CHILD PEDESTRIAN TRAFFIC EXPOSURE AND ROAD ATTITUDES
A comparative study in France, USA and Northern Ireland

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Abstract:
This paper describes the results of a comparative study of school children in France, the south states of the United States: Louisiana, Mississippi, and Tennessee, and Northern Ireland. It aims to seek causal explanations for the differences in child pedestrian casualties with regard to child pedestrian traffic exposure and road attitudes. This study is based on questionnaires. Those surveyed are primary school children (5 to 11 years old) and their parents and secondary school children (12 to 15 years old).
The findings of this study show different patterns in the exposure of children to traffic in the three countries. Overall French respondents have the highest level of traffic exposure mainly due to their walking activity. Respondents in the Southern States of USA have the lowest level of exposure and Respondents in Northern Ireland are highly exposed to roads for playing activities. Results of respondents' attitudes show that children in Northern Ireland have less safe traffic attitudes. Injury prevention programmes would benefit taking into account children use of the roads other than for walking.

Topic area: Road Safety

Keywords: child pedestrian accidents, traffic exposure, road attitudes

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Introduction:
Accidents involving young people are a major concern (Lawson, 1990). Traffic accidents among children are, according to the WHO (2002), the most serious epidemic problem in the industrialised world. After motor vehicle occupant accidents, pedestrian injury is the second cause of accidental child death (Guyer and Ellers, 1994). Most road safety problems for pedestrians are common to all member states of the European Union (European Transport Safety Council, 1999) and this statement can be extended to most industrialised countries.
France and the USA have poor road safety records with 12.3 and 13.6 road death per 100 000 population in 2002 (ONISR, 2003, NCSA, 2003). While having a lower road death rate (8.9 per 100 000 population in 2002), children face the highest risk to be injured as a pedestrian on Northern Ireland roads than anywhere else in Europe with 2.37 of child pedestrian death rates per million population in 2002 (PSNI, 2003). Concerning child

pedestrian deaths, the USA (1.37 per million population in 2002) and France (0.98 per million population in 2002) compare well.

There is a direct relation between accidents and exposure (Grayson and Howarth, 1982). Risk of being injured is defined as the ratio of the number of accidents to exposure to the hazards. When considering traffic accidents, child pedestrian accidents are related to the exposure of children to road traffic. The more time children spend near roads or the more roads they cross (also called quantity of exposure) the more likely they are to get involved in an accident. Not withstanding this, the type of environment children are exposed to or the quality of exposure is essential when dealing with pedestrian casualties. A large number of studies have reviewed risks associated with the road environment (Lawson, 1990, Rivara, 1990, Assailly, 1993). High level of kerb parking (Agram et Al., 1996), high traffic volume and speed (Roberts, Marchall and Lee-joe, 1995), and lack of pedestrian facilities such as footpaths, pedestrian crossing, crossing patrols and traffic calming (U.S. department of Transportation, 1999) represent a more dangerous environment regarding pedestrian accidents. Moreover, elements of the more general physical environment have an impact on child pedestrian accidents. Backett and Johnston (1959) and Roberts, Norton, and Jackson (1995) reveal a correlation between the lack of playing areas and child pedestrian accidents. Apartment blocks (Mueller et al., 1990) and driveways (Lightstone et al., 2001) have also been recognised as risk factors.

Exposure and behaviour are also related. Hillman et al. (1990) stated that children with reduced mobility in early age (primary school) were less likely to be able to cope with traffic when older (secondary school). Other studies, however suggest that exposure as well as being associated with risk may have a positive connotation (Firth, 1982). Children usually exposed to traffic are more able to cope with the dangers than children less exposed.

The major aim of this investigation is to seek causal explanations for the differences between child pedestrian accidents rates in France, Northern Ireland and the southern States of the USA. Another objective of this study is to identify groups of children that might be at increased risks of pedestrian accidents in relation to their traffic exposure. Factors influencing children's quantity and quality of exposure are studied as well as children's attitudes in terms of traffic exposure. This would help the identification of some risk factors associated with child pedestrian casualties in these countries.

