-wise. Drawing from concepts in communication studies, the objective of this paper is to investigate how AST is framed in Ontario. 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). From this perspective, stakeholders involved in STP efforts play an important role in shaping public perception about AST by generating frames that create meaning, thus influencing the degree of attention and recognition of a "problem" that needs to be addressed through behaviour change or new policies.

Our research is supported by natural language processing techniques, applied to the analysis of documents produced by three STP stakeholder groups in Ontario (municipalities, school boards, and transportation consortia). We assemble a corpus of texts from public sources that present information for the general public or parents who are interested in AST and examine word frequency, bigrams, and concordances in these selected documents. Furthermore, we use topic analysis to identify themes 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 scholarly literature on AST and materials shared with the public. The results of this analysis, along with spot checks of the corpus by the authors, lead us to conclude that AST if framed as a matter of individual choices instead of collective action. The message is reasonable but anodyne, and it fails to communicate a sense of urgency about health and environmental issues, which may help to explain the limited success of policy.

2. Literature Review: AST

The desire to increase AST in Canada is warranted given its potential 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. This relationship could be dose-dependent, and contingent on sufficiently long trips to school 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).

More recently, the link between transport and children's wellbeing has attracted interest too (way, 2020). Being driven to school reduces community interactions for children, which may negatively impact their social wellbeing (Waygood and Friman, 2015). In contrast, walking and bicycling give children opportunities to socialize (Michail et al., 2021) and increase positive emotions that contribute to wellbeing (Ramanathan et al., 2014), a feeling that children seem to value (Zwerts et al., 2010). AST can also provide opportunities for children to engage with natural environments (Fusco et al., 2012; Romero, 2015).

Rather than describing an extensive list of factors that influence AST and mode choice for travel to school in Canada (e.g., Mammen et al., 2012; Mitra, 2013; Rothman et al., 2018; Wilson et al., 2018), we focus on two key aspects that may be targeted from a policy perspective: perceptions and behaviors by parents and built environmental factors.

First, research has found that parents are key decision-makers with respect to children's form of travel to school (Rothman et al., 2015). Particularly, parental perceptions of the built or school environment (De Meester et al., 2014; Panter et al., 2010; Mandic et al., 2020) and their children's skills (Mammen et al., 2012; Faulkner et al., 2010) tend to influence mode choice to school. Furthermore, children's mode choice to school is strongly influenced by their parents' travel behaviours, the complexity of their household's travel needs (Buliung et al., 2021), as well as daily parental support (Mah et al., 2017). This suggests that shifting parental perceptions and habits is important.

With respect to the built environment, distance between home and school is most negatively 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 (of Canada, 2020). Finally, concerns about traffic and strangers have been reported by parents who drive their children to school (Mammen et al., 2012): ironically, concerns about traffic become a self-fulfilling prophecy.

3. School travel planning in Canada and relevance of frames

AST has become a policy issue on the education and public health agendas in Ontario, supported, albeit in a modest way, by financial contributions from the provincial government. Still, the support from a range of municipal representatives (see Buttazzoni et al., 2018; Mammen et al., 2015) demonstrates that the AST issue is on the political agenda. One of the main vehicles to promote AST is school travel planning (STP), which has been implemented in Canada since at least the late 2000s. Within the STP process, facilitators establish multi-sector committees which intervene at the participating school through a range of activities consisting of *[E]ducation* strategies, *[E]ncouragement* through in-person events or programs, *[E]ngineering* improvements to or around the school site, and *[E]nforcement* of traffic speeds around schools (or 4Es, Lang et al., 2011; Mammen et al., 2014b). Following the first large-scale evaluation of STP as an intervention in Canada, AST rates increased and 14% of parents reported a perceived reduction in traffic outside the school (Buliung et al., 2011). Assessments of the efficacy of STP (Buttazzoni et al., 2019; Mammen et al., 2014b) indicate its potential to encourage behaviour change and adoption of AST.

The relevance of policy frames is highlighted by Béland (2014), who remarks "framing processes as public relations are central to policy issues related to sustainable transportation". Seeing how highly influential parental perceptions are to AST, it is important to understand AST-related communications, since the construction of frames for policy positions or public issues can activate or restrict a particular response in the intended audience (Pan and Kosicki, 1993). Besides parents and children, framing can also affect broader policy support for AST in the community. Municipal representatives are perceived to be instrumental but the involvement of other stakeholder groups (e.g., busing consortia representatives and local residents) can be lacking (Buttazzoni et al., 2018). In this sense, 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. Contrariwise, framing can be instrumental to revealing more diverse policy options than more diverse policy options than conventional wisdom would have

(Bosomworth, 2015). Ultimately, it is important to understand framing of policy issues because creating meaning through frames contributes to the constant process of shaping of our collective identities, uncovering what we collectively find (un)acceptable and why (Béland, 2014).

Given the heavy focus of STP activities on education or encouragement (Buliung et al., 2011; Mammen et al., 2014b; Buttazzoni et al., 2018), it is important for the issues to be effectively framed. In the past, parents have been found to express different understandings, language, and perceptions than planners of how the built environment can influence school travel: while parents tend to view mixed land use as conducive for driving, transport planners see mixed uses as a key for encouraging more active travel (Buliung et al., 2021). Similarly mismatched understandings have been detected with respect to factors like the convenience of different modes to school (Lang et al., 2011). As a consequence, STP stakeholders must pay special attention to parents' and communities' understanding of the decline of AST as a problem, which may affect their receptivity to proposed solutions (Buttazzoni et al., 2018).

So framing is important, but not all frames are equally effective. Frames can appeal to economic reasons, to science and logic, or to moral obligation. For example, Severson and Coleman (2015) report that overall support for climate change policy is increased more when scientific frames, secular moral frames, and economic equity frames are used, compared to economic efficiency or religious moral frames. Frames can also be positive or negative, and there is evidence that negative framing may be more effective at motivating individuals, for example, to change transport modes to reduce CO2 emissions (Waygood and Avineri, 2018). As well, the effectiveness of the framing depends on the psychological distance to the relevant issues: how socially, temporally, geographically, or hypothetically close an individual perceives themselves to the issues can affect their support for various policies (Maiella et al., 2020). For this reason, stakeholders involved in STP must make conscious choices about how issues surrounding AST are communicated if the goal is to increase support for and buy-in of AST policies.

4. Data

4.1. Data retrieval

4.1.1. 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 involve collaborations between municipal regions and school boards to deliver more efficient and timely regional transportation services to schools. 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 do not consistently participate in STP initiatives in 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 downloaded. Next, we searched municipal government and transportation consortia websites. These were identified based on geographic area. Likewise, webpages related to active transport or school travel were downloaded.

Webpages from STP stakeholder groups were included in our analysis if they were findable. This primary criterion was important since our analysis pertains communication of issues to the general public. Thus, we included only webpages that were readily accessible, which we defined as requiring no more than four links from the initial Google search to reach.

The initial corpus of documents from STP stakeholder groups included 69 relevant webpages. We refer to these as policy+practice 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.

