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Test-retest reliability and convergent validity of measures of children's travel behaviours and independent mobility

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ABSTRACT

Introduction: Active transportation (AT) and independent mobility (IM) represent promising avenues for increasing children's physical activity and minimizing car use. However, there are limited data on the psychometric properties of measures of AT and IM.
Methods: 94 child and parent dyads living in Ottawa (Canada) consented to complete a questionnaire twice, approximately two weeks apart, in English or French language. They were questioned on children's travel to/from places (e.g., school, parks, shops) and on the extent of the child's IM. The weekly volume of AT to/from school was calculated by multiplying the number of active trips by the home-school distance. An IM index consisting of six "mobility licenses" (to travel home from school, travel to other places within walking distance, cross main roads, cycle on main roads, go out after dark, and travel on local buses without adult supervision) was computed. Test-retest reliability and convergent validity between children and parents were assessed with Cohen's kappa or intra-class correlation coefficients (ICC).
Results: The volume of AT to/from school showed high test-retest reliability and convergent validity in both languages (ICC range = 0.81–0.97). Similarly, test-retest reliability was also high for the number of active trips to/from all destinations (ICC range = 0.60–0.94) and the IM index (ICC range = 0.63–0.88). Convergent validity for trips to/from all destinations was fair in the English language subsample (ICC range = 0.22–0.25), but substantial in the French language subsample (ICC range = 0.60–0.82). The IM index showed substantial validity at both test and retest and in both languages (ICC range = 0.61–0.80). Coefficients were generally lower when examining single destinations or mobility licenses.
Conclusion: With minor modifications, the child and parent mobility questionnaires can provide valid and reliable estimates of AT to/from a broad range of destinations and IM among English and French speaking grade 4–6 children.

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1. Introduction

Physical inactivity is among the most important risk factors implicated in the development of non-communicable diseases (Bouchard et al., 2012; Lee et al., 2012). Even in children and youth, physical inactivity is associated with the development of cardiovascular disease risk factors (Ekelund et al., 2012), obesity (Jiménez-Pavón et al., 2010), poor motor skills (Lubans et al., 2010), and adverse mental health outcomes (Biddle and Asare, 2011). Yet, the majority of children and youth do not meet current physical activity (PA) guidelines (Colley et al., 2011; Hallal et al., 2012). The promotion of active transportation (AT; i.e., using non-motorized modes such as walking and cycling) is increasingly regarded as an important strategy to increase PA (British Medical Association, 2012; Larouche et al., 2014a). Furthermore, increasing AT may help mitigate climate change, reduce traffic congestion, and prevent cardiovascular diseases caused by exposure to particulate matter emitted by motor vehicles (Larouche, 2012).

Systematic reviews have concluded that children and youth who engage in AT to/from school are more active than their peers who are driven (Larouche et al., 2014a; Lubans et al., 2011). In studies using accelerometers, the difference in moderate-to-vigorous PA between active and inactive travellers ranged from 0 to 45 min per day (Larouche et al., 2014a). Nevertheless, previous studies may have underestimated the contribution of AT to PA because they typically considered only the trip to/from school. While many children may live too far away from their school to engage in active school travel, other destinations such as friends' and relatives' houses, parks and shops could represent alternative opportunities to incorporate AT (Larouche et al., 2013a). As a first step to examine the contribution of such trips to children's PA, it is important to develop valid and reliable measures of AT in order to reduce measurement error. According to a recent systematic review, limited data are available on the psychometric properties of instruments to assess AT for non-school trips (Larouche et al., 2014b).

In parallel, children's independent mobility (IM) is gaining increased attention as a potential enabler of AT, outdoor play, and overall PA (Hillman et al., 1990; Schoeppe et al., 2013). Following Hillman et al. (1990) seminal study, IM is broadly defined as children's freedom to move around in public space without adult supervision (Hillman et al., 1990). Recent studies have indeed shown that children who are granted more IM are more likely to engage in AT (Carver et al., 2014a; Page et al., 2010), spend more time outside (Mackett et al., 2007; Page et al., 2010) and are more physically active overall (Page et al., 2009; Schoeppe et al., 2013; Stone et al., 2014). However, according to a recent systematic review, few studies have examined the reliability of measures of IM and none has assessed their validity (Bates and Stone, 2015).

To address the methodological issues discussed above, we conducted a study to examine the test-retest reliability and convergent validity (between children and parent reports) of measures of AT and IM in a bilingual sample of parent-child dyads recruited in English and French schools within the City of Ottawa, Canada. Based on the results of the study, we suggest some modifications that, we believe, could improve the reliability and validity of the questionnaires.

2. Methods

2.1. Participants and setting

155 children in grades 4 to 6 were invited to participate in the study and 94 child-parent dyads provided consent (response rate = 60.6%). Test questionnaires were returned by 77 children and 78 parents whereas retest questionnaires were returned by 81 children and 73 parents. Participants were recruited in three suburban catholic public schools within the City of Ottawa (two English schools and one French school). Data collection was completed between January and March 2016. Following the approach proposed by Zou (2012), it was estimated *a priori* that 69 participants would be needed to have a power of 0.80 to detect intra-class correlation coefficients of 0.80 with 95% confidence intervals ranging from 0.70 to 0.90. Anticipating that approximately 75% of participants would provide valid AT and IM data, we aimed to recruit 90 parent-child dyads. Approval was obtained from the institutional Research Ethics Board and the participating school boards. Written consent and assent were obtained from all parents and children.

Ottawa is the capital of Canada and the fourth largest census metropolitan area in the country (Statistics Canada, 2012). While the majority of Ottawans speak English, the City includes a large French-speaking community. This presented an ideal setting to validate our questionnaires in both official languages of Canada. In a previous study, we observed that Ottawa children attending French schools were less likely to engage in AT than their counterparts attending English schools, but this difference was no longer significant after controlling for reported school travel time (Larouche et al., 2014c). Given that distance is the most consistent environmental correlate of AT (Wong et al., 2011), this finding may reflect the fact that French schools in Ottawa have larger catchment areas. This highlights the importance to sample both English and French schools to uphold external validity.

2.2. Protocol

Participants and one of their parents (or guardians) were asked to complete a mobility questionnaire in their own time. The data collection period lasted seven days. Test and retest questionnaires were distributed in schools between one and two weeks apart, at the schools' convenience. We asked the same parent to complete the test and retest questionnaires, although we cannot rule out the possibility that, in some cases, different parents completed the test and retest questionnaire.

2.2.1. Child questionnaire

English and French versions of the original child questionnaire for the study are provided online in the Supplementary File. Children were asked to indicate how they traveled to/from school on each day of the week in tables similar to those proposed by Bere and Bjorkelund (2009). Response options were: walk, bike, skateboard, rollerblade, car, bus, or other. They were also asked to report the number of times they travelled to/from each of the following destinations using an active travel mode on each day of the week: school, friend's home, relative's home, parks or playgrounds, shops or markets or restaurants, sport venues, faith places, and other. Children were asked to respond to these questions every day.

Based on the questions used by Hillman et al. (1990), children were asked to indicate whether they are allowed to do any of the following on their own: cross main roads, cycle on main roads, go on local buses (other than a school bus) and go out alone after dark. They were also asked to indicate if, when going to places other than school that are within walking distance, they are allowed to go alone (options included "I usually go alone", "I am usually taken", and "Varies"), and with whom they usually travel from school (options included "I go to home alone", "Parent", "Another adult", "Older child/teenager", "Child of same age or younger"; multiple responses were allowed). While these mobility licenses reflect permissions to travel or play outside independently, they do not measure the extent of children's IM, or "home range" (Spilsbury, 2005; van Vliet, 1983). Thus, we added two questions proposed by Carver et al. (2014b) which examine how far children are allowed to roam on their own and with friends respectively (options included "I am not allowed out alone", "Within my street", "Within 2–3 streets away from home", "Within a 15 min walk from home", and "More than a 15 min walk from home").