METHOD

Subjects and Survey

The subjects of this study are children between 5 and 15 years old in France, Northern Ireland and the Southern States of USA: Mississippi, Louisiana and Tennessee. The study consists of a questionnaire sent to primary and secondary school children. Originally, the questionnaires were to be completed by the children. After the pilot study, however, primary school children were judged unable to complete the questionnaire accurately. It was then decided that questionnaires would still be sent to primary school and distributed to the children as homework to complete with their parents. This method represented several advantages. Firstly, it provides more accurate responses to the questionnaires. At the same time, it enabled a dialogue between parents and their children on road safety. Finally, this approach helps some parents to become more aware of their children's activities. Consequently, two versions of the same questionnaires were designed. These questionnaires, identical in their content, differ in their design and wording; the questionnaire for the older children being more attractive and using less formal language.

Data collection

The study was conducted in four different types of area in France, Northern Ireland and the Southern States of the USA. Those areas were selected in order to represent a big city (more than 300 000 inhabitants), the suburbs of a big city, a town (between 15 000 and 20 000 inhabitants) and a country village (less than 10 000). Quotas based on the density of population were set to ensure the areas chosen in each countries where comparable. Within those areas, one, two, and sometimes even three schools were selected in order to represent the age group from 5 to 15 years old depending on the country and its school system. Questionnaires were sent to the schools to be distributed to 20 children in each grade from 5 to 15 years old. Children from 5 to 11 years old were asked to complete the questionnaires together with their parents as homework. For secondary school children, an authorisation to participate in the study was previously sent to their parents and questionnaires were completed in class.

Data Analysis

When coding the data for the analysis, both maternal and paternal occupations were classified, with the highest level of the two being chosen as the value of the socio-economic group variable for the child. If neither of the parents had undertaken paid employment, the child was classified as "other" and included with the lowest socio-economic group. The chi-square test was used to test whether association between variables existed. Person correlation coefficients and 95% confidence intervals were calculated. When an association was found, the effects of other variables were controlled with a partial correlation analysis using the Statistical Package for the Social Sciences (SPSS).

RESULTS AND DISCUSSION

991 questionnaires were collected giving and response rate of 38%. The response rate was much higher amongst secondary school (12 to 15 years old) children with 56% of respondents in their age group compared to 27% of children in primary school (5 to 11 years old). The Table 2 represents the characteristics of the respondents.

Table 2: Characteristics of the respondents.

Variable	Value	Number of respondents	%
Gender			
	Male	473	48%
	Female	518	52%
Age			
	5 – 11	452	46%
	11 –15	539	54%
Country			
	France	365	37%
	Northern Ireland	481	49%
	USA	145	15%
Area			
	Big city	214	22%
	Suburbs	110	11%
	Town	282	28%
	Village	385	39%

Traffic exposure

Respondents have higher traffic exposure for their playing activity than when walking to or from school or walking somewhere. 72% of respondents admitted to always or often (at least 3 days a week) playing near roads when only 35% would walk to or from school and 43% would walk somewhere (Figure 1). They also spent significantly more time near roads playing than walking ($r=0.44$, $p<.001$).

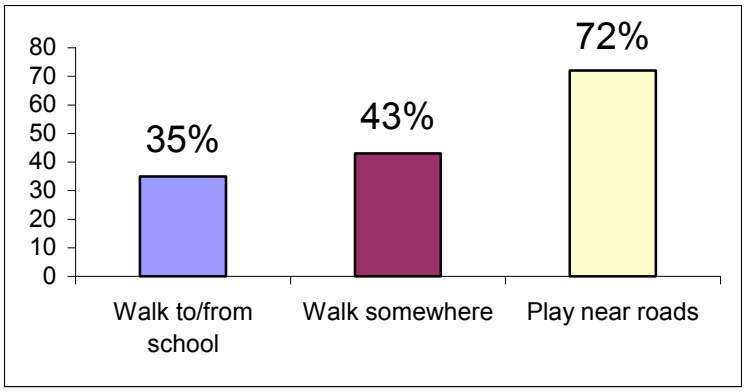

Figure 1: Traffic exposure and children's activity

Compare to the weekdays during the school term, respondents spent significantly more time near roads ($r= .55$, $p< .001$) and have a higher crossing activity during the holidays ($r= .66$, $p< .001$) despite the fact that they are not walking to or from school anymore (Table 2). They admitted walking more often, playing near roads more often. Overall, respondents are more exposed to traffic during the holidays.

Table 2: Exposure during school term and holidays.