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

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

4.1.2. Academic papers

We conducted a search on Web of Science for scholarly papers on the topic of school travel using Web of Science's Core Collection. The search was conducted in the Winter of 2021 and the parameters used were {active OR walk* or cycl* or bicycl*} AND {"school travel"}. Initially, we found 322 papers, which we reduced to 250 after selecting only papers in the fields of transportation, planning, urban studies, geography, and public health. These fields were chosen because they had the greatest volume of documents and/or were of disciplinary interest to the authors. This list with 250 documents was then manually curated by the authors to ensure that all documents were relevant. This was done by checking the title and reading the abstract of the papers. For example, a paper with the title "Impact of automated photo enforcement of vehicle speed in school zones" (Quistberg et al., 2019) was excluded as being tangential to our research; the abstract of another paper revealed that it was mainly concerned with survey methods: "Common methods for measuring mode share include Hands Up surveys and family surveys, but these require teacher and parental involvement." (Sersli et al., 2019). After this process, our academic corpus comprised 227 journal articles that were readied for analysis.

4.2. 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 = 227). Webpages were manually downloaded in portable document format (PDF) and trimmed so that pages that only consisted of tables, figures, or references were removed. After converting into `txt` files and importing for analysis, we manually removed any remaining tables, figures, references, headers/footings, and captions that could not be trimmed. We also manually removed any extraneous material that did not pertain to AST specifically (e.g., references, footnotes, weblinks, etc.). In the final step, we removed all blank spaces, punctuation, capitalization, and numbers. English stop words (i.e., words such as *and* or *the*) and other frequent terms in the documents like "school" and specific location names were removed from the corpora.

5. Methods

5.1. Process of Framing Analysis

Topic modelling was used to analyze the documents retrieved. This is a natural language processing technique used to analyze text to identify the language and concepts being communicated. This method is practical for researchers working with large amounts of text because it can assist and complement the manual coding of topics that would normally take place to analyze or summarize textual data (Jacobi et al., 2016). We primarily use the following `R` packages: `tidytext` (Silge and Robinson, 2016), `topicmodels` (Grün and Hornik, 2011), `word2vec` (Wijffels, 2021), and `wordcloud` (Fellows, 2018).

We estimate latent Dirichlet allocation (LDA) models to identify topics contained in both the STP and academic documents. 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.

This paper is an example of open and reproducible research that uses only open software. The source document is an R markdown document. Following best practices in spatial data science (Brunsdon and Comber, 2020), the code and data needed to reproduce our research or conduct a similar analysis for other regions are available in a publicly available repository[2].

6. Results

6.1. Word and document frequency

We analyzed word and document frequency for each corpus of text. Table 2 shows the most frequent terms found in the municipal, transportation consortia, school board, and academic documents. 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 that these are common concerns for parents. The word *physical* is present in each corpus, but this could refers to *physical activity* or the *physical environment*. Furthermore, documents from STP stakeholder groups discuss *resources*, *information*, and *services* about school travel. Unlike the academic papers, policy+practice documents frequently include the words *route* or *routes*. This could indicate the role of STP stakeholder groups in identifying safe routes to school to share with parents or families. In the section below, the context in which these terms are used is explored further.

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. The prevalence of these terms is consistent with an academic focus on exploring the variables that influence travel to school. These words are absent from the list of common words in policy+practice 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 substantially higher due to the inclusion of more documents.

Examination of document frequency reveals terms that are not present in all policy documents. This suggests that although documents pertain to school travel, not all stakeholders across Ontario disseminate information about AST. We manually searched the policy+practice corpus and found that 48% of documents mention AST and 16% mention STP. In contrast, inclement weather and its impacts on busing is a common topic addressed in school board and transportation consortia documents.

6.2. Bigrams and concordances

Bigrams refer to a pair of consecutive words. We combined all municipality, school board, and transportation consortia documents into the policy+practice corpus. Figure 1 shows all of the bigrams that occur more than 10 times in this corpus. This figure highlights the main ideas that are presented to the public in each of the policy corpora. The directional arrows indicate the arrangement of the words (e.g., active travel and not travel active) and the colour gradient of the arrows corresponds to the most frequently mentioned pairs (e.g., bigrams with darker arrows are found in the corpus more often).

STP stakeholders discuss *physical activity* and *public health* in the context of AST. In addition, *travel planning*, *bike lanes*, and *safe routes* are also identified, conceivably as either proposed solutions or built environment factors that support AST. Key issues related to transport such as *traffic safety*, *air quality*, and *greenhouse gases* 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 travel to offset transport-related emissions in urban areas. We also found *mental health*, *walk zone*, and *green communities* as common pairs of consecutive words. Their presence makes sense given the involvment of *Green Communities Canada* in AST initiatives in Ontario. Overall, the policy documents from STP stakeholder groups seem to focus on four key areas: i) benefits or impacts of AST; ii) mechanisms

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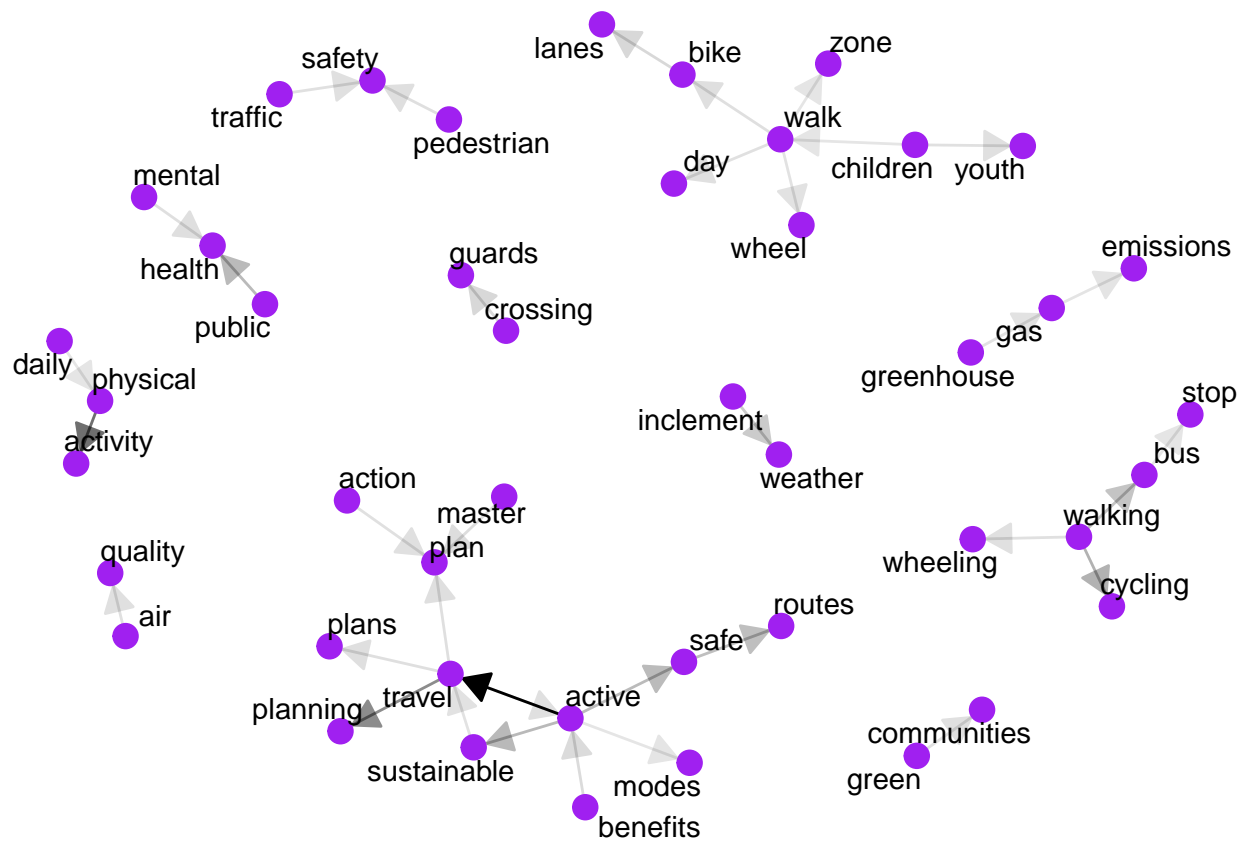[2]`https://github.com/desjae/AST-Framing-Analysis-Ontario`