2.2.2. Parent questionnaire

The English and French versions of the parent questionnaire used in the study were similar to the child questionnaire and are also provided online in the Supplementary File. However, it is worth noting that, following Hillman et al. (1990), the question targeting the license to travel to school differed between the child and parent questionnaires. Specifically, parents were simply asked to indicate if their child traveled home from school alone (options: yes or no). Parents were also asked to provide information about the socio-demographic characteristics of their household. The child and parent surveys were translated to French by a professional translator and the accuracy of the translation was verified by three bilingual members of the research team (GL, FT and RL).

2.2.3. Mapping exercise

Children were asked (with the help of their parents) to draw their route to/from school on a custom map that was provided to them using the same protocol described by Buliung et al. (2013). To produce the maps, parents were asked to indicate their home address in the consent form. Then the home and school addresses were geocoded using the DMTI 2014 route file, and custom maps were prepared for each participant using ArcGIS 10.3 software (ESRI Canada, Ottawa, ON). The maps contained the local street network and parks, and the child's home and school locations were marked to facilitate completion of this task. The drawn routes were entered in ArcGIS to calculate the distance between home and school. In many instances, the drawn routes started and ended on the central line of the road. This error was corrected by extending the drawn routes to the school footprint and the child's home location. This mapping approach was used given previous findings indicating that many children do not take the shortest path to school that might otherwise be estimated by the researcher (Buliung et al., 2013; Harrison et al., 2014). Moreover, previous studies indicate that children in this age group are capable of completing such a mapping task (Buliung et al., 2013; Villanueva et al., 2012).

2.3. Data treatment

The weekly volume of AT to/from school was calculated by multiplying the number of school trips where an active mode (e.g., walk, bike, skateboard, rollerblade or "other" as appropriate) was reported by the home-school distance, as in a previous study by Larouche et al. (2013b). The weekly frequency of active trips to/from each destination was calculated, and these frequencies were added to obtain the number of active trips to/from all destinations. The six mobility licenses were dichotomized as yes (1) or no (0). For the license to travel to places (other than school) within walking distance, the options "I usually go alone" and "Varies" were coded as yes; and "I am usually taken" was coded as no. For the question about who the child usually travels from school with, the options "I go home alone" and "child of same age or younger" were coded as yes and all other options were coded as no. An IM index ranging from 0 to 6 was then computed as the sum of the scores for each mobility licenses. The home range questions were dichotomized as "within my street" (i.e., "I am not allowed out alone" or "within my street") or "beyond my street" (i.e., all other options).

2.4. Statistical analyses

For the number of trips to/from different destinations, test-retest reliability and convergent validity were determined using intra-class correlation coefficients (ICC). Specifically, the two-way mixed procedure for consistency was used to compute the ICCs. Cohen's (1960) kappa statistic (κ) was used to determine the test-retest reliability and convergent validity for the individual mobility licenses and the child's home range. Because kappa coefficients are affected by the distribution of the variable, the percent agreement statistic and the prevalence-adjusted bias-adjusted kappa coefficient (PABAK) are provided as complements to Cohen's kappa (Cicchetti and Feinstein, 1990; Byrt et al., 1993). ICCs were used to assess the test-retest reliability and convergent validity of the IM index. Reliability and validity coefficients were interpreted using the cut-points proposed by Landis and Koch (1977): < 0 = no agreement; 0–0.20 = slight agreement; 0.21–0.40 = fair agreement; 0.41–0.60 = moderate agreement; 0.61–0.80 = substantial agreement; 0.81–1.0 = almost perfect agreement. Analyses stratified by school language are presented to explore potential differences in reliability and validity estimates between English and French respondents. Differences were flagged when the 95% confidence intervals of the estimates did not overlap. All analyses were conducted with SPSS version 23 (IBM Corporation, Armonk, New York)

Table 1
Selected characteristics of the sample.

Variable	Test		Retest	
	n or mean	%, SD or IQR	n or mean	%, SD or IQR
Participants (n)				
Returned child questionnaire	77	82	81	86
Returned parent questionnaire	78	83	73	78
Gender (n)				
Female	49	64	50	62
Male	28	36	31	38
Age (mean ± SD)	10.2	0.8	10.2	0.8
School language (n)[a]				
English	49	52	49	52
French	45	48	45	48
Parent education (n)[b]				
College or less	28	36	25	34
University	46	59	41	56
Not stated	4	5	7	10
Car ownership (n)				
1 or less	37	47	31	43
2 or more	39	50	34	46
Not stated	2	3	8	11
Distance between home and school (km; median ± IQR)	1.1	0.6–2.7	1.1	0.6–2.7
Child reported AT and IM measures				
Volume of AT to/from school (km; mean ± SD)	1.4	2.1	1.4	2.2
Number of active trips to/from all destinations (median ± IQR)	6.0	1.0–15.0	5.0	0.0–14.5
IM index (median ± IQR)	2.0	1.0–3.0	1.0	1.0–3.0
Home range alone (n)[c]				
Within my street	35	46.1	27	35.5
Beyond my street	41	53.9	49	64.5
Home range with friends (n)				
Within my street	27	36.0	27	35.5
Beyond my street	48	64.0	49	64.5
Parent reported AT and IM measures				
Volume of AT to/from school (km; mean ± SD)	1.4	2.2	1.3	2.2
Number of active trips to/from all destinations (median ± IQR)	8.0	0.0–14.0	7.0	0.0–14.0
IM index (mean ± SD)	2.0	1.0–3.0	2.0	1.0–3.0
Home range alone (n)				
Within my street	35	46.1	31	45.6
Beyond my street	41	53.9	37	54.4
Home range with friends (n)				
Within my street	27	35.5	24	35.3
Beyond my street	49	64.5	44	64.7

Note: AT: active transportation; IM: independent mobility; IQR: interquartile range; SD: standard deviation. Missing data were handled by listwise deletion.
[a] School language is shown from all participants who consented (n = 94).
[b] Parental education refers to the most educated of the child's parents.
[c] Home range was assessed as how far children are allowed to roam on their own and with friends and dichotomized as "within street" or "beyond street".

and missing data were deleted listwise.

3. Results

Descriptive characteristics of the sample for the test and retest assessments are presented in Table 1. Briefly, participants were aged between 8 and 12 years with a mean of 10.2, and just over 60% were female. The majority of parents had university education and just over half owned at least two cars. The median distance between home and school as estimated from the mapping exercise was 1.1 km (interquartile range = 0.6–2.7 km). Based on child reports, the mean weekly volume of AT to/from school was 1.4 ± 2.1 km while the median was 0.0 km because the majority of participants reported no active trip. Participants reported undertaking a median of 6.0 active trips per week (interquartile range = 1.0–15.0) and they had a median IM score of 2 (interquartile range = 1.0–3.0). The proportions of children reporting that they were allowed to roam beyond their street alone and with friends were 53.9% and 64.0% respectively. Similar results were obtained based on parent reports (Table 1).

Test-retest reliability of the child- and parent-reported measures of AT is shown in Tables 2 and 3 respectively. Of particular interest, the sum of trips to/from all destinations reported by children and parents showed substantial to almost perfect reliability in the English (child: ICC = 0.94; parent: 0.68), French (child: ICC = 0.68; parent: ICC = 0.60), and overall (child: ICC = 0.91; parent: ICC = 0.66) samples. Similarly, the volume of AT to/from school showed almost perfect reliability with all ICCs over 0.80. Tables 4 and 5 display the convergent validity of AT measures for the test and retest. At both assessments, convergent validity for the number of trips to/from all destinations was markedly higher among French-speaking respondents (test: ICC = 0.56; retest: ICC = 0.82) than

Table 2
Test-retest reliability for the number of trips using active transportation to/from different destinations based on child report, stratified by school language.

