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〈論　文〉

〈Original Article〉 International Origins of Walking School Buses and Child Fatalities in Japan and Canada by *Owen WAYGOOD, Ayako TANIGUCHI, Catherine CRAIG-ST-LOUIS and Xin XU*

International Origins of Walking School Buses and Child Fatalities in Japan and Canada

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要　旨

日本の小学校における集団登下校は，少なくとも半世紀以上前には存在していた．この集団登下校はアングロサクソンの国々では Walking School Bus(WSB : 歩く通学バス)と呼ばれ，1990 年代に始まった新しいコンセプトである．アングロサクソンの国々では，WSB は増加しつつある自動車通学を抑制できる安全な手法であると見なされている．近年，日本では「集団登下校が通学時の安全性向上に資するのか」に関して議論されている．本研究では，カナダと日本における集団登下校(WSB)のシステムを比較するとともに，単独で通学するカナダと WSB が慣習として根付いている日本の交通事故データを比較する．

Abstract

The concept of a Walking School Bus (WSB) has existed in Japan for over half a century, but is a relatively new concept in Anglo-Saxon countries, tracing its origins to the early 1990s. In Anglo-Saxon countries the WSB is seen as a safe means of addressing the negative impacts of increased school trips by car. Recently in Japan, a discussion as to the value and appropriateness of the *shuudantōgekō* (the Japanese WSB) has emerged as some suggest that it could reduce safety. This paper introduces and compares the two WSB systems, and then uses traffic fatality data from Canada and Japan to compare travel-to-school in an open choice system with a country where WSB is common practice.

キーワード：

Keywords: walking school bus, *shuudantōgekō*, traffic fatalities, children, Canada, Japan

1. Introduction

Japan and Anglo-Saxon countries face different problems with respect to travel to elementary (or primary or grammar) schools (in Japan, *shōgakkō*). In the Anglo-Saxon countries, the problem relates primarily to an increasing use of private vehicles as this has been associated with a decrease in physical activity, increased danger for children, and increased congestion (e.g. Gilbert and O'Brien, 2005). In Japan, this problem was addressed many decades ago with the introduction of children walking together to school, called *shuudantōgekō*, which is known as a walking school bus in English literature. A common question in both the Japanese and the Anglo-Saxon context is the safety of such systems.

In this paper, the two systems will be first introduced, and then an examination of fatality data from Canada and Japan is conducted.

2. Background

In response to the growing dependence of children on car travel in Anglo-Saxon countries, considerable research has looked at what explains active travel to elementary schools (e.g. Sirard and Slater, 2008). Recently, the exceptional case of the independence of Japanese children has been highlighted in research (Susilo and Waygood, 2012; Waygood, 2009a, b; Waygood and Kitamura, 2009; Waygood and Susilo, 2011) and in the media (Rogers, 2015). A key component of the high rates of walking in Japan for young children is linked to the walking school bus system, known as *shuudantōgekō* (集団登下校), or often just *shuudantōkō* (集団登校) which refers to just the trip to school and not the return.

Walking school buses (WSBs) are used around the world to promote healthy and safe travel to school. The origin of the

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WSB is often attributed to the Australian transport activist David Engwicht (e.g. Neuwelt and Kearns, 2006) in 1992. As of 2009, WSBs could be found in the USA, Canada, Great Britain, Australia, New Zealand and Denmark (Heelan et al., 2009). The lack of Japan's system in such documents perhaps shows a Western bias, or simply that the Japanese system is not well documented in English, although it has been briefly described (e.g. Schoppa, 2009; Susilo and Waygood, 2012), but has not been well detailed.

In Japan the practice dates back to at least 1962 when the former Ministry of Education, Culture, Sports, Science and Technology directed that the system be applied across the country (MEXT, 2009a). Evidence exists of a WSB in 1963 in Japan when a documentary highlighted its success at Kemigawa elementary school in Chiba[1]. In 1968, a notice was made by the Ministry of Education, Culture, Sports, Science and Technology relating to application of the *shuudantōkō* (MEXT, 2009b). Thus, it would appear that the practice of a walking school bus has existed for many more decades in Japan than in Anglo-Saxon countries.

Recently in Japan some people have begun to question whether the WSB is safe and its application is on the decline. The system was developed in order to address the problem of traffic danger towards children, but if there is an accident, more children are involved. This was evident in the six accidents that happened over 2011 to 2013 where twelve people died. Some suggest that a long line creates more danger as there is a larger target, but children walking alone would create multiple targets without the same visibility that the larger group gives. However, one study in Tokyo found that children in the WSB were 1.6 times more likely to be in a crash than children going individually to school (Kōya City Research Lab, 2015). The crash rate for the return trip was equal. It did not specify injury or fatality rates.