Figure 1: Most common bigrams found across all policy documents (i.e., school board, municipality, and transportation consortia combined).

Table 2: Top 25 terms identified in each corpus. 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	inclement	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

of intervention; iii) concerns or barriers; and iv) supports for AST. This interpretation indicates that the general public accessing information about AST in Ontario is informed about a wide range of content related to this issue.

Next, we analyzed bigrams in the academic corpus separately to comparE with the policy+practice corpus. Figure 2 indicates that academic papers include several common bigrams that were also found in the policy documents including *physical activity*, which is the top bigram, as well as *traffic safety* and *safe routes*. However, many other factors are identified in the academic corpus that are not presented to the general public through policy documents. Terms like *built environment*, *independent mobility*, and *urban form* are other frequent pairs of consecutive words. Academic papers also often discuss *distance home*, *car ownership*, *household income*, and *population density*, which are factors that have been found to influence AST. Finally, the presence of *statistically significant* among the top bigrams indicates that researchers often aim to identify associations using statistical measures. We found that the academic corpus focuses on a greater range of topics than found in the policy+practice documents.

We interpreted the most common bigrams from the policy+practice corpus (see Figure 1) as the main ideas that STP stakeholder groups focus on and communicate to the public about AST. We then examined the context of these key ideas by extracting words-in-context from the corpora. Table 3 presents some examples from select policy documents that illustrate how the most common bigrams are communicated to the public.

6.3. Topic modelling

We conducted topic modelling to examine the different topics found in the policy+practice and academic corpora. We estimated Latent Dirichlet Allocation (LDA) models for each corpus. Parameter tuning suggests that the policy+practice corpus has between 9 and 13 topics and the academic corpus has between 17 and 25 topics. After running the LDA model for the academic corpus, we realized the difficulty of interpreting as many as 17 topics based on the clusters of words that were identified. We experimented with the model by adjusting the number of topics and evaluating the output of terms in each topic. We found that there were 9 distinct topics that could be interpreted in the policy+practice corpus and 11 topics in the academic corpus,
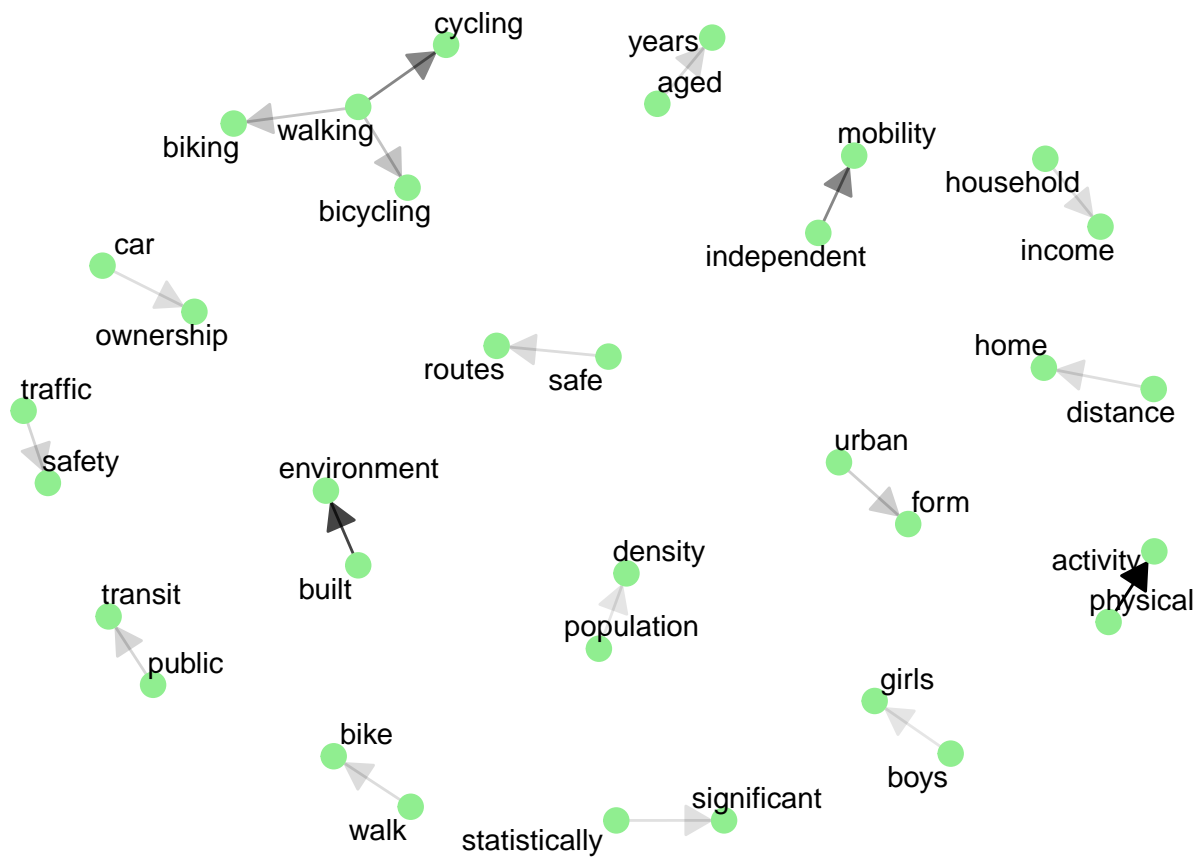
Figure 2: Most common bigrams found in the academic papers.