Number of trips	French				English				Total			
	n	ICC	95% CI	p	n	ICC	95% CI	p	n	ICC	95% CI	p
To different destinations												
School	35	0.68	0.45; 0.82	< .001	34	0.47	0.16; 0.69	0.002	69	0.58	0.39; 0.71	< .001
Friends	35	0.30	−0.03; 0.58	0.036	34	0.57	0.29; 0.76	< .001	69	0.50	0.30; 0.66	< .001
Relatives	35	0.53	0.25; 0.73	< .001	34	0.77	0.58; 0.88	< .001	69	0.59	0.41; 0.72	< .001
Parks	35	0.34	0.01; 0.60	0.023	34	0.74	0.53; 0.86	< .001	69	0.73	0.60; 0.83	< .001
Shops	35	0.76	0.57; 0.87	< .001	34	0.85	0.73; 0.92	< .001	69	0.83	0.74; 0.89	< .001
Sport venues	35	0.76[a]	0.58; 0.87	< .001	34	0.24	−0.11; 0.53	0.088	69	0.41	0.20; 0.59	< .001
Faith places	35	0.79	0.62; 0.89	< .001	34	0.92	0.85; 0.96	< .001	69	0.92	0.87; 0.95	< .001
Others	35	0.01	−0.32; 0.34	0.480	34	0.55	0.26; 0.74	< .001	69	0.25	0.01; 0.45	0.01
All destinations	35	0.66	0.42; 0.81	< .001	34	0.94[a]	0.89; 0.97	< .001	69	0.90	0.84; 0.94	< .001
From different destinations												
School	35	0.65	0.41; 0.81	< .001	34	0.39	0.07; 0.64	0.01	69	0.51	0.31; 0.66	< .001
Friends	35	0.30	−0.03; 0.57	0.036	34	0.46	0.15; 0.69	0.003	69	0.42	0.21; 0.60	< .001
Relatives	35	0.54	0.25; 0.74	< .001	34	0.15	−0.20; 0.46	0.198	69	0.42	0.21; 0.60	< .001
Parks	35	0.38	0.06; 0.63	0.01	34	0.84	0.71; 0.92	< .001	69	0.83	0.75; 0.89	< .001
Shops	35	0.44	0.13; 0.67	0.004	34	0.77	0.58; 0.88	< .001	69	0.70	0.55; 0.80	< .001
Sport venues	35	0.56	0.29; 0.75	< .001	34	0.43	0.12; 0.67	0.005	69	0.47	0.27; 0.64	< .001
Faith places	35	0.79	0.62; 0.89	< .001	34	0.82	0.67; 0.91	< .001	69	0.82	0.72; 0.88	< .001
Others	35	−0.01	−0.34; 0.32	0.522	34	0.52	0.23; 0.73	0.001	69	0.25	0.02; 0.46	0.017
All destinations	35	0.58	0.31; 0.76	< .001	34	0.92[a]	0.84; 0.96	< .001	69	0.87	0.80; 0.92	< .001
To/from destinations												
All destinations except school	35	0.50	0.20; 0.71	0.001	34	0.96[a]	0.91; 0.98	< .001	69	0.91	0.85; 0.94	< .001
All destinations	35	0.68	0.45; 0.83	< .001	34	0.94[a]	0.88; 0.97	< .001	69	0.91	0.85; 0.94	< .001
Volume of active transportation to/from school (km/week)	33	0.92	0.84; 0.96	< .001	30	0.91	0.81; 0.95	< .001	63	0.92	0.86; 0.95	< .001

Note: Results are reported as intra-class correlation coefficients (ICCs) with 95% confidence intervals. ICCs were calculated with the two-way mixed procedure for consistency.
[a] denotes significant difference in ICCs between English and French samples.

among English-speaking respondents (test: ICC = 0.18; retest: ICC = 0.22). Reliability and validity estimates varied across destinations, but estimates were generally lowest for trips to/from “other” destinations which were seldom reported. However, convergent validity was excellent for the volume of AT to/from school (ICCs ≥ 0.84).

Test-retest reliability of the child- and parent-reported measures of IM is shown respectively in Tables 6 and 7. Notably, substantial to almost perfect reliability was observed for the IM index in the English (child: ICC = 0.63; parent: ICC = 0.83), French (child: ICC = 0.83; parent: ICC = 0.71) and overall (child: ICC = 0.76; parent: ICC = 0.77) samples. As illustrated in Tables 8 and 9, convergent validity of the IM index was also substantial to almost perfect at the test and retest assessments in the English (test: ICC = 0.77; retest: ICC = 0.88), French (test: ICC = 0.61; retest: ICC = 0.71), and overall (test: ICC = 0.68; retest: ICC = 0.75) samples. Cohen's kappa for individual mobility licenses varied substantially, but lower kappa values were observed for travelling on local buses which was permitted to no more than 5 participants (data not shown). In this case, the PABAK values suggested almost perfect test-retest reliability and convergent validity. The questions on home range alone and with friends showed higher reliability and validity when dichotomized as “within my street” and “beyond my street”. Inspection of the cross tabulations showed that many disagreements occurred between the “within 2–3 streets away from home” and “within a 15 min walk from home” (data not shown). The hierarchical order of these two options is unclear and our dichotomization appeared to circumvent this issue.

4. Discussion

Addressing a measurement need, this study assessed the test-retest reliability and convergent validity of a comprehensive set of measures of AT and IM in English and French. In general, estimates of reliability and validity were greater for composite variables such as the volume of AT to/from school, the number of active trips to/from all destinations and the IM index. The results of this study suggest that, with some modifications, the surveys can provide valid and reliable measures of AT and IM in English and French. They also suggest that children can report their AT and IM as reliably as their parents.

While a number of studies have examined the psychometric properties of measures of AT, the majority has focused solely on the trip to/from school (Larouche et al., 2014b). Among the few studies that examined AT to/from a broader range of destinations, Ducheyne et al. (2012) indicated that the 1-week test-retest reliability ICCs for the number of non-school cycling trips reported on weekdays and weekends days were 0.44 and 0.64 respectively. Philippaerts et al. (2006) noted substantial reliability for the amount of time reported engaging in AT to school, to non-school destinations and overall in Flemish-speaking Belgian adolescents.

The excellent reliability and convergent validity of our measure of the volume of AT to/from school confirms the results of a small pilot-study using the same approach (Larouche et al., 2013b). In the previous study, 22 participants completed a travel diary on two

Table 3
Test-retest reliability for the number of trips using active transportation to/from different destinations based on parent report, stratified by school language.