As in most countries, transport is a leading cause of death for children and youth in Japan (McNicoll, 2001; Shinsugi et al., 2015; Toroyan and Peden, 2007). In a report examining the death rates from injury between 1991 and 1995 (McNicoll, 2001), Sweden was held up as an example for other countries with a death rate from injuries of 5.2 per 100,000 for children aged 1 to 14. Japan had a death rate of 8.4 and Canada a death rate of 9.7 per 100,000. For children aged 10 to 14, Japan had the lowest rate with 4.8 per 100,000, while Sweden had a rate of 5.5 and Canada a rate of 10.2. Thus, for children who have grown up using the WSB system, there is a very low injury rate, though the percentage relative to transport was not given for individual countries. Overall, transport accounted for 41% of deaths by injury (ibid).

One problem that is avoided through the WSB that exists for travel alone is the incidence of criminal activity (though at rates much lower than fatalities in and by cars). Between 2004 and 2005 there were four cases in Japan where a 1st grade girl was abducted and killed. This prompted the Ministry of Education, Culture, Sports, Science and Technology to re-emphasize the importance of the WSB in preventing such crime. As will be discussed below, in one system of the walking school bus, children independently walk to the meeting point, and thus are alone for some portion of their morning trip, which some people point out as a potential risk.

The proposal that the walking school bus may not be safe is hard to study in a country where it is still the common practice. In this paper we will first introduce the WSB practice in Japan and in Anglo-Saxon countries then present crash statistics related from each country.

3. Anglo-Saxon context

In this research Anglo-Saxon countries are: Australia, Canada, New Zealand, the United Kingdom (UK), and the United States of America (USA). In its simplest definition from Anglo-Saxon literature, a Walking School Bus (WSB) is a "group of children who walk to and from school with one or more adults" (Kong et al., 2009). This system (adult lead) can also be found in South Korea since 2010, which may be related to the establishment of Safe Kids Korea with the assistance of U.S. Safe Kids (KOTI, 2015, p. 31).

3.1 *Origins*

Australian transport activist David Engwicht is often given credit for inventing the WSB system in the 1990s (Neuwelt and Kearns, 2006). In Canada, one of the earliest accounts of a WSB was in 1996 (Kingham and Ussher, 2007)). That may have been the first application of this system. In New Zealand, Christchurch was possibly the first city to adopt a WSB (Collins and Kearns, 2010), but those authors point to St. Alban, England, for the origins of the concept in 1998 (Collins and Kearns, 2005). Still others retrace the origin of the first WSB program to Brisbane, Australia though no date was given (Kong et al., 2009).

3.2 *How are Walking School Buses organized in the*

[1] https://www.youtube.com/watch?v=0WMY91uJekA

Anglo-Saxon context?

A WSB group can be informal and comprised of only a few families, or part of a structured program with predefined routes and schedules, resembling an actual school bus (Kingham and Ussher, 2007). In most cases the supervision of an adult and the determination of specific routes and pick-up times are key concepts of a WSB (Collins and Kearns, 2005; Heelan et al., 2009; Neuwelt and Kearns, 2006).

In Auckland, New Zealand, the Regional Transport Authority hires a coordinator for the program and grants financial support. For each route, a parent coordinator schedules two volunteers to supervise up to 30 children over a 20-minute walk. In order to maintain control over the group, it is sometimes necessary for the adults to have the boys in one line, and the girls in another. In 2006, almost all routes (85%) in Auckland operated in the morning, whereas it was only half (53%) for the afternoon (Collins and Kearns, 2010). In places such as Christchurch, New Zealand, the government also supports such efforts (Kingham and Ussher, 2007). While anyone who wishes to volunteer on the WSB will be accepted in Auckland, police will run background checks on individuals in the UK (Collins and Kearns, 2005). In the USA, liability waivers might have to be signed by volunteers operating in more structured WSBs (National Center for Safe Routes to School, nd) and in both the USA and in Canada, the WSB leaders can be insured (Beaton, 2015).

In the USA, researchers have emphasized the need to secure stakeholders' investments early in the process (Kong et al., 2009). In that study, the research group started by handing out flyers, setting up posters, making presentations and offering training for parents up to three months prior to start up. Children in the study were from kindergarten through fifth-grade and police officers approved of the routes chosen for the WSB. Children even had health-related themes presented to them during the walk every other week (Kong et al., 2009).

In Nebraska, a study was conducted on two schools with WSB programs where the routes were limited to a 1-mile radius of the school. The WSB was operated every weekday, but was cancelled when the weather was unpleasant (e.g. cold or raining/snowing). Children usually walked four out of five times over a week with the WSB, walking on average 0.65 miles (1km) each time they took part in the WSB (Heelan et al., 2009).

For the USA in general, there are online training modules aimed for parents, teachers, school administrators and community leaders to help them launch a WSB program (i.e. National Center for Safe Routes to School website).

For Canada as a whole, there is the Active and Safe Routes to School organization that proposes on its old website a toolkit to set up a WSB. The toolkit is made up of a checklist, sample letters and flyers for promotion, a leaflet destined to parents with information, and stories of WSB successes (Green Communities, 2011).

In Ottawa, a pilot project was put into place with routes being mapped by the Ottawa Student Transportation Authority's software using information provided by school boards. The goal was to include as many students located in a predetermined zone as possible, and have them walk no more than 30 minutes. Registration of a child was completed online (Beaton, 2015).