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

| Terms	Stakeholder	Context
Air Quality	School Board	Active transportation [...] improves air quality.
Benefit	Municipality	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	Active and Sustainable School Travel (ASST) not only improves physical and mental health but contributes to a healthier environment and safer streets.
Physical Health	Municipality	Encouraging Active Transportation promotes physical health and recreation, helps manage congestion, reduces emissions and supports municipal objectives for efficient land use.
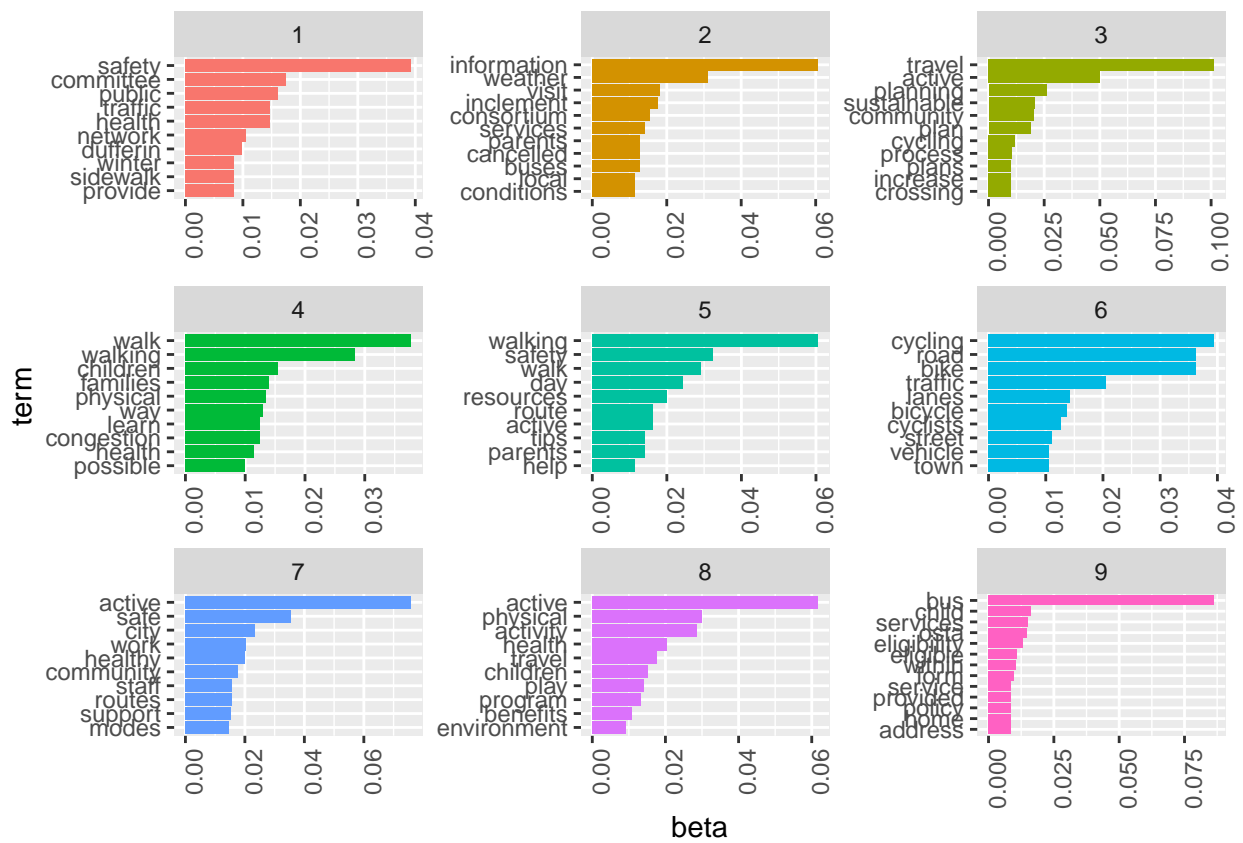
Figure 3: Topics identified in the policy+practice corpus according to clusters of words. The per-word-per-topic probabilities are shown by beta.
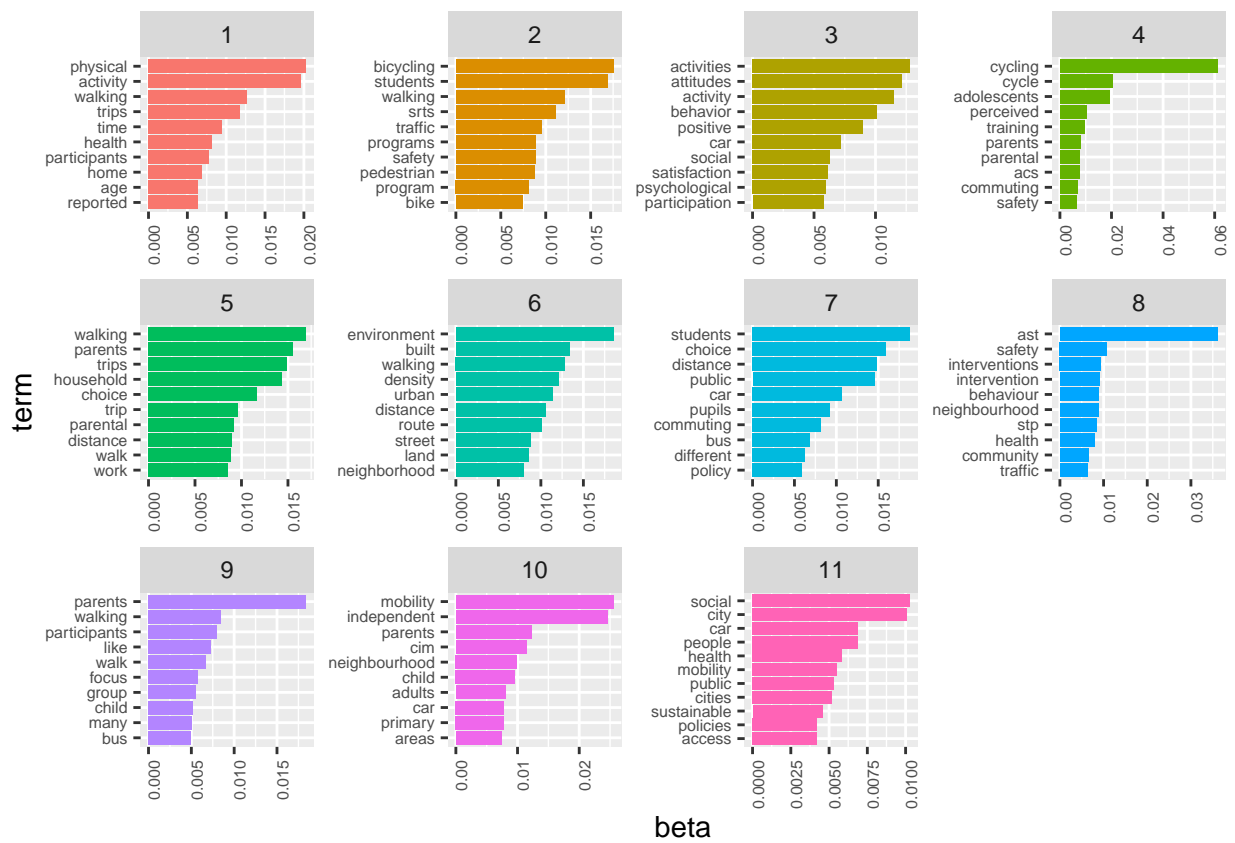
Figure 4: Topics identified in the academic corpus according to clusters of words. The per-word-per-topic probabilities are shown by beta.

after which there was too much overlap for the clusters to be meaningfully distinguished. Figures 3 and 4 present the main terms associated with the topics found in each corpus.