	Weekdays		Weekends/ Holidays	
	Number of respondents	%	Number of respondents	%
Number of roads				
0-2	376	39%	243	27%
2-10	425	45%	352	39%
More than 10	155	16%	313	34%
Time spent near roads				
0-10 mins	729	43%	440	25%
10-30 mins	527	31%	510	29%
More than 30 mins	430	26%	834	47%

Whatever their activity, respondents are significantly more often exposed to roads during the spring and summer months than during the winter months (Figure 2). They walk more often to or from school ($r = .80$, $p < .001$) and somewhere ($r = .68$, $p < .001$), or play near roads more often ($r = .52$, $p < .001$).

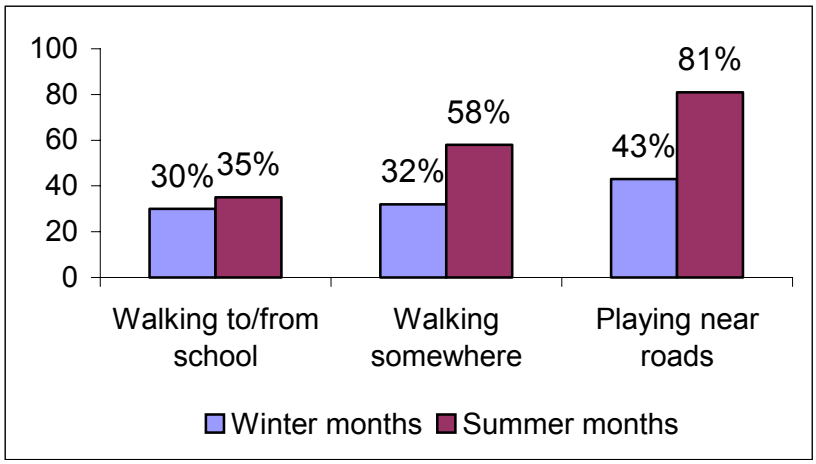

Figure 2: Exposure during winter and summer time

Level of traffic exposure increases with the age of respondents both in terms of time spent near roads and number of roads crossed (Figure 3). When controlling for other variables, the association between age and exposure remain significant for the number of roads crossed ($r = .55$, $p < .001$). 97% of secondary school children (12 to 15 years old) are allowed to cross the road on their own as opposed to 48% of primary school children (5 to 11 years old). This might be an explanation for the significant difference in the number of roads crossed between primary and secondary school children.

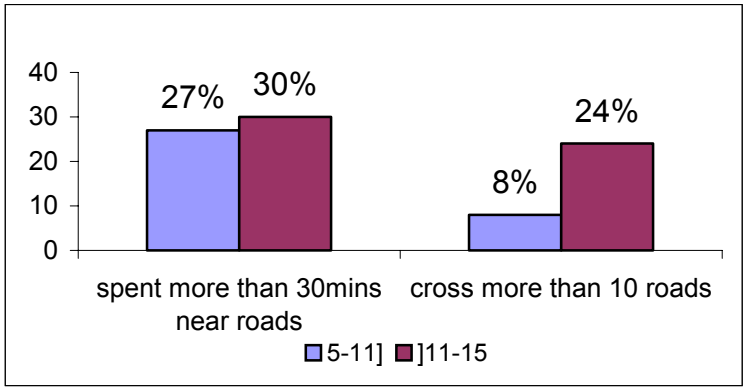

Figure 3: Exposure and age of children

Boys spend more time near roads and cross more roads, than girls (Figure 4). This higher level of exposure for boys might be an explanation for the over-representation of boys in child pedestrian accidents.