In British Columbia, Canada the Hub for Active School Travel, or HASTe, also offers a toolkit and a step-by-step of how to organize a WSB (HASTe, 2012). Three models are proposed: one that uses a single location as departure point with no stops along the way (e.g. from a park to the school), one that runs through a neighborhood with pick-up points along the way, and another one that runs through a neighborhood but picks up every child at his or her home. It also lists minimum requirements, such as: the approval of the parents for the registration of their children, a written agreement on the part of adult volunteers, basic traffic safety concerns addressed (visibility, for one), one best route identified, and a list of emergency contacts.

In Canada and the USA, there are also a few references made to an alternative to the WSB, the bicycle train (HASTe, 2012).

3.2 *Are WSB successful in the Anglo-Saxon context?*

In Auckland, NZ 42% of schools with a School Travel Plan (STP) have incorporated a WSB, and many schools without such a plan also have a WSB (Collins and Kearns, 2010). The STPs have primarily been implemented in Auckland, NZ as opposed to other cities in that country (Hinckson and Hannah, 2011). In the USA, one study reported that 6.2% of public elementary schools nationally use WSBs (Turner et al., 2013).

The number of routes and participants are on the rise in Auckland, though not much more than half of the children registered actually join the WSB every morning. In 2005, 77 schools, 156 WSB routes, and 2,400 children were involved in WSBs in Auckland (Neuwelt and Kearns, 2006). Collins and Kearns (2010) also state that "the longer a route endures,

the more embedded it becomes in the routines of families and the tradition of the school community." The evidence they give remains sparse: they explain that of half the schools surveyed, one or more WSB route is 1-year old or older.

Volunteer recruitment and retention determines the WSB's likelihood of success; school involvement then appears as essential for continuity, because in Auckland almost no school ever dropped the project entirely (Collins and Kearns, 2010). The success of the pilot operation in New Mexico, USA is also said to be attributed to the inclusion of parents and school staff in the WSB (Kong et al., 2009).

A next key to success then seems to be the desire of the participants to take part in a WSB. But sometimes, it isn't enough: in New Mexico, a lack of funding did not permit the initiative to continue past the length of the initial study experiment (Kong et al., 2009). In terms of participants, it isn't always volunteers that are hard to keep: WSBs can eventually fail when children get older and acquire the necessary independence and skills to walk to school by themselves (Kingham and Ussher, 2007), which may be linked to a lack of diversity in the ages of households in a neighborhood.

Related to encouraging children to use the WSB, South Korea (which began piloting the Anglo-Saxon WSB system in 2010) uses a reward system where children who participate in the WSB for the entire month are given prizes (KOTI, 2015, p. 180).

3.3. *Is there evidence of improving safety?*

Safety issues raised by parents go from stranger danger to children's lack of street knowledge. Walking in a group with responsible individuals reduces these concerns. Neuwelt and Kearns (2006) noted that parents felt that their children learn more about safety measures through the WSB process.

Perceived benefits also include the improvement of safety, though hard data is difficult to come across. More walkers and cyclists on the street would likely raise the awareness towards such users and result in fewer collisions with motorized vehicles (Collins and Kearns, 2010; Ewing and Dumbaugh, 2009). Although it is said that an increase in traffic volume has been linked to an increased threat to child safety, it is not necessarily true that reducing traffic will result in increased child safety. In fact, it might only be because fewer and fewer children have been exposed to traffic in recent years that the number of injuries has come down (Hillman et al., 1990; Kingham and Ussher, 2007).

While walking, accompaniment by an adult is said to reduce risk of injury for children (Kingham and Ussher, 2007). Safety rules have sometimes been implemented to limit aggressive play between children and safety vests have been added to ensure visibility (Collins and Kearns, 2010). The involvement of police officers to determine routes and the addition of a crossing guard where needed as a guarantee of increased safety.

In some cases, WSB initiatives are linked with changes to the infrastructure that would aid pedestrians. In Auckland, NZ, minor improvements such as upgrading footpaths were documented (Collins and Kearns, 2010). An initiative in South Carolina, USA, reported changes made to the infrastructures (streetlights, sidewalks, etc.) once the WSB program was put in place. There was also a suggestion that traffic had slowed (National Center for Safe Routes to School, 2010).

WBS are often concentrated in low deprivation neighborhoods (e.g. better-off neighborhoods), but collisions involving pedestrian are disproportionately found in areas of high deprivation (e.g. Pabayo et al., 2012), thus it is possible to wonder whether WSBs have an actual impact matching that of their true potential (Collins and Kearns, 2005).

3.4 *Other benefits associated with WSB*

Most of the WSB benefits are hard to quantify (Kingham and Ussher, 2007). Beyond safety, suggested benefits would also include: "reduced level of parental chauffeuring, less traffic congestion in the vicinity of primary schools at peak times and increased routine physical activity" (Collins and Kearns, 2010). Kingham and Ussher (2007) indeed speak of WSBs encouraging "children's independent mobility" because they are not always chauffeured by their own parents anymore, but sometimes walked to school lead by other adults (though this does not correspond with definitions of independent mobility as the child is still supervised, thus dependent on an adult). The creation of a long-term habit and norm regarding physical activity is sometimes given (e.g. Active and Safe Routes to School, Canada).