In the policy+practice corpus, we identified the following topics based on the cluster of words: (1) safety; (2) weather and busing; (3) active travel planning; (4) walking; (5) resources for walking; (6) bicycling; (7) active travel concerns; (8) benefits of active travel; and (9) busing logistics. These topics indicate that STP stakeholder groups are sending the message that walking and bicycling to school are healthy travel modes for students, particularly in terms of physical activity. We also found that information is shared to support parents and students in using active modes to school, for example regarding the availability of bicycling lanes and tips for route choice for walking.

The academic corpus has a higher number of topics likely due to the volume of papers included. The following topics were identified based on the clusters of words: (1) physical activity; (2) safe routes to school for active travel; (3) behaviours and attitudes; (4) bicycling; (5) walking; (6) built environment; (7) trip choice; (8) active school travel interventions; (9) parents; (10) children's independent mobility; and (11) public health and policies. This corpus reflects a broader range of topics than the policy+practice corpus.

6.4. Frames

Based on the identified bigrams and topics, we determined that the policy+practice corpus primarily frames AST as a health and environmental issue. STP stakeholder groups appear to position walking, bicycling, or rolling to school as beneficial to individual health, via physical activity and improved mental health, and to the broader community through a reduction in traffic and vehicle emissions. Here, we present an example that illustrates how the health and environmental frame is communicated:

> *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)

Furthermore, we found that policy documents make claims about the benefits of AST that are consistent with the findings of academic research and evaluation.

> *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 in policy documents is that AST is accessible and feasible for children and parents. Despite the emphasis on the logistics of busing in the topic modelling, the documents indicate that there is an opportunity for 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. 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. Examples of this secondary frame include:

> *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)

Finally, both AST frames present the benefits of AST. STP stakeholder groups seem to be communicating that AST is a healthy and accessible option as a result of school travel plans and improvements to the built environment. This could include examples of various efforts that are underway to support AST including route planning.

> *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)

Beyond supporting communities to develop STPs, these frames tend to place responsibility for change squarely on the members of the community:

> ___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 schoolbus. . . [tips]. . . Have fun!__ (City of Ottawa)

7. Discussion

7.1. Current AST frames in Ontario

Interpretation of the text assisted by natural language processing reveals that AST in Ontario is not always communicated to members of the public. As noted above, less than 50% of documents from municipalities, school boards, and transportation consortia discuss AST. In the rest of the documents, the primary way AST is framed tends to emphasize the benefits to the health and wellbeing of children and to the environment. The policy documents 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 are less well-supported in the extant literature (Westman et al., 2020). STP stakeholder groups also communicate that increasing AST may reduce traffic near and around schools. This is conveyed presumably 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 to reduce the frequency of risky behaviours from drivers around schools (Rothman et al., 2017).

In the secondary frame, AST is presented as an accessible and feasible way for children to travel to and from school. Children and parents are encouraged to adopt new travel behaviours. STP stakeholder groups identified different ways that parents could encourage or support their children to commute to school by using active modes (e.g., walking tip sheets, walking school buses, etc.). The general emphasis of this frame 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.

Both frames present the AST issue in a positive light. Neither frame appears to explain why declining rates of AST are a problem or convey any urgency to this issue so that it attracts the attention of parents, the general public, or policy makers. For example, parents who drive 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). Communicating the potential outcomes of increased AST present the issues in a positive light, but these frames do not seem to encourage parents or the general public to view their current behaviour as problematic or unhealthy for their children and the environment. Further, behaviour change is mainly presented as an option for some but not an imperative for all, which keeps collective action through government entities out of the frame. This echoes the findings of Reynard et al. (2021), who found in their analysis of Canadian municipal documents that one of the dominant frames was to present behaviours that help mitigate the climate crisis as an individual choice but not "the expected norm".

Overall, we find that the proposed solutions in the secondary frame reinforce some of the same ideas: 1) behaviour change from households making different travel decisions (individual responsibility); 2) policies that create resources for AST (mainly through education and plannning); and 3) engineering solutions like bicycle lanes. This reflects findings from the AST literature that a range of solutions are needed to address different factors that influence AST (*inter alia, see* Mitra, 2013; Panter et al., 2010). The recognition of engineering changes may reflect the strong engagement of engineering staff and municipal representatives in the Canadian STP process (Buttazzoni et al., 2018; Mammen et al., 2015), as well as the evidence that the built environment influences mode choice to school.

As well as what is *in* the frame, it is also interesting to look for what is *not*. As noted, a call for collective action tends to be missing, whereas the positive tone does not convey urgency about some critical stakes, including for instance climate change. By presenting the issues in an empirical-scientific way no moral imperative is mobilized to encourage change (Severson and Coleman, 2015).

7.2. Implications for school travel planning

As we noted in Section 3 above, STP in Ontario relies heavily on education and encouragement. From the get-go, these are two of the weakest tools in the arsenal of government actions (O'Hare, 1989). For this reason, it is important that both are used effectively. Our analysis leads us to question the efficacy of the frames currently used for talking about AST in Ontario. If we had to paraphrase the way AST is framed, it would be like this: "eating spinach is good for you; here are some tips to help you choose spinach." The issues are presented as a matter of personal choice, purely optional, and without a sense of urgency. While emphasizing the risks may seem counterproductive, this approach has been found to be effective at motivating change (e.g., Lawlor and Crow, 2018; Waygood and Avineri, 2018). Accordingly, communications with the public could emphasize the risks associated with continued use of nonactive modes to school.

In addition to privileging choice, the frames tend to leave out a number of household determinants of AST. For example, there was no discussion about the role of convenience and inclement weather in shaping household travel decisions (Buliung et al., 2011) and the complexity of travel arrangements that must be coordinated by households (see Buliung et al., 2021). The desire to escort children to school, which has been noted by parents as a reason to continue driving (Westman et al., 2017), is also not adequately addressed by STP stakeholders. Parental assessment of a child's ability to undertake the journey to school was likewise overlooked despite its role in decision making for mode choice to school (Faulkner et al., 2010). Framing AST as a developmental opportunity or a rite of passage that children have been denied could challenge the prevailing culture of risk avoidance which discourages parents from letting their children use active modes to school.