# of trips	French				English				Total			
	n	ICC	95% CI	p	n	ICC	95% CI	p	n	ICC	95% CI	p
To different destinations												
School	34	0.66	0.42; 0.82	< .001	31	0.50	0.18; 0.72	0.002	65	0.59	0.41; 0.73	< .001
Friends	34	0.29	−0.04; 0.57	0.043	31	0.54	0.23; 0.75	0.001	65	0.40	0.18; 0.59	< .001
Relatives	34	−0.00	−0.34; 0.33	0.503	31	0.32	−0.03; 0.60	0.036	65	0.11	−0.14; 0.34	0.188
Parks	34	0.33	−0.01; 0.60	0.027	31	0.63	0.36; 0.80	< .001	65	0.51	0.30; 0.67	< .001
Shops	34	0.50	0.20; 0.72	< .001	31	0.53	0.22; 0.74	0.001	65	0.54	0.35; 0.69	< .001
Sport venues	34	0.58	0.30; 0.76	< .001	31	0.45	0.12; 0.69	0.005	65	0.52	0.32; 0.68	< .001
Faith places	34	0.25	−0.09; 0.54	0.076	31	0.66	0.40; 0.82	< .001	65	0.35	0.12; 0.55	0.002
*Others	34	N/A	N/A	N/A	31	−0.05	−0.39; 0.30	0.611	65	−0.02	−0.26; 0.23	0.549
All destinations	34	0.62	0.37; 0.79	< .001	31	0.63	0.36; 0.80	< .001	65	0.64	0.48; 0.77	< .001
From different destinations												
School	34	0.53	0.24; 0.73	< .001	31	0.55	0.25; 0.75	0.001	65	0.57	0.38; 0.72	< .001
Friends	34	0.36	0.03; 0.62	0.017	31	0.60	0.32; 0.79	< .001	65	0.49	0.28; 0.65	< .001
Relatives	34	−0.04	−0.37; 0.30	0.580	31	−0.01	−0.36; 0.34	0.524	65	−0.02	−0.26; 0.23	0.550
Parks	34	0.50	0.20; 0.71	0.001	31	0.66	0.41; 0.82	< .001	65	0.60	0.42; 0.74	< .001
Shops	34	0.70	0.47; 0.84	< .001	31	0.26	−0.10; 0.56	0.073	65	0.33	0.13; 0.55	0.002
Sport venues	34	−0.00	−0.34; 0.33	0.504	31	0.70[a]	0.46; 0.84	< .001	65	0.31	0.08; 0.52	0.005
Faith places	34	0.53	0.23; 0.73	0.001	31	0.66	0.40; 0.82	< .001	65	0.57	0.38; 0.71	< .001
*Others	34	N/A	N/A	N/A	31	−0.06	−0.40; 0.30	0.620	65	−0.02	−0.26; 0.22	0.566
All destinations	34	0.57	0.30; 0.76	< .001	31	0.64	0.37; 0.81	< .001	65	0.63	0.46; 0.76	< .001
To/from destinations												
All destinations except school	34	0.48	0.18; 0.70	0.002	31	0.60	0.32; 0.79	< .001	65	0.56	0.37; 0.71	< .001
All destinations	34	0.60	0.34; 0.78	< .001	31	0.68	0.43; 0.83	< .001	65	0.66	0.50; 0.78	< .001
Volume of active transportation to/from school (km/week)	29	0.97	0.93; 0.98	< .001	25	0.81*	0.62; 0.91	< .001	54	0.90	0.83; 0.94	< .001

Note: Results are reported as intra-class correlation coefficients (ICCs) with 95% confidence intervals. ICCs were calculated with the two-way mixed procedure for consistency.

[a] denotes significant difference in ICCs between English and French samples.

* At neither the test nor retest, no French-speaking parent reported a trip to any "other" destinations, thus ICC for test-retest reliability for this variable could not be calculated.

consecutive weeks, and an ICC of 0.87 was reported. This measure could help researchers to quantify the dose-response relationship between active transportation, PA and health-related indicators. Of particular interest, the relationship between AT and body composition remains unclear, and one of the potential reasons is that, in most studies, participants were merely categorized as active vs. motorized travellers (Bere and Andersen, 2009; Faulkner et al., 2009; Larouche et al., 2014a).

We observed low convergent validity between children and parent reports of the number of active trips to/from most destinations. These results may be explained by 1) parents' lack of awareness of all the active trips that their children undertook; 2) different understanding of what constitutes a "trip" between parents and children; and 3) misreporting of the number of trips by either children or parents – or both. In addition, children where specifically asked to respond to the questions on the number of trips to/from destinations every day whereas parents were not given specific instructions on when to complete the questionnaire. Interestingly, Oliver et al. (2014) compared trips reported in a child diary with trips identified by a global positioning system algorithm, and they observed that only 54.5% of trips were captured by both methods. To further understand this discrepancy, they conducted focus group interviews with 30 children aged 9 to 11 years, and they noted that the perception of what constitutes a trip varied markedly between children (Oliver et al., 2014). For example, some children considered that going to more than one destination in one outing qualifies as more than one trip while others considered it as a single trip. Similarly, Rodriguez et al. (2012) also found moderate concurrent validity between a travel diary and a combination of global positioning systems and accelerometers (Rodriguez et al., 2012). Further qualitative work examining children's and parents' understanding of the concept of trips may shed light on this issue. To clarify the meaning of a trip, we have added pictographs in the revised child questionnaire (see online Supplementary File). We have also regrouped the questions that children need to answer every day and harmonized the layout of these questions so that the days of the week are always presented as column titles. These improvements should make it easier for children to complete the questionnaire.

To date, very few previous studies have reported on the reliability of IM measures (Bates and Stone, 2015). Specifically, Prezza et al. (2009) examined the internal consistency of an IM subscale consisting of 6 mobility licenses scored on 4-point Likert scales among 8-year-olds and one of their parents in Italy. They observed substantial reliability among children ($\alpha = 0.71–0.74$) and moderate-to-substantial reliability among parents ($\alpha = 0.56–0.64$). More recently, Carver et al. (2014b) examined the 1-week test-retest reliability of Australian children's home range either alone or with friends and reported moderate reliability ($\kappa = 0.59$ and 0.52 respectively). Finally, Tetali et al. (2015) examined the one week test-retest reliability of some mobility licenses in Indian children aged 11–14 years. They reported fair-to-moderate agreement for questions on accompaniment on the trip from school to home ($\kappa =$

Table 4
Convergent validity between child and parent reports of the number of active trips to/from different destinations at the test, stratified by school language.

# of trips	French				English				Total			
	n	ICC	95% CI	p	n	ICC	95% CI	p	n	ICC	95% CI	p
To different destinations												
School	38	0.65	0.42; 0.80	< .001	37	0.51	0.22; 0.71	0.001	75	0.60	0.43; 0.73	< .001
Friends	38	0.78	0.62; 0.88	< .001	37	0.79	0.62; 0.88	0.001	75	0.79	0.68; 0.86	< .001
Relatives	38	0.87[a]	0.77; 0.93	< .001	37	0.03	−0.29;0.35	0.421	75	0.68	0.53; 0.78	< .001
Parks	38	0.20	−0.12; 0.49	0.109	37	0.01	−0.31; 0.33	0.470	75	0.03	−0.19; 0.26	0.385
Shops	38	0.20	−0.12; 0.49	0.107	37	0.43	0.13; 0.66	0.003	75	0.39	0.18; 0.57	< .001
Sport venues	38	0.43	0.13; 0.66	0.003	37	0.28	−0.04; 0.55	0.044	75	0.38	0.17; 0.56	< .001
Faith places	38	0.31	−0.01; 0.57	0.027	37	−0.00	−0.32; 0.32	0.504	75	0.03	−0.20; 0.25	0.413
Others	38	0.92[a]	0.86; 0.96	< .001	37	0.58	0.32; 0.76	< .001	75	0.71	0.58; 0.81	< .001
All destinations	38	0.59	0.33; 0.76	< .001	37	0.26	−0.07; 0.53	0.059	75	0.36	0.15; 0.54	0.001
From different destinations												
School	38	0.62	0.38; 0.78	< .001	37	0.32	−0.01; 0.58	0.027	75	0.46	0.26; 0.62	< .001
Friends	38	0.75	0.57; 0.86	< .001	37	0.64	0.40; 0.80	< .001	75	0.66	0.51; 0.77	< .001
Relatives	38	0.73[a]	0.53; 0.85	< .001	37	−0.02	−0.33; 0.31	0.536	75	0.33	0.12; 0.52	0.002
Parks	38	0.26	−0.07; 0.53	0.059	37	0.02	−0.30; 0.34	0.451	75	0.05	−0.18; 0.27	0.346
Shops	38	0.04	−0.28; 0.35	0.410	37	0.49	0.20; 0.70	0.001	75	0.28	0.06; 0.47	0.007
Sport venues	38	0.22	−0.10; 0.50	0.088	37	0.38	0.06; 0.62	0.010	75	0.27	0.05; 0.47	0.009
Faith places	38	0.53	0.26; 0.73	< .001	37	0.00	−0.32; 0.32	0.491	75	0.06	−0.17; 0.28	0.308
Others	38	0.13	−0.20; 0.43	0.221	37	0.29	−0.03; 0.56	0.039	75	0.27	0.05; 0.47	0.010
All destinations	38	0.55	0.28; 0.74	< .001	37	0.24	−0.09; 0.52	0.076	75	0.32	0.10; 0.51	0.002
To/from destinations												
All destinations except school	38	0.56	0.29; 0.74	< .001	37	0.18	−0.15; 0.47	0.139	75	0.24	0.01; 0.44	0.019
All destinations	38	0.60	0.36; 0.77	< .001	37	0.25	−0.07; 0.53	0.062	75	0.35	0.13; 0.53	0.001
Volume of active transportation to/from school (km/week)	35	0.94	0.88; 0.97	< .001	33	0.84	0.71; 0.92	< .001	68	0.90	0.84; 0.94	< .001

Note: Results are reported as intra-class correlation coefficients (ICCs) with 95% confidence intervals. ICCs were calculated with the two-way mixed procedure for consistency.