Some authors, without giving numbers or explaining further, will write about the possibility of reduced air pollution exposure for children in WBSs, as their participation in it ensures that fewer cars gather around the school at peak hours (Kingham and Ussher, 2007). In Auckland, it was calculated that 429 vehicle journeys had been saved by 22 schools on approximately 23 WSB routes in operation,

contributing to reducing congestion and threats of injuries around schools (Collins and Kearns, 2005). A WSB in Auckland was reported to have saved 19.5 car journeys on average per day (Collins and Kearns, 2010).

It is often proposed that children would also get to school more ready to learn and more alert, show better academic results, better moods and reduced anxiety (Kingham and Ussher, 2007), however it is difficult to find published literature related to these assertions. Research has found that children who are active, for example those who have just walked 20 minutes, have shown more neural activity than children who have been sedentary, as would be the case in passive modes such as cars (Castelli et al., 2015). In New Zealand, principals at schools also reported having the impression that their children got to school more ready to learn and calmer if they walked (Neuwelt and Kearns, 2006).

Other perceived benefits include social connections made by the children and adults participating in the WSB, the promotion of community spirit, the increased fitness level, the influence it has on the entire family, the time saving for parents who do not need to accompany their children to school everyday, the enjoyment of the walk, and the development of traffic skills (Neuwelt and Kearns, 2006; Kingham and Ussher, 2007; Collins and Kearns, 2010).

Health benefits were rated higher than all other benefits by parents of children using the WSB; 5% of children's daily physical activity can be attained simply by walking to school (Neuwelt and Kearns, 2006). As demonstration of physical activity benefits, in the USA, a study reported that over two-thirds of children in schools where a WSB had been implemented walk to school at least 50% of the time, versus only one out of four children in schools where no WSB had been implemented achieved that same goal (Heelan et al., 2009).

Not only would WSB initiatives help increase the level of fitness in children, but it would potentially help reduce obesity, as children who where part of one WSB study had a body mass index (BMI) that "did not increase over the trial" (Kong et al., 2009).

4. The Japanese Context

Japan has had an institutionalized form of a WSB since at least 1962 when the former Ministry of Education, Culture, Sports, Science and Technology directed that the system be applied across the country. The system is known as *shuudantōgekō* (集団登下校), or often just *shuudantōkō* (集団登校) which refers to just the trip to school and not the return. It was created fundamentally as a safety measure and groups children to walk safely together to and from school. Although the total number of participating schools is declining, over 65% of the Japan's elementary schools and still practice *shuudantōgekō* (MEXT, 2013).

4.1 *Fundamentals of the system*

The exact application of the *shuudantōgekō* varies by location and school. In its most general description it is a small group of roughly ten children who are lead to school by a child in the fifth or sixth grade (ages roughly ten to twelve) who carries a yellow flag. As well, it is common for the children to have yellow caps. Walking in a group with the yellow flag and caps is intended to increase their visibility to vehicles (thus reducing their vulnerability to traffic danger) and prevent criminal acts such as abduction. In participating schools, all children are involved.

The groups may be organized by the school, the safety committee of the local parent-teachers' association (PTA in Japanese as well), or a combination of the two. As well, there is an adult who is responsible for the group and this may be a teacher or a PTA member.

The grouping of the children varies, but has two key components. The first is geographic proximity. Depending on the density of children, it may only be one apartment building and its immediate surroundings, or perhaps a couple of blocks.

The second component is the age of the children. There is typically a mix of ages, but it must include an older child (grade five or six) to lead the younger children on the route.

The meeting location may be a park, in front of a home or business, in the lobby of an apartment building, or other such (semi-) public space. In some systems, the children go to the meeting point on their own, in others, the children are escorted by a guardian to the meeting point. In the latter system, a child is thus never alone. In the system where children are not escorted to the meeting point, a member of the local PTA will keep surveillance on the group when it starts up at the beginning of the school year. Recently, a teacher might be assigned by the school to be present along the route. In some areas where this is not the case, a local PTA member will be present at some point along the route and this responsibility rotates amongst the members.

4.2 *Operational issues*

As in most situations that involve organizing a wide range of individuals, there are various problems. A list of those potential problems is given here with potential solutions following:

1) A child is late to the meeting point. The lead child may have difficulty deciding when to leave, which can lead to the group being late. If it is uncommon for that child to be late, the lead child may swing by the tardy child's home and call out "we're off!" to prompt the child to come quickly. If the child is chronically late, they may be dropped from the group.

2) A child is absent/unable to go to school. In such cases, the parent may inform the school, but no message is sent to the group of children who remain at the meeting point, waiting for the absent child.

3) The meeting time is considered too early. Even though schools will typically start at around 8:30 AM, the meeting time may be considerably earlier such as 7:45 AM for a 10-minute walk. This may be a result of trying to allow for children who are late (no matter the time) and thus giving ample "cushion" time; it may also be the result of anticipating slow or leisurely walking speeds by the children.