7.3. Limitations

A limitation of this study is that we only analyzed English-language texts that were easily accessible to the general public on the websites of STP stakeholders in Ontario. We did not include French-language materials from Ontario's 12 French school boards (a mixture of public and Catholic schools). Parents likely receive information about AST directly from schools, which may contain more content that reflects the local barriers to AST, but these materials were not used in our analysis.

8. Conclusion

In this paper we examined how AST is framed in Ontario. Our analysis was supported by the use of natural language processing techniques, and reavealed that STP stakeholders frame AST as an accessible and feasible way to travel to school that is valuable to children's health and to the environment. STP stakeholders are communicating that this issue can be addressed through household behaviour change and policy solutions. Policy documents reveal that STP stakeholders 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 stakeholders should emphasize why AST rates should increase in local communities and how the negative effects of nonactive modes to school may impact children's health and wellbeing.

In terms of future research, we suggest the need for further investigation into how parents or the general public respond to messages or information that encourages the adoption of AST and evaluate which are most effective. It would be helpful to understand 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. If Canadian STP stakeholders 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.

Finally, we would like to close with a brief note on the methodology. Natural language processing and analysis of frames are still not widely adopted in transportation research. Based on our experience, we tend

to see computer-assisted text analysis as a complement rather than a substitute to expert reading of the documents. We would not recommend to proceed to interpretation without reading the documents, but the supervised automation helps to detect patterns that can be validated by an expert based on spot checks or more in-depth reading of the original sources. Like with any qualitative research, interpretation of the frames may differ by expert; in this research we aimed to develop a consensus interpretation by involving all authors in the discussion of the results. Furthermore, since the research is an open, reproducible project, all our assumptions are open to scrutiny and use the data to check and/or expand the analysis presented here.

References

Transport and children's wellbeing. pages i–ii. Elsevier, January 2020. ISBN 978-0-12-814694-1. doi: 10.1016/B978-0-12-814694-1.09993-0.

Nick Bearman and Alex D. Singleton. Modelling the potential impact on co2 emissions of an increased uptake of active travel for the home to school commute using individual level data. *Journal of Transport & Health*, 1(4):295–304, 2014. ISSN 2214-1405. doi: https://doi.org/10.1016/j.jth.2014.09.009. URL https://www.sciencedirect.com/science/article/pii/S2214140514000772.

Daniel Béland. Developing sustainable urban transportation: Lesson drawing and the framing of montreal's bikesharing policy. *International Journal of Sociology and Social Policy*, 2014. ISSN 0144-333X.

Karyn Bosomworth. Climate change adaptation in public policy: Frames, fire management, and frame reflection. *Environment and Planning C: government and Policy*, 33(6):1450–1466, 2015. ISSN 0263-774X.

Chris Brunsdon and Alexis Comber. Opening practice: Supporting reproducibility and critical spatial data science. *Journal of Geographical Systems*, August 2020. ISSN 1435-5949. doi: 10.1007/s10109-020-00334-2.

Ron Buliung, Guy Faulkner, Theresa Beesley, and Jacky Kennedy. School travel planning: Mobilizing school and community resources to encourage active school transportation. *Journal of School Health*, 81(11):704–712, 2011. ISSN 0022-4391. doi: 10.1111/j.1746-1561.2011.00647.x.

Ronald Buliung, Paul Hess, Lori Flowers, Fiona J. Moola, and Guy Faulkner. Living the journey to school: Conceptual asymmetry between parents and planners on the journey to school. *Social Science & Medicine*, 284:114237, September 2021. ISSN 0277-9536. doi: 10.1016/j.socscimed.2021.114237.

Adrian N. Buttazzoni, Stephanie E. Coen, and Jason A. Gilliland. Supporting active school travel: A qualitative analysis of implementing a regional safe routes to school program. *Social Science & Medicine*, 212:181–190, September 2018. ISSN 0277-9536. doi: 10.1016/j.socscimed.2018.07.032.

Adrian N. Buttazzoni, Andrew F. Clark, Jamie A. Seabrook, and Jason A. Gilliland. Promoting active school travel in elementary schools: A regional case study of the school travel planning intervention. *Journal of Transport & Health*, 12:206–219, March 2019. ISSN 2214-1405. doi: 10.1016/j.jth.2019.01.007.

Green Communities Canada. Ontario active school travel, 2020. URL https://ontarioactiveschooltravel.ca/about-ontario-active-school-travel/.

Green Communities Canada. Ontario active school travel fund, 2021. URL https://ontarioactiveschooltravel.ca/ontario-active-school-travel-fund/.

Peng Chen, Junfeng Jiao, Mengyuan Xu, Xu Gao, and Chris Bischak. Promoting active student travel: A longitudinal study. *Journal of Transport Geography*, 70:265–274, June 2018. ISSN 0966-6923. doi: 10.1016/j.jtrangeo.2018.06.015.

Damian C. A Collins and Robin A Kearns. The safe journeys of an enterprising school: Negotiating landscapes of opportunity and risk. *Health & Place*, 7(4):293–306, December 2001. ISSN 1353-8292. doi: 10.1016/S1353-8292(01)00021-1.

Femke De Meester, Delfien Van Dyck, Ilse De Bourdeaudhuij, and Greet Cardon. Parental perceived neighborhood attributes: Associations with active transport and physical activity among 10-12 year old children and the mediating role of independent mobility. *BMC public health*, 14:631, June 2014. ISSN 1471-2458. doi: 10.1186/1471-2458-14-631.

Cody Evers, Shawn Boles, Deb Johnson-Shelton, Marc Schlossberg, and David Richey. Parent safety perceptions of child walking routes. *Journal of Transport & Health*, 1(2):108–115, June 2014. ISSN 2214-1405. doi: 10.1016/j.jth.2014.03.003.

Guy Faulkner, Michelle Stone, Ron Buliung, Bonny Wong, and Raktim Mitra. School travel and children's physical activity: A cross-sectional study examining the influence of distance. *BMC public health*, 13:1166, December 2013. ISSN 1471-2458. doi: 10.1186/1471-2458-13-1166.

Guy E. J. Faulkner, Ron N. Buliung, Parminder K. Flora, and Caroline Fusco. Active school transport, physical activity levels and body weight of children and youth: A systematic review. *Preventive Medicine*, 48(1):3–8, January 2009. ISSN 1096-0260. doi: 10.1016/j.ypmed.2008.10.017.

Guy EJ Faulkner, Vanessa Richichi, Ronald N. Buliung, Caroline Fusco, and Fiona Moola. What's "quickest and easiest?": Parental decision making about school trip mode. *International Journal of Behavioral Nutrition and Physical Activity*, 7(1):1–11, December 2010. ISSN 1479-5868. doi: 10.1186/1479-5868-7-62.

Ian Fellows. *wordcloud: Word Clouds*, 2018. URL https://CRAN.R-project.org/package=wordcloud. R package version 2.6.

Caroline Fusco, Fiona Moola, Guy Faulkner, Ron Buliung, and Vanessa Richichi. Toward an understanding of children's perceptions of their transport geographies: (non)active school travel and visual representations of the built environment. *Journal of Transport Geography*, 20(1):62–70, January 2012. ISSN 0966-6923. doi: 10.1016/j.jtrangeo.2011.07.001.