[a] denotes significant difference in ICCs between English and French samples.

0.58), license to cross main roads alone (κ = 0.18–0.24) and license to cycle on main roads alone (κ = 0.20–0.30). To our knowledge, our study is the first to examine the convergent validity of IM measures.

It is worth emphasizing that Hillman et al. (1990) used different questions to address the school travel licenses in their child and parent questionnaires. Specifically, they asked children *with whom* they traveled home from school and they asked parents *if* their child travel home from school alone. A substantial amount of subsequent work used these different questions (e.g., Shaw et al., 2013, 2015). In addition to being difficult to compare, we believe that these questions may lack construct validity given that the underlying construct is whether children are *allowed* to travel home from school on their own, and not if they do it. Therefore, in the revised version of the questionnaires (see online Supplementary File), children and parents are both asked to report whether the child is *allowed* to travel home from school *on their own*. We believe that this modification should improve both convergent and construct validity.

Our study also extends previous work on IM by developing and validating an IM index based on the mobility licenses proposed by Hillman et al. (1990). This index has shown high test-retest reliability and convergent validity in both English and French samples. In addition, we believe that examining mobility licenses in combination rather than separately should provide a more holistic representation of the concept of IM.

Interestingly, we found substantial difference in reliability and validity estimates between the English-speaking and French-speaking participants. For example, there was much better convergent validity in the French-speaking sample compared to the English speaking sample for the number of active trips reported, particularly at the retest. We noted that English-speaking children and their parents reported about two times more trips than their French-speaking counterparts (data not shown). Parents who drive their children to/from school may be more likely to report such trips accurately, whereas parents whose children travel on their own may be less aware of the trips undertaken by their children. It is also worth noting that there were snow storms during data collection in the English schools, which may have disrupted children's usual travel behaviour, potentially making it harder for participants to recall trips accurately. Teachers' engagement in the study (e.g., reminding participants to complete their questionnaires) may also have varied between classrooms and schools. Following completion of the study, we also realized that the words "alone" and "on your own" were sometimes used interchangeably in the English questionnaires. This may have confused respondents and it may explain some of the disagreement between children and parents. In the revised questionnaires (available in the online Supplementary File), we chose to consistently use "on your own" to minimize this potential source of error. We believe that "on your own" better reflects the instrumental role of friends in helping children develop their IM (Goodman et al., 2014; Mikkelsen et al., 2009).

The implications of our study for practitioners and researchers are as follows. First, the fact that convergent validity was high for the measure of the volume of AT to/from school and the IM index suggest that children and parents give similar responses. Therefore,

Table 5

Convergent validity between child and parent reports of the number of active trips to/from different destinations at the retest, stratified by school language.

# of trips	French				English				Total			
	n	ICC	95% CI	p	n	ICC	95% CI	p	n	ICC	95% CI	p
To different destinations												
School	37	0.84[a]	0.71; 0.91	< .001	35	0.49	0.20; 0.71	0.001	72	0.63	0.46; 0.74	< .001
Friends	37	0.81	0.66; 0.90	< .001	35	0.50	0.20; 0.70	0.001	72	0.64	0.48; 0.76	< .001
Relatives	37	0.93[a]	0.87; 0.96	< .001	35	0.50	0.20; 0.71	0.001	72	0.72	0.59; 0.81	< .001
Parks	37	0.48	0.18; 0.69	0.001	35	0.27	−0.07; 0.55	0.056	72	0.30	0.07; 0.49	0.006
Shops	37	0.31	−0.01; .58	0.027	35	0.33	0.00; 0.60	0.024	72	0.33	0.11; 0.52	0.002
Sport venues	37	0.60	0.35; 0.77	< .001	35	0.14	−0.20; 0.45	0.203	72	0.25	0.02; 0.45	0.018
Faith places	37	0.85[a]	0.73; 0.92	< .001	35	0.03	−0.30; 0.36	0.431	72	0.18	−0.05; 0.40	0.061
Others	37	−0.03	−0.35; 0.29	0.578	35	−0.02	−0.35; 0.31	0.55	72	−0.02	−0.25; 0.22	0.553
All destinations	37	0.81[a]	0.66; 0.90	< .001	35	0.24	−0.10; 0.52	0.084	72	0.40	0.18; 0.57	< .001
From different destinations												
School	37	0.79[a]	0.62; 0.88	< .001	35	0.36	0.04; 0.62	0.035	72	0.53	0.34; 0.68	< .001
Friends	37	0.83[a]	0.70; 0.91	< .001	35	0.44	0.13; 0.67	0.004	72	0.63	0.47; 0.75	< .001
Relatives	37	0.97[a]	0.94; 0.98	< .001	35	0.41	0.10; 0.65	0.006	72	0.76	0.65; 0.85	< .001
Parks	37	0.65	0.41; 0.80	< .001	35	0.22	−0.12; 0.51	0.104	72	0.26	0.03; 0.47	0.012
Shops	37	0.57	0.30; 0.75	< .001	35	0.29	−0.05; 0.56	0.045	72	0.34	0.12; 0.53	0.002
Sport venues	37	0.32	0.00; 0.58	0.024	35	−0.06	−0.38; 0.24	0.639	72	0.05	−0.18; 0.28	0.342
Faith places	37	0.83[a]	0.69; 0.91	< .001	35	0.09	−0.24; 0.41	0.296	72	0.45	0.24; 0.61	< .001
Others	37	−0.01	−0.33; 0.31	0.525	35	−0.02	−0.34; 0.32	0.536	72	−0.02	−0.25; 0.21	0.560
All destinations	37	0.82[a]	0.67; 0.90	< .001	35	0.22	−0.12; 0.51	0.097	72	0.40	0.19; 0.58	< .001
To/from destinations												
All destinations except school	37	0.84[a]	0.70; 0.91	< .001	35	0.14	−0.20; 0.45	0.207	72	0.29	0.06; 0.49	0.007
All destinations	37	0.82[a]	0.67; 0.91	< .001	35	0.22	−0.11; 0.52	0.095	72	0.30	0.08; 0.50	0.005
Volume of active transportation to/from school (km/week)	32	0.97	0.94; 0.99	< .001	25	0.93	0.86; 0.97	< .001	57	0.95	0.92; 0.97	< .001

Note: Results are reported as intra-class correlation coefficients (ICCs) with 95% confidence intervals. ICCs were calculated with the two-way mixed procedure for consistency.

[a] denotes significant difference in ICCs between English and French samples.

practitioners facing time and financial constraints may ask our questions only to children or parents. However, practitioners and researchers interested in measures exhibiting lower convergent validity (e.g., the number of active trips to/from some destinations) should consider questioning both children and parents.

The main limitation of this study is the small sample size which may lead to imprecision in the estimates of reliability and validity. Confidence intervals and standard errors would likely have been smaller had we recruited a larger sample. Second, self- and parent-reports are subject to social desirability and recall biases (Shephard, 2003). Third, while we assessed distance between home and school, it was not feasible to measure distance for trips undertaken to/from all destinations examined in the survey. Fourth, trip chains would be difficult to capture using our measures of AT where we asked participants to indicate the number of active trips that they took to/from a range of destinations. Given that there is limited literature on trip chains among children (Oliver et al., 2014), further research is warranted to address this issue. Fifth, our analyses could have been strengthened by examining the convergent validity between our surveys and global positioning systems, but this was not feasible due to budgetary constraints. Sixth, travel behaviour may be subject to seasonal variations. While some Canadian studies found no evidence of seasonal changes in the prevalence of AT to/from school (Mitra and Faulkner, 2012; Robertson-Wilson et al., 2008), we are not aware of any previous study that has examined whether travel to/from other destinations and IM vary across seasons. While the psychometric properties of our instruments may vary by season, we think that reliability and validity estimates would have been higher in the spring or fall when travel behaviours would be less likely to be affected by extreme weather conditions.