4) A child is very early. Some children may want to get to the school in order to play. Others may come from homes where the parents must work early. In such cases, the child may not wait around for the others and simply go to the school directly. This can cause the same problem as above (1) with the group waiting for the non-present child.

5) The meeting location is problematic. In some cases, the meeting point may be further from the school than the child's home. In others, it may be located at a point where there is considerable traffic such as by a convenience store parking lot. In still others, the children may be waiting at a point that inconveniences other people such as in the lobby of an apartment.

6) The lead child is not responsible enough. The lead child may see a friend in another WSB and begin chatting, forgetting their responsibilities. However, it is not clear whether this has ever happened.

7) The children get excited. As happens when children get together, they may begin to have fun. Although we do not want to suggest that children should not have fun, this can result in dangerous situations if the child suddenly darts out of the group into traffic.

8) Trailing line and limited vision. As the children cross roads, they may not be aware that the lights have changed because of limited vision due to walking closely behind another child.

9) A parent's schedule may not allow for participation. Parents are expected to help in some fashion, but if their work obligations prevent them from helping, other parents who must take their place may feel resentment. In some cases the parent who is unable to help with the walking school bus may help in other ways such as cleaning.

10) The parent is not good at disciplining the children. In the case where children are too excited and a dangerous situation may arise, the adult who is responsible for the group must control the group. However, some parents are not good at this, and they may then feel stressed, as they would be held responsible if something were to happen.

Many of those problems have possible solutions. Here are some potential ones (numbers correspond to the problems):

1) As mentioned, choosing an earlier meeting point would allow for a "cushion" with the time, but it may cause other problems such as parents feeling that the meeting time is too early. To handle the problem of the lead child having difficulty knowing when to leave, an adult could give a definitive time to leave that could be set as an alarm on a watch.

2) A message could be passed to anyone in the group to share that one of the members is absent.

3) The meeting time could be reviewed by the school by anonymous vote.

4) This could be a problem, as it might be difficult for a message to be given to the walking group. However, with modern technology and the ownership rates of cellular telephones, mailing lists that send a text message to the parents could facilitate an available adult to go and inform the group.

5) Meeting points should be considered with respect to context. Although some locations are "easy", as they are familiar to everyone, consideration to the potential danger or inconvenience to others should be made.

6) As it is not clear whether this is a real problem, or just a potential one, it is not necessary to deal with it currently.

7) This problem has two sides to it. One is the "problem" of children having fun. The other is the traffic. As far as possible, the traffic speed along such routes should be kept under 30 km/h to reduce the danger caused by the traffic (the risk of death significantly increases at 50 km/h (Rosen et al., 2011)). The burden of safety should not lie only on children (Hillman et al., 1990; Parusel and McLaren, 2010), or as the Director of Korea Transportation Safety Authority, KANG Dong Su wrote, "children should be able to freely walk and play

anytime and anywhere, while adults have the duty to protect children no matter what transport mode they use" (KOTI, 2015; p. 57). The individual creating the danger should carry the majority of the burden, which requires the state to set safe traffic speeds. On more major routes such as arterials, separated walkways (whether that is a sidewalk or a level area with barriers) should be used with the children staying away from the edge that separates the modes.

8) There are several potential solutions that come to mind for this problem. One is that the children do not walk so close that they cannot see the traffic light. A second would be that the lead child must wait at an intersection for all of the children to be ready to cross in a tighter group (e.g. 2 lines) that would take less time to cross the road. A third solution would be a technological one where the traffic light would have a sensor or button that allows for more time to cross. This would also help elderly or others with mobility problems.

9) As society changes, some adjustment is necessary. There are more households now where there is not a parent available due to work obligations. Consideration must be made to such contexts.

10) Not all people are equally able to control children. A guidebook and examples of how to handle such situations could help.

5. Differences in the Systems

If the two systems are compared (Table 1), numerous differences can be observed. In terms of success, the Japanese system has shown greater longevity, school participation rates, and child participation rates.

Table 1. Comparison of the two systems

	Anglo-Saxon	Japanese
Date origin or implementation	1992 and after	Likely before 1955, but first official documentation is 1962.
Organized by	Local organizer or volunteer	School or the PTA
Safety equipment	May use reflective vests	Yellow flag; yellow caps common
Size of group	Up to 30	Roughly 10
School participation	Unclear. Auckland, NZ reports the highest participation with over 50% of schools with STPs using WSB.	Over 65% of elementary schools nationally.
Student participation	Optional, exact percentage unknown	All students in school
Distances	≤1.6 km (1 mile)	Unknown
Time	< 30 minutes	Unknown
Longevity	More than 50% of schools with a WSB have operated one for at least one year (NZ)	Has continued for decades.

A key difference in the systems is that in the Japanese system, parents or volunteers do not lead the groups. However, parents are involved in various aspects of the system.