William A. Gamson and Andre Modigliani. The changing culture of affirmative action. In E. Owen D. Waygood, Margareta Friman, Lars E. Olsson, and Raktim Mitra, editors, *Research in political sociology*, pages 137–177. JAI Press, 1987.

Erving Goffman. *Frame Analysis: An Essay on the Organization of Experience*. Frame Analysis: An Essay on the Organization of Experience. Harvard University Press, Cambridge, MA, US, 1974.

Anna Goodman, Ilan Fridman Rojas, James Woodcock, Rachel Aldred, Nikolai Berkoff, Malcolm Morgan, Ali Abbas, and Robin Lovelace. Scenarios of cycling to school in england, and associated health and carbon impacts: Application of the 'propensity to cycle tool'. *Journal of Transport & Health*, 12:263–278, 2019. ISSN 2214-1405. doi: https://doi.org/10.1016/j.jth.2019.01.008. URL https://www.sciencedirect.com/science/article/pii/S2214140518301257.

Bettina Grün and Kurt Hornik. topicmodels: An R package for fitting topic models. *Journal of Statistical Software*, 40(13): 1–30, 2011. doi: 10.18637/jss.v040.i13.

Erika Ikeda, Erica Hinckson, Karen Witten, and Melody Smith. Associations of children's active school travel with perceptions of the physical environment and characteristics of the social environment: A systematic review. *Health & Place*, 54:118–131, November 2018. ISSN 1873-2054. doi: 10.1016/j.healthplace.2018.09.009.

Carina Jacobi, Wouter van Atteveldt, and Kasper Welbers. Quantitative analysis of large amounts of journalistic texts using topic modelling. *Digital Journalism*, 4(1):89–106, January 2016. ISSN 2167-0811. doi: 10.1080/21670811.2015.1093271.

Debbie Lang, Damian Collins, and Robin Kearns. Understanding modal choice for the trip to school. *Journal of Transport Geography*, 19(4):509–514, July 2011. ISSN 0966-6923. doi: 10.1016/j.jtrangeo.2010.05.005.

Richard Larouche, Michelle Stone, Ron N. Buliung, and Guy Faulkner. "i'd rather bike to school!": Profiling children who would prefer to cycle to school. *Journal of Transport & Health*, 3(3):377–385, September 2016. ISSN 2214-1405. doi: 10.1016/j.jth.2016.06.010.

Kristian Larsen, Jason Gilliland, and Paul M. Hess. Route-based analysis to capture the environmental influences on a child's mode of travel between home and school. *Annals of the Association of American Geographers*, 102(6):1348–1365, November 2012.

Andrea Lawlor and Deserai Crow. Risk-based policy narratives. *Policy Studies Journal*, 46(4):843–867, 2018. ISSN 0190-292X. doi: 10.1111/psj.12270. URL https://dx.doi.org/10.1111/psj.12270.

Catherine L. Mah, Catherine Hamill, Krista Rondeau, and Lynn McIntyre. A frame-critical policy analysis of canada's response to the world food summit 1998–2008. *Archives of Public Health*, 72(1):41, November 2014. ISSN 2049-3258. doi: 10.1186/2049-3258-72-41.

S. K. Mah, L. Nettlefold, H. M. Macdonald, M. Winters, D. Race, C. Voss, and H. A. McKay. Does parental support influence children's active school travel? *Preventive Medicine Reports*, 6:346–351, June 2017. ISSN 2211-3355. doi: 10.1016/j.pmedr.2017.04.008.

Roberta Maiella, Pasquale La Malva, Daniela Marchetti, Elena Pomarico, Adolfo Di Crosta, Rocco Palumbo, Luca Cetara, Alberto Di Domenico, and Maria Cristina Verrocchio. The psychological distance and climate change: A systematic review on the mitigation and adaptation behaviors. *Frontiers in Psychology*, 11, 2020. ISSN 1664-1078. doi: 10.3389/fpsyg.2020.568899. URL https://www.frontiersin.org/articles/10.3389/fpsyg.2020.568899.

George Mammen, Guy Faulkner, Ron Buliung, and Jennifer Lay. Understanding the drive to escort: A cross-sectional analysis examining parental attitudes towards children's school travel and independent mobility. *BMC public health*, 12:862, October 2012. ISSN 1471-2458. doi: 10.1186/1471-2458-12-862.

George Mammen, Michelle R. Stone, Ron Buliung, and Guy Faulkner. School travel planning in canada: Identifying child, family, and school-level characteristics associated with travel mode shift from driving to active school travel. *Journal of Transport & Health*, 1(4):288–294, December 2014a. ISSN 2214-1405. doi: 10.1016/j.jth.2014.09.004.

George Mammen, Michelle R. Stone, Guy Faulkner, Subha Ramanathan, Ron Buliung, Catherine O'Brien, and Jacky Kennedy. Active school travel: An evaluation of the canadian school travel planning intervention. *Preventive Medicine*, 60:55–59, March 2014b. ISSN 0091-7435. doi: 10.1016/j.ypmed.2013.12.008.

George Mammen, Michelle R. Stone, Ron Buliung, and Guy Faulkner. "putting school travel on the map": Facilitators and barriers to implementing school travel planning in canada. *Journal of Transport & Health*, 2(3):318–326, September 2015. ISSN 2214-1405. doi: 10.1016/j.jth.2015.05.003.

Sandra Mandic, Debbie Hopkins, Enrique García Bengoechea, Charlotte Flaherty, Kirsten Coppell, Antoni Moore, John Williams, and John C. Spence. Differences in parental perceptions of walking and cycling to high school according to distance. *Transportation Research Part F: Traffic Psychology and Behaviour*, 71:238–249, 2020. ISSN 1369-8478. doi: https://doi.org/10.1016/j.trf.2020.04.013. URL https://www.sciencedirect.com/science/article/pii/S1369847820304095.

Nafsika Michail, Ayse Ozbil, Rosie Parnell, and Stephanie Wilkie. Children's experiences of their journey to school: Integrating behaviour change frameworks to inform the role of the built environment in active school travel promotion. *International Journal of Environmental Research and Public Health*, 18(9):4992, January 2021. doi: 10.3390/ijerph18094992.

Raktim Mitra. Independent mobility and mode choice for school transportation: A review and framework for future research. *Transport Reviews*, 33(1):21–43, January 2013. ISSN 0144-1647. doi: 10.1080/01441647.2012.743490.

Transportation Association of Canada. Safety performance of bicycle infrastructure in canada, 2020. URL https://www.tac-atc.ca/en/publications/ptm-spbi-e.

Michael O'Hare. A typology of governmental action. *Journal of Policy Analysis and Management*, 8(4):670–672, 1989. ISSN 0276-8739.

Zhongdang Pan and Gerald M. Kosicki. Framing analysis: An approach to news discourse. *Political Communication*, 10(1): 55–75, January 1993. ISSN 1058-4609. doi: 10.1080/10584609.1993.9962963.