In contrast, this is one of the first studies that examined the psychometric properties of instruments to assess IM and AT beyond the trip to/from school. Moreover, to our knowledge, no previous studies have assessed the reliability and validity of measures of AT and IM in French. The IM index developed in this study represents a more holistic measure of the concept of IM than the mobility licenses taken in isolation. Furthermore, the measure of the volume of AT to/from school should facilitate the assessment of the "dose-response" relationship between AT and PA.

5. Conclusion

This study indicates that the English and French versions of the child and parent mobility questionnaires can provide reliable estimates of AT to/from a broad range of destinations and IM among grade 4–6 children. However, the convergent validity of child and parent reports was low for the number of active trips to/from different destinations, suggesting that children and parents may have different perceptions of what constitutes a trip. We believe that by clarifying the definition of "trip" in the child questionnaire, the test-retest reliability and convergent validity of our instruments should be improved. Nevertheless, "substantial" to "almost

Table 6
Test-retest reliability of child-reported independent mobility variables.

Measure	French						English						Total					
	n	% agree	pabak	kappa / ICC	St. error	p	N	% agree	pabak	kappa / ICC	St. error	p	n	% agree	pabak	kappa / ICC	St. error	p
Travel home from school alone/with child of same age or younger	33	84.8	0.70	0.68	0.13	< .001	32	75.0	0.50	0.47	0.16	0.007	65	80.0	0.60	0.58	0.10	< .001
Cross main roads on your own	33	93.9	0.88	0.88	0.08	< .001	33	93.9	0.88	0.88	0.08	< .001	66	93.9	0.88	0.88	0.06	< .001
Travel alone within walking distance	29	86.2	0.72	0.58	0.18	0.001	32	87.5	0.75	0.75	0.12	< .001	61	86.9	0.74	0.70	0.10	< .001
Cycle on main roads on your own	31	87.1	0.74	0.74	0.12	< .001	24	75.0	0.50	0.40	0.20	0.046	55	81.8	0.64	0.62	0.11	< .001
Go on buses on your own	35	94.3	0.89	0.64	0.24	< .001	29	96.6	0.93	N/A	N/A	N/A	64	95.3	0.91	0.55	0.23	< .001
Go alone after dark	34	97.1	0.94	0.87	0.13	< .001	29	100	1.00	1.00	0	< .001	63	98.4	0.97	0.90	0.10	< .001
Independent mobility index*	24	N/A	N/A	0.83	0.64; 0.92	< .001	20	N/A	N/A	0.63	0.28; 0.84	< .001	44	N/A	N/A	0.76	0.61; 0.86	< .001
Home range alone	34	52.9	0.06	0.38	0.11	< .001	30	53.3	0.07	0.38	0.12	< .001	64	53.1	0.06	0.38	0.08	< .001
Home range with friends	34	67.6	0.35	0.57	0.11	< .001	29	51.7	0.03	0.37	0.12	< .001	63	60.3	0.21	0.48	0.08	< .001
Home range alone - dichotomized	34	76.5	0.53	0.47	0.16	0.006	30	73.8	0.48	0.47	0.16	0.008	64	75.0	0.50	0.47	0.11	< .001
Home range with friends - dichotomized	34	94.1	0.88	0.85	0.10	< .001	29	86.2	0.72	0.70	0.14	< .001	63	90.5	0.81	0.77	0.09	< .001

Note: Unless otherwise noted, results are reported as percent agreement, prevalence-adjusted bias-adjusted kappa (pabak), and Cohen's kappa and its standard error and p-value.
 * The independent mobility index was computed as the sum of the six mobility licenses above and is reported as ICC with 95% confidence interval.

Table 7
Test-retest reliability of parent-reported independent mobility variables.

Measure	French						English						Total					
	n	% agree	pabak	kappa	St. error	p	n	% agree	pabak	kappa	St. error	p	n	% agree	pabak	kappa	St. error	p
Travel home from school alone	34	88.2	0.76	0.76	0.11	< .001	31	87.1	0.74	0.74	0.12	< .001	65	87.7	0.75	0.75	0.08	< .001
Cross main roads alone	28	75.0	0.50	0.50	0.16	0.008	31	87.1	0.74	0.74	0.12	< .001	59	81.4	0.63	0.63	0.10	< .001
Travel alone within walking distance	33	78.8	0.58	0.55	0.15	0.001	31	67.7	0.35	0.36	0.17	0.045	64	73.4	0.47	0.46	0.11	< .001
Cycle on main roads alone	28	85.7	0.71	0.71	0.14	< .001	26	80.8	0.62	0.53	0.18	0.006	54	83.3	0.67	0.66	0.10	< .001
Go on buses alone	29	96.6	0.93	0.65	0.32	< .001	30	93.3	0.87	−0.03	0.02	0.85	59	94.9	0.90	0.38	0.28	0.003
Go alone after dark	30	93.3	0.87	0.46	0.32	0.011	31	90.3	0.81	0.53	0.23	0.001	61	91.8	0.84	0.50	0.19	< .001
Independent mobility index*	27	N/A	N/A	0.71	0.46; 0.86	< .001	26	N/A	N/A	0.83	0.65; 0.92	< .001	53	N/A	N/A	0.77	0.63; 0.86	< .001
Home range alone	29	72.4	0.45	0.64	0.11	< .001	30	70.0	0.40	0.55	0.12	< .001	59	71.2	0.42	0.61	0.08	< .001
Home range with friends	29	62.1	0.24	0.50	0.11	< .001	30	63.3	0.27	0.46	0.13	< .001	59	62.7	0.25	0.49	0.09	< .001
Home range alone - dichotomized	29	96.6	0.93	0.93	0.07	< .001	30	83.3	0.67	0.67	0.14	< .001	59	89.8	0.80	0.80	0.08	< .001
Home range with friends – dichotomized	29	89.7	0.79	0.78	0.12	< .001	30	80.0	0.60	0.49	0.18	0.007	59	84.7	0.69	0.65	0.11	< .001

Note: Unless otherwise noted, results are reported as percent agreement, prevalence-adjusted bias-adjusted kappa (pabak), and Cohen's kappa and its standard error and p-value.

* The independent mobility index was computed as the sum of the six mobility licenses above and is reported as ICC with 95% confidence interval.

Table 8
Convergent validity between child and parent reports of independent mobility at the test.