As described by the literature from Western countries, it is not only danger that one hopes to avoid with WSBs. In situations where parents are left to arrange travel for their children, the car has become the most common means of transport in many Anglo-Saxon countries (Gilbert and O'Brien, 2005). The parents give numerous reasons for this such as distance, climate, stranger danger, and traffic danger (McDonald and Aalborg, 2009). This final point is important as often the traffic danger is caused by the parents themselves rushing to drop children off. So, in such a system, parents are rushed, but rather than rushing on foot to a meeting point, they are rushing in cars to a place where all of the children attending a school are congregating.

Although it is more common for children who live within a reasonable walking distance of school to go by foot, even children at distances of less than 800m may be driven in the Anglo-Saxon countries (e.g. McDonald and Aalborg, 2009; Waygood and Susilo, 2015). As these are often additional trips, it follows that along with increased danger to other children, these trips also reduce the child's physical activity, reduce air quality in the area around the school, produce more greenhouse gases, create greater congestion, and likely consume more of the parents' time (this is certainly the case for the walking school bus system where the child walks to the meeting point). Further, although given as a potential source of danger, children who walk have more opportunity to socially engage with their friends (Kirby and Inchley, 2013; Panter et al., 2008; Westman et al., 2015; Zwerts et al., 2010) and their community (Waygood and Friman, 2015).

6. Fatalities in individual versus walking school bus systems

As mentioned in the introduction, one analysis found that children in Tokyo who were not in WSBs had a lower crash rate than children in WSBs on the trip to school. It was not clear from that study, which was not peer reviewed, what the modes of the children were for the individual trips, nor whether the injury or fatality rates were different, simply that the crash rates were different.

In this study, a comparison will be made between Canada and Japan's fatality rates.

Of the Anglo-Saxon countries, according to a UNICEF report, traffic deaths for children aged 1 to 14 over the years 1991-1995, the UK had the lowest deaths per 100,000 with 2.9, followed by Canada with 4.3, then Australia with 4.4, the USA with 5.8, and finally New Zealand with 6.9 (UNICEF, 2001). According to Statistics Canada, accidental injuries are the leading cause of death for children aged 1 to 14 in Canada, with the majority of those being transport (Statistics Canada, 2015). The average for children aged 1 to 14 between 2000 and 2011 was 6.5, suggesting an increase (compared with UNICEF, 2001).

In Canada, as in most countries around the world, transport is one of the leading causes of death for children and youth. Based on statistics from Statistics Canada on cause of death, from 2001-2011 transport deaths were on average responsible for 1.85 deaths per 100,000 for five to nine year olds (2nd most common after malignant neoplasms), and 2.6 deaths per 100,000 for ten to fourteen year olds (most common, representing 20%). Motorised vehicle crashes were attributed to 92% (5 to 9 year olds) and 94% (10 to 14 year olds) of those deaths. Unfortunately, national statistics on the modal share of children's travel in Canada is not available, but studies on children's travel do not find that over 90% of trips are by motor vehicle. Considering that likely most deaths for pedestrians and cyclists are caused by motor vehicles, the question might be how to better tame traffic rather than to potentially encourage more (if parents were allowed to start driving their children to school).

Comparing available data from Japan and Canada for children fifteen and under (Figure 1), it can be seen that Japan has a much lower rate of fatalities by transport than Canada.

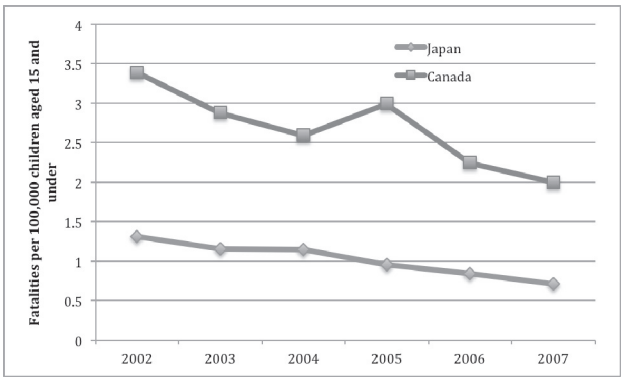

Figure 1. Fatalities per 100,000 children aged 15 and under by transport for Canada and Japan between 2002 and 2007. (Data from (Statistics Canada, 2015) for Canada and (IATSS, 2008) for Japan).

If only pedestrian deaths for children aged 15 and under are examined (Figure 2), the rates are similar, though Canada is still higher. Keeping in mind that most children are driven to school and to their activities in Canada (Gilbert and O'Brien, 2005) that would suggest the rate should be lower than Japan's.

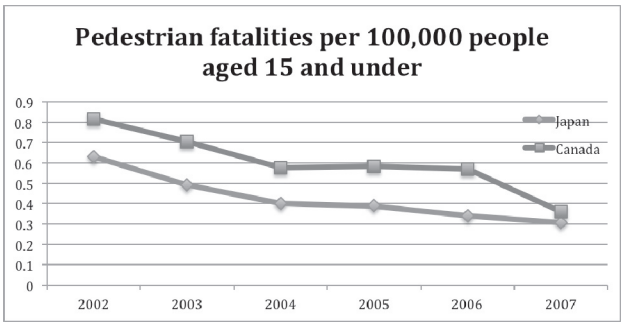

Figure 2. Pedestrian fatalities per 100,000 children aged 15 and under by transport for Canada and Japan between 2002 and 2007. (Data from (Transport Canada, 2015) for Canada and (IATSS, 2008) for Japan).