J. R. Panter, A. P. Jones, E. M. F. van Sluijs, and S. J. Griffin. Attitudes, social support and environmental perceptions as predictors of active commuting behaviour in school children. *Journal of Epidemiology & Community Health*, 64(01):41–48, January 2010. ISSN 0143-005X, 1470-2738. doi: 10.1136/jech.2009.086918.

Karina Pont, Jenny Ziviani, David Wadley, Sally Bennett, and Rebecca Abbott. Environmental correlates of children's active transportation: A systematic literature review. *Health & Place*, 15(3):849–862, September 2009. ISSN 1353-8292. doi:

10.1016/j.healthplace.2009.02.002.

D. Alex Quistberg, Leah L. Thompson, James Curtin, Frederick P. Rivara, and Beth E. Ebel. Impact of automated photo enforcement of vehicle speed in school zones: interrupted time series analysis. *Injury Prevention*, 25(5):400–406, 2019. ISSN 1353-8047. doi: 10.1136/injuryprev-2018-042912. URL https://dx.doi.org/10.1136/injuryprev-2018-042912.

Subha Ramanathan, Catherine O'Brien, Guy Faulkner, and Michelle Stone. Happiness in motion: Emotions, well-being, and active school travel. *Journal of School Health*, 84(8):516–523, 2014. ISSN 1746-1561. doi: 10.1111/josh.12172.

Darcy Reynard, Damian Collins, and Manish Shirgaokar. Growth over resilience: How canadian municipalities frame the challenge of reducing carbon emissions. *Local Environment*, 0(0):1–13, February 2021. ISSN 1354-9839. doi: 10.1080/13549839.2021.1892046.

Negin A. Riazi, Sébastien Blanchette, François Trudeau, Richard Larouche, Mark S. Tremblay, and Guy Faulkner. Correlates of children's independent mobility in canada: A multi-site study. *International Journal of Environmental Research and Public Health*, 16(16), August 2019. ISSN 1660-4601. doi: 10.3390/ijerph16162862.

Vivian Romero. Children's experiences: Enjoyment and fun as additional encouragement for walking to school. *Journal of Transport & Health*, 2(2):230–237, June 2015. ISSN 2214-1405. doi: 10.1016/j.jth.2015.01.002.

Linda Rothman, Ron Buliung, Teresa To, Colin Macarthur, Alison Macpherson, and Andrew Howard. Associations between parents perception of traffic danger, the built environment and walking to school. *Journal of Transport & Health*, 2(3):327–335, September 2015. ISSN 2214-1405. doi: 10.1016/j.jth.2015.05.004.

Linda Rothman, Ron Buliung, Andrew Howard, Colin Macarthur, and Alison Macpherson. The school environment and student car drop-off at elementary schools. *Travel Behaviour and Society*, 9:50–57, October 2017. ISSN 2214-367X. doi: 10.1016/j.tbs.2017.03.001.

Linda Rothman, Alison K. Macpherson, Timothy Ross, and Ron N. Buliung. The decline in active school transportation (ast): A systematic review of the factors related to ast and changes in school transport over time in north america. *Preventive Medicine*, 111:314–322, June 2018. ISSN 0091-7435. doi: 10.1016/j.ypmed.2017.11.018.

Linda Rothman, Brent Hagel, Andrew Howard, Marie Soleil Cloutier, Alison Macpherson, Alberto Nettel Aguirre, Gavin R. McCormack, Pamela Fuselli, Ron Buliung, Tate HubkaRao, Rebecca Ling, Moreno Zanotto, Mathieu Rancourt, and Meghan Winters. Active school transportation and the built environment across canadian cities: Findings from the child active transportation safety and the environment (chase) study. *Preventive Medicine*, 146:106470, May 2021. ISSN 0091-7435. doi: 10.1016/j.ypmed.2021.106470.

Stephanie Schoeppe, Mitch J Duncan, Hannah M Badland, Melody Oliver, and Matthew Browne. Associations between children's active travel and levels of physical activity and sedentary behavior. *Journal of Transport & Health*, 2(3):336–342, September 2015. ISSN 2214-1405. doi: 10.1016/j.jth.2015.05.001.

Stephanie Sersli, Linda Rothman, and Meghan Winters. Getting at mode share: Comparing 3 methods of travel mode measurement for school travel research. *Journal of School Health*, 89(5):365–372, 2019. ISSN 0022-4391. doi: 10.1111/josh.12743. URL https://dx.doi.org/10.1111/josh.12743.

Alexander W. Severson and Eric A. Coleman. Moral frames and climate change policy attitudes*. *Social Science Quarterly*, 96(5):1277–1290, 2015. ISSN 0038-4941. doi: 10.1111/ssqu.12159. URL https://dx.doi.org/10.1111/ssqu.12159.

Julia Silge and David Robinson. tidytext: Text mining and analysis using tidy data principles in r. *JOSS*, 1(3), 2016. doi: 10.21105/joss.00037. URL http://dx.doi.org/10.21105/joss.00037.

E. O. D. Waygood and Margareta Friman. Children's travel and incidental community connections. *Travel Behaviour and Society*, 2(3):174–181, September 2015. ISSN 2214-367X. doi: 10.1016/j.tbs.2015.03.003.

E. Owen D. Waygood and Erel Avineri. Co2 valence framing: Is it really any different from just giving the amounts? *Transportation Research Part D: Transport and Environment*, 63:718–732, August 2018. ISSN 1361-9209. doi: 10.1016/j.trd.2018.07.011.

Jessica Westman, Margareta Friman, and Lars E. Olsson. What drives them to drive? —parents' reasons for choosing the car to take their children to school. *Frontiers in Psychology*, 8, November 2017. ISSN 1664-1078. doi: 10.3389/fpsyg.2017.01970.

Jessica Westman, Margareta Friman, and Lars E. Olsson. Travel and child wellbeing: The psychological and cognitive domains. In E. Owen D. Waygood, Margareta Friman, Lars E. Olsson, and Raktim Mitra, editors, *Transport and Children's Wellbeing*, pages 41–59. Elsevier, January 2020. doi: 10.1016/B978-0-12-814694-1.00003-8.

Jan Wijffels. *word2vec: Distributed Representations of Words*, 2021. URL https://CRAN.R-project.org/package=word2vec. R package version 0.3.4.

Katherine Wilson, Andrew F. Clark, and Jason A. Gilliland. Understanding child and parent perceptions of barriers influencing children's active school travel. *BMC public health*, 18(1):1053, August 2018. ISSN 1471-2458. doi: 10.1186/s12889-018-5874-y.

Enid Zwerts, Georges Allaert, Davy Janssens, Geert Wets, and Frank Witlox. How children view their travel behaviour: A case study from flanders (belgium). *Journal of Transport Geography*, 18(6):702–710, November 2010. ISSN 0966-6923. doi: 10.1016/j.jtrangeo.2009.10.002.