Measure	French						English						Total					
	n	% agree	pabak	kappa	St. error	p	n	% agree	pabak	kappa	St. error	p	n	% agree	pabak	kappa	St. error	p
Travel home from school alone/with child of same age or younger	34	79.4	0.59	0.58	0.14	0.001	35	74.3	0.49	0.51	0.13	0.001	69	76.8	0.54	0.54	0.10	< .001
Cross main roads alone/ on your own	36	75.0	0.50	0.50	0.14	0.003	37	78.4	0.57	0.56	0.14	0.001	73	76.7	0.53	0.53	0.10	< .001
Travel alone within walking distance	35	62.9	0.26	0.13	0.14	0.324	36	83.3	0.67	0.66	0.13	< .001	71	73.2	0.46	0.42	0.11	< .001
Cycle on main roads alone/on your own	34	85.3	0.71	0.70	0.12	< .001	28	82.1	0.64	0.58	0.17	0.002	62	83.9	0.68	0.67	0.10	< .001
Go on buses alone/on your own	37	89.2	0.78	0.28	0.26	0.102	36	97.2	0.94	N/A	N/A	N/A	73	93.2	0.86	0.25	0.23	0.030
Go alone after dark	38	94.7	0.89	0.72	0.19	< .001	36	94.4	0.89	0.47	0.32	0.005	74	94.6	0.89	0.64	0.17	< .001
Independent mobility index *	28	N/A	N/A	0.61	0.31; 0.80	< .001	25	N/A	N/A	0.77	0.55; 0.89	< .001	53	N/A	N/A	0.68	0.50; 0.80	< .001
Home range alone	37	54.1	0.08	0.40	0.11	< .001	36	52.8	0.06	0.35	0.11	< .001	73	53.4	0.07	0.38	0.08	< .001
Home range with friends	37	54.1	0.08	0.38	0.10	< .001	35	57.1	0.14	0.43	0.11	< .001	72	55.5	0.11	0.41	0.08	< .001
Home range alone - dichotomized	37	83.8	0.68	0.66	0.13	< .001	36	75.0	0.50	0.50	0.14	0.003	73	79.5	0.59	0.58	0.10	< .001
Home range with friends - dichotomized	37	78.4	0.57	0.53	0.15	0.001	35	88.6	0.77	0.75	0.11	< .001	72	83.3	0.67	0.63	0.10	< .001

Note: Unless otherwise noted, results are reported as percent agreement, prevalence-adjusted bias-adjusted kappa (pabak), and Cohen's kappa and its standard error and p-value.
* The independent mobility index was computed as the sum of the six mobility licenses above and is reported as ICC with 95% confidence interval.

Table 9
Convergent validity between child and parent reports of independent mobility at the retest.

Measure	French						English						Total					
	n	% agree	pabak	kappa	St. error	p	n	% agree	pabak	kappa	St. error	p	n	% agree	pabak	kappa	St. error	p
Travel home from school alone/with child of same age or younger	37	75.7	0.51	0.50	0.14	0.002	34	55.9	0.12	0.12	0.16	0.473	71	66.2	0.32	0.32	0.11	0.006
Cross main roads alone/on your own	32	75.0	0.50	0.50	0.15	0.004	33	81.8	0.64	0.61	0.14	< .001	65	78.5	0.57	0.56	0.10	< .001
Travel alone within walking distance	34	67.6	0.35	0.25	0.17	0.138	34	70.6	0.41	0.41	0.16	0.016	68	69.1	0.38	0.35	0.11	0.003
Cycle on main roads alone/on your own	30	76.7	0.53	0.53	0.16	0.004	24	95.8	0.92	0.88	0.11	< .001	54	85.2	0.70	0.69	0.10	< .001
Go on buses alone/on your own	34	97.1	0.94	0.65	0.32	< .001	31	90.3	0.81	−0.05	0.03	0.790	65	93.8	0.88	0.31	0.25	0.009
Go alone after dark	33	90.9	0.82	0.52	0.24	0.002	31	83.9	0.68	0.21	0.23	0.178	64	87.5	0.75	0.36	0.18	0.004
Independent mobility index *	27	N/A	N/A	0.71	0.46; 0.86	< .001	22	N/A	N/A	0.80	0.58; 0.91	< .001	49	N/A	N/A	0.75	0.59; 0.85	< .001
Home range alone	34	64.7	0.29	0.52	0.11	< .001	32	53.1	0.06	0.34	0.13	0.001	66	59.1	0.18	0.45	0.08	< .001
Home range with friends	34	58.8	0.17	0.46	0.11	< .001	32	43.8	−0.12	0.24	0.11	0.014	66	51.6	0.03	0.36	0.08	< .001
Home range alone - dichotomized	34	85.3	0.71	0.64	0.14	< .001	32	65.6	0.31	0.32	0.16	0.067	66	75.8	0.52	0.50	0.11	< .001
Home range with friends - dichotomized	34	82.4	0.65	0.58	0.15	< .001	32	81.3	0.63	0.62	0.14	< .001	66	81.8	0.64	0.60	0.10	< .001

Note: Unless otherwise noted, results are reported as percent agreement, prevalence-adjusted bias-adjusted kappa (pabak), and Cohen's kappa and its standard error and p-value.
* The independent mobility index was computed as the sum of the six mobility licenses above and is reported as ICC with 95% confidence interval.

perfect" convergent validity was observed for the IM index and the volume of AT to/from school which represents important methodological contributions to the literature. Building on the present work, future research should examine the psychometric properties of the revised surveys in larger and more diverse samples of children and parents.

Disclosure statement

The authors have no conflicts of interest to declare.

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Appendix A. Supplementary material

Supplementary data associated with this article can be found in the online version at http://dx.doi.org/10.1016/j.jth.2017.05.360.

References

Bates, B., Stone, M.R., 2015. Measures of outdoor play and independent mobility in children and youth: a methodological review. J. Sci. Med. Sport. 18 (5), 545–552.
Bere, E., Andersen, L.B., 2009. Why no support for an association between active commuting to school and weight status in the literature? J. Phys. Act. Health. 6, 533–534.
Bere, E., Bjorkelund, L.A., 2009. Test-retest reliability of a new self reported comprehensive questionnaire measuring frequencies of different modes of adolescents commuting to school and their parents commuting to work – the ATN questionnaire. Int. J. Behav. Nutr. Phys. Act. 6 (68).
Biddle, S.J.H., Asare, M., 2011. Physical activity and mental health in children and adolescents: a review of reviews. Br. J. Sport. Med. 45 (11), 886–895.
Bouchard, C., Blair, S.N., Haskell, W., 2012. Physical activity and health, 2nd Ed. Human Kinetics, Champaign, IL.
British Medical Association, 2012. Healthy transport = healthy lives. British Medical Association, London.
Buliung, R.N., Larsen, K., Faulkner, G.E.J., Stone, M.R., 2013. The "path" not taken: exploring structural differences in mapped- versus shortest-network-path school travel routes. Am. J. Public Health. 103, 1589–1596.
Byrt, T., Bishop, J., Carlin, J.B., 1993. Bias, prevalence and kappa. J. Clin. Epidemiol. 46, 423–429.
Carver, A., Panter, J.R., Jones, A.P., van Sluijs, E.M.F., 2014a. Independent mobility on the journey to school: a joint cross-sectional and prospective exploration of social and physical environmental influences. J. Transp. Health. 1 (1), 25–32.
Carver, A., Veitch, J., Sahlqvist, S., Crawford, D., Hume, C., 2014b. Active transport, independent mobility and territorial range among children residing in disadvantaged areas. J. Transp. Health. 1 (4), 267–273.
Cicchetti, D.V., Feinstein, A.R., 1990. High agreement but low kappa: ii. Resolving the paradoxes. J. Clin. Epidemiol. 43 (6), 551–558.
Cohen, J., 1960. A coefficient of agreement for nominal scales. Educ. Psychol. Meas. 20, 37–46.
Colley, R.C., Garriguet, D., Janssen, I., Craig, C.L., Clarke, J., Tremblay, M.S., 2011. Physical activity of Canadian children and youth: accelerometer results from the Canadian Health Measures Survey. Health Reps. 22 (1), 15–23.
Ducheyne, F., de Bourdeaudhuij, I., Lenoir, M., Cardon, G., 2012. Test-retest reliability and validity of a child and parental questionnaire on specific determinants of cycling to school. Pediatr. Exerc. Sci. 24, 289–311.
Ekelund, U., Luan, J., Sherar, L.B., Esliger, D.W., Griew, P., Cooper, A.R., 2012. Moderate to vigorous physical activity and sedentary time and cardiometabolic risk factors in children and adolescents. JAMA. 307, 704–712.
Faulkner, G.E.J., Buliung, R.N., Flora, P.K., Fusco, C., 2009. Active school transport, physical activity levels and body weight of children and youth: a systematic review. Prev. Med. 48 (1), 3–8.
Goodman, A., Jones, A., Roberts, H., Steinbach, R., Green, J., 2014. 'We Can All Just Get on a Bus and Go': rethinking independent mobility in the context of the universal provision of free bus travel to young Londoners. Mobilities 9 (2), 275–293.
Hallal, P., Andersen, L.B., Bull, F.C., et al., 2012. Global physical activity levels: surveillance progress, pitfalls, and prospects. Lancet. 380 (9838), 247–257.
Harrison, F., Burgoine, T., Corder, K., van Sluijs, E.M.F., Jones, A., 2014. How well do modelled routes to school record the environments children are exposed to?: a cross-sectional comparison of GIS-modelled and GPS-measured routes to school. Int. J. Health Geogr. 13 (5).
Hillman, M., Adams, J., Whitelegg, J., 1990. One false move… A study of children's independent mobility. PSI Publishing, London.
Jiménez-Pavón, D., Kelly, J., Reilly, J.J., 2010. Association between objectively measured habitual physical activity and adiposity in children and adolescents: systematic review. Pediatr. Obes. 5 (1), 3–18.
Landis, J.R., Koch, G.G., 1977. The measurement of observer agreement for categorical data. Biometrics. 33, 159–174.
Larouche, R., 2012. The environmental and population health benefits of active transport: a review. In: Liu, G. (Ed.), Greenhouse Gases – Emissions. Measurement and Management. InTech, Rijeka, Croatia, pp. 413–440.
Larouche, R., Barnes, J., Tremblay, M.S., 2013a. Too far to walk or bike? Can. J. Public Health. 104 (7), e487–e489.
Larouche, R., Faulkner, G., Tremblay, M.S., 2013b. Assessing the influence of the transition from primary to secondary school on the volume of active school transport and physical activity: a prospective pilot-study. Bioenergetics. 2 (1).
Larouche, R., Saunders, T.J., Faulkner, G.E.J., Colley, R.C., Tremblay, M.S., 2014a. Associations between active school transport and physical activity, body composition and cardiovascular fitness: a systematic review of 68 studies. J. Phys. Act. Health. 11 (1), 206–227.
Larouche, R., Oyeyemi, A.L., Prista, A., Onywera, V.O., Akinroye, K.K., Tremblay, M.S., 2014b. A systematic review of active transportation research in Africa and the psychometric properties of measurement tools in children and youth. Int. J. Behav. Nutr. Phys. Act. 11 (129).
Larouche, R., Chaput, J.-P., Leduc, G., et al., 2014c. A Cross-sectional Examination of Socio-Demographic and School-level Correlates of Children's School Travel Mode in Ottawa. 14 BMC Public Health, Canada.
Lee, I.M., Shiroma, E.J., Lobelo, F., et al., 2012. Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy. Lancet 380 (9838), 219–229.
Lubans, D.R., Boreham, C.A., Kelly, P., Foster, C.E., 2011. The relationship between active travel to school and health-related fitness in children and adolescents: a