If we examine modal share for fatalities (Figures 3 & 4), in both countries it is travel by motorised vehicle that is the most associated in Canada.

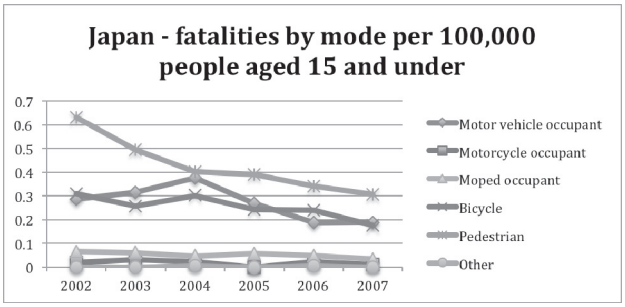

Figure 3. Fatalities per 100,000 children aged 15 and under by transport for Japan between 2002 and 2007. (Data from (IATSS, 2008))

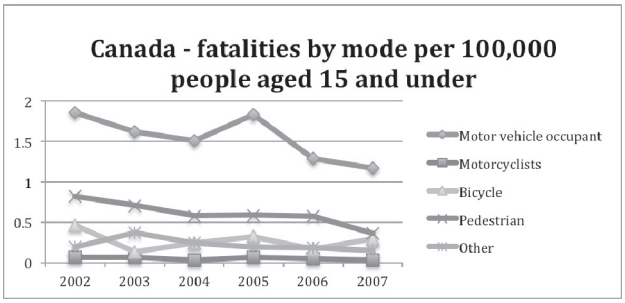

Figure 4. Fatalities per 100,000 children aged 15 and under by transport for Japan between 2002 and 2007(Transport Canada, 2015).

For fatalities by mode during the week (Figure 5), the total for Canada is much higher, and the most common mode related to fatalities is different. In Canada, where travel by car represents the majority of trips, it represents 2/3^{rds} of all fatalities. In Japan, it represents 1/5th, but car travel during the week for children aged seven to twelve is likely low (e.g. (Susilo and Waygood, 2012; Waygood and Kitamura, 2009).

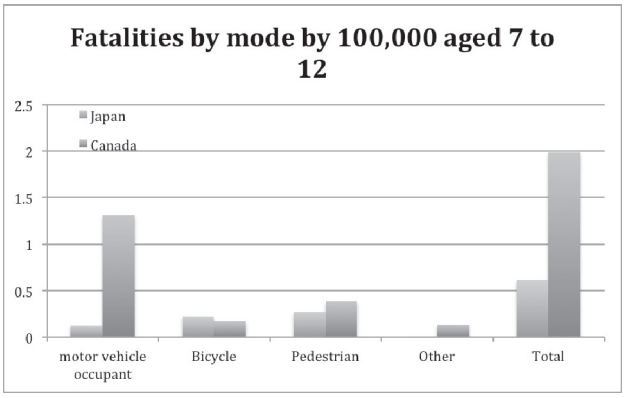

Figure 5. Fatalities per 100,000 children aged 7 to 12 in Japan and Canada by mode (Data from (Transport Canada, 2015) for Canada, and (IATSS, 2008) for Japan).

Now, if we look at the time of day (over the entire week) and children between the ages of seven and twelve (e.g. those likely in elementary school; Figure 6), it can be seen that one of the lowest points for the Japanese children is the morning commute when the WSB is practiced, whereas in Canada, where most children go individually (i.e. not in groups or on buses), the fatality rate is considerably higher. The same result as that was found for Canada exists in South Korea (KOTI, 2015) where children generally go independently to school, which suggests that it is not an "Asian" phenomenon.

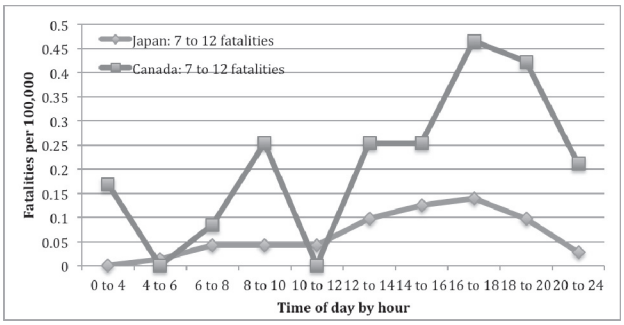

Figure 6. Fatalities per 100,000 children aged 7 to 12 by time of day for Canada and Japan (data from (Transport Canada, 2015) for Canada, and (IATSS, 2008) for Japan).