systematic review. Int. J. Behav. Nutr. Phys. Act. 8 (5).
Lubans, D.R., Morgan, P.J., Cliff, D.P., Barnett, L.M., Okely, A.D., 2010. Fundamental motor skills in children and adolescents: review of associated health benefits. Sport. Med. 40 (12), 1019–1035.
Mackett, R., Brown, B., Gong, Y., 2007. Children's independent movement in the local environment. Built Environ. 33, 454–468.
Mikkelsen, M.R., Christensen, P., 2009. Is children's independent mobility really independent? A study of children's mobility combining ethnography and GPS/mobile phone technologies. Mobilities 4 (1), 37–58.
Mitra, R., Faulkner, G., 2012. There's no such thing as bad weather, just the wrong clothing: climate, weather and active school transportation in Toronto. 103. Can J Public Health, Canada, pp. S35–S41.
Oliver, M., Mavoa, S., Badland, H.M., Carroll, P.A., Asiasiga, L., Tavae, N., Witten, K., 2014. What constitutes a 'trip'? Examining child journey attributes using GPS and self-report. Child. Geogr. 12 (2), 249–256.
Page, A.S., Cooper, A.R., Griew, P., 2009. Independent mobility in relation to weekday and weekend physical activity in children aged 10-11 years: the PEACH project. Int. J. Behav. Nutr. Phys. Act. 6 (2).
Page, A.S., Cooper, A.R., Griew, P., Jago, R., 2010. Independent mobility, perceptions of the built environment, and children's participation in play, active travel and structured exercise and sport: the PEACH project. Int. J. Behav. Nutr. Phys. Act. 7 (17).
Philippaerts, R.M., Matton, L., Wijndaele, K., Balduck, A.-L., de Bourdeaudhuij, I., Lefevre, J., 2006. Validity of a physical activity computer questionnaire in 12- to 18-year-old boys and girls. Int. J. Sport. Med. 27, 131–136.
Prezza, M., Alparone, F.R., Renzi, D., Pietrobono, A., 2009. Social participation and independent mobility in children: the effects of two implementations of "We go to school alone". J. Prev. Interv. Community. 38 (1), 8–25.
Robertson-Wilson, J.E., Leatherdale, S.T., Wong, S.L., 2008. Social-ecological correlates of active commuting to school among high school students. J. Adolesc. Health. 42 (5), 486–495.
Rodriguez, D.A., Cho, G.-H., Elder, J.P., et al., 2012. Identifying walking trips from GPS and accelerometer data in adolescent females. J. Phys. Act. Health. 9, 421–431.
Schoeppe, S., Duncan, M.J., Badland, H., Oliver, M., Curtis, C., 2013. Associations of children's independent mobility and active travel with physical activity, sedentary behaviour and weight status: a systematic review. J Sci Med Sport. 16 (4), 312–319.
Shaw, B., Bicket, M., Elliot, B., Fagan-Watson, B., Mocca, E., Hillman, M., 2015. Children's Independent Mobility: an International Comparison and Recommendations for Action. Policy Studies Institute, London.
Shaw, B., Watson, B., Frauendienst, B., Redecker, A., Jones, T., Hillman, M., 2013. Children's Independent Mobility: A Comparative Study in England and Germany (1971–2010). Policy Studies Institute, London.
Shephard, R.J., 2003. Limits to the measurement of habitual physical activity by questionnaires. Br. J. Sport. Med. 37, 197–206.
Spilsbury, J.C., 2005. 'We don't really get to go out in the front yard' – children's home range and neighborhood violence. Child. Geogr. 3 (1), 79–99.
Statistics Canada, 2012. Focus on Geography Series, 2011 Census. Statistics Canada, Ottawa, ON. 〈http://www12.statcan.gc.ca/census-recensement/2011/as-sa/fogs-spg/Facts-cma-eng.cfm?LANG=Eng&GK=CMA&GC=505〉(accessed 08.06.16).
Stone, M.R., Faulkner, G.E.J., Mitra, R., Buliung, R.N., 2014. The freedom to explore: examining the influence of independent mobility on weekday, weekend and after-school physical activity behaviour in children living in urban and inner-suburban neighbourhoods of varying socio-economic status. Int. J. Behav. Nutr. Phys. Act. 11 (5).
Tetali, S., Edwards, P., Murthy, G.V.S., Roberts, I., 2015. Development and validation of a self-administered questionnaire to estimate the distance and mode of children's travel to school in urban India. BMC Med. Res. Methodol. 15, 92.
van Vliet, W., 1983. Exploring the fourth environment: an examination of the home range of city and suburban teenagers. Env. Behav. 15 (5), 567–588.
Villanueva, K., Giles-Corti, B., Bulsara, M., et al., 2012. How far do children travel from their homes? Exploring children's activity spaces in their neighborhood. Health Place. 18 (2), 263–273.
Wong, B.Y.M., Faulkner, G., Buliung, R.N., 2011. GIS measured environmental correlates of active school transport: a systematic review of 14 studies. Int. J. Behav. Nutr. Phys. Act. 8 (39).
Zou, G.Y., 2012. Sample size formulas for estimating intraclass correlation coefficients with precision and assurance. Stat. Med. 31, 3972–3981.