As the amount of energy contained in a crash is related to the mass and velocity (kinetic energy = ½ * mass * velocity^2), the difference in impact between walking and traveling by motorized vehicle is considerable. This brings us to the point about the study in Tokyo that found that crash rates were higher for children in walking school buses. As mentioned, it is not known what modes were used by the children not in WSBs. Although Japan has a lower fatality rate, it does have a higher injury rate (341/100,000) than Canada (153/100,000) for children aged seven to twelve. What this suggests is that crashes are more severe in Canada, as they are more likely to lead to death. For the overall population, it can be seen that indeed Canada has a higher fatality (8.9/100,000 in 2005) and serious injury rate (53.5/100,000 in 2005) versus Japan (4.5 fatalities per 100,000 in 2007 and 47.4 serious injuries per 100,000 in 2007). Unfortunately, it was not possible to find the number of crashes for Canada. In Japan, the rate has remained at roughly 1.2 injuries per crash for decades, though a small increase (less than 0.1% per year) can be seen.

A further important point is that in Japan the injuries per capita increase with total vehicle kilometers traveled (VKMT; Figure 7). As the progression of VKMT with time is almost exact, the impact of cars on Japan's society increases with each year.

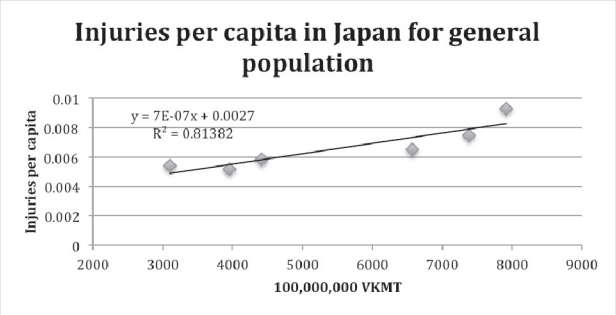

Figure 7. Injuries per capita in Japan for the general population by vehicle kilometers travelled (VKMT; Data from (IATSS, 1977, 1982, 1987, 1992, 1997, 2002).

The link with fatalities is less clear (Figure 8). Here, traditional measures of transport safety (fatalities per distance travelled) would show that driving is getting safer. However, the overall impact on society remains nearly constant.

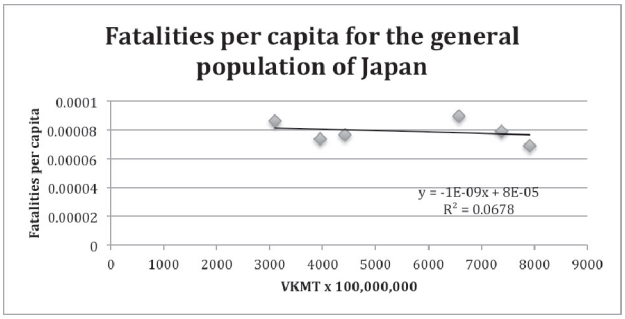

Figure 8. Fatalities per capita in Japan for the general population by vehicle kilometers travelled (VKMT; Data from (IATSS, 1977, 1982, 1987, 1992, 1997, 2002).

Considering that leaving parents the responsibility to get their children to school would likely lead to an increase in distances travelled by car, the comparison with Canada would suggest a likely increase in fatalities. The trends in Japan, would suggest that at the very least, more injuries would be expected for the population. In much of Japan, public transport could offer an alternative to walking or using a car, and the potential impact on safety would be an important addition to this area of research. However, public transport is not typically an option for short trips, as is typical for elementary schools.

7. Discussion

The differences demonstrated by these two contrasting approaches to children's travel relates to recent literature on traffic fatalities. Reduced exposure (e.g. kilometers travelled in motor vehicles) is associated with lower fatalities (e.g. Ewing and Dumbaugh, 2009; Welle et al., 2016). This is the case for the Japanese children as compared to the Canadian children. If the WSB can effectively reduce use of motorized vehicles, it can increase safety. The second key component is speed (Ewing and Dumbaugh, 2009; Welle et al., 2016; Tefft, 2013; Rosen et al., 2011) as discussed above. Speeds are generally reduced in built-up areas where streets are "less forgiving" (for the driver, but not necessarily for pedestrians) by engineering street design guidelines. However, Canadian streets tend to follow guidelines for design speed that recommend designing for speeds higher than the legal speed. Even residential streets in Canada are quite wide and straight. This supports and may encourage higher speeds, thus increasing the distance required to stop and the energy in an impact, thus making it more dangerous for pedestrians. Narrow streets, more common in Japan, especially in residential, built-up areas, do not encourage high speeds. This may be an additional explanatory factor in the differences observed.

8. Conclusions

The Japanese system of WSBs was found to have been formed at a much earlier date than the Anglo-Saxon system and continues to have high rates of participation. In comparison to Canada, it can be seen that the fatality rates in Japan are much lower for elementary school-aged children. Although a spike occurs in Canada in the morning (likely associated with the trip to school), no such spike exists for Japan where the majority of elementary aged children participated in WSBs. In both countries, it is travel after school that is associated with more deaths, when WSBs are less commonly used. For Japan, an increase in VKMT is associated with an increase in the per capita injury rate, but very little influence is seen for fatalities. If a reduction in WSB was to lead to more car use in Japan, than one could reasonably expect an increase in injuries. If the trend was to follow the Canadian one, than fatalities may also increase for the trip to school.

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（平成27年12月29日受付）（平成28年 3 月16日受理）