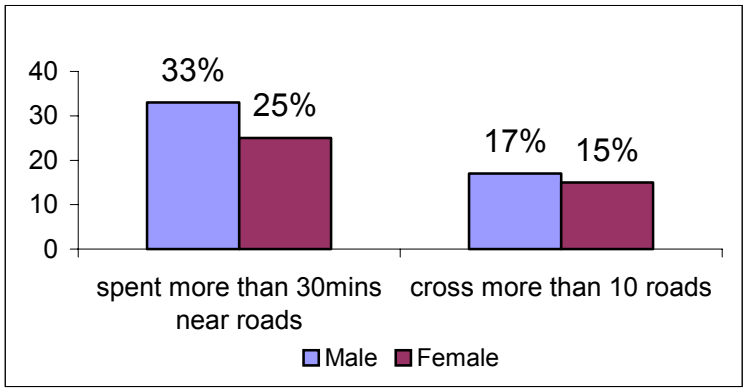

Figure 4: Daily exposure and gender

Not only are males more exposed to roads in terms of quantity but their activity when near roads also differs from females (Figure 5). Male respondents have a significantly higher traffic exposure for playing activities ($r = .13$, $p = .001$). The number of roads crossed is associated with walking to or from school and walking somewhere ($r = .26$, $p < .001$) but not with children's playing activity. Therefore, the increased playing activity of boys explains their higher exposure in terms of time spent near roads and the little difference in terms of number of roads crossed.

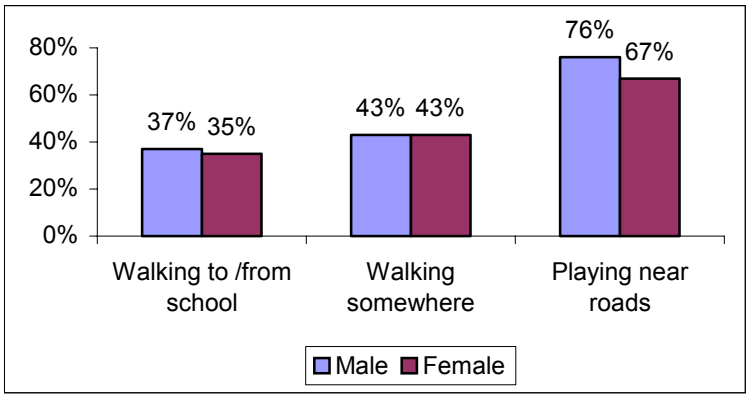

Figure 5: Exposure, activities and gender

Respondents from lower socio-economic groups have a higher level of exposure in terms of road crossed (Figure 6).

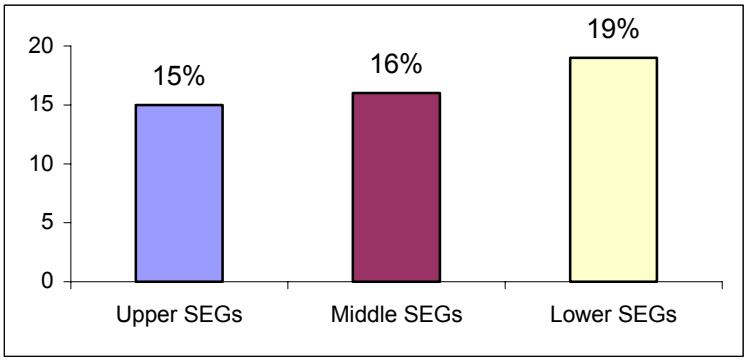

Figure 6: Number of roads crossed and socio-economic groups

Respondents living in bigger cities and in suburban areas spend more time walking and cross more roads than those living in smaller cities, villages and in the countryside.
More respondents walk back from school than walk to school. Higher accident rates have been observed when children are walking back from school than when walking to school (DfT, 2002). Higher level of exposure meaning higher numbers of children on the road might explain this rise in accidents in the afternoon.
Overall, French respondents have higher traffic exposure than children in Northern Ireland and the Southern States of USA. They spent more time near roads (Figure 7) and cross more roads (Figure 8). When controlling for other factors, the association remains significant only for the crossing activity ($r = .13$, $p < .001$).

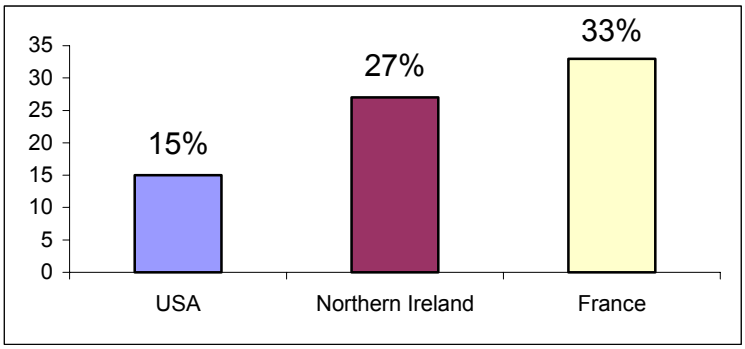

Figure 7: Time spent near roads and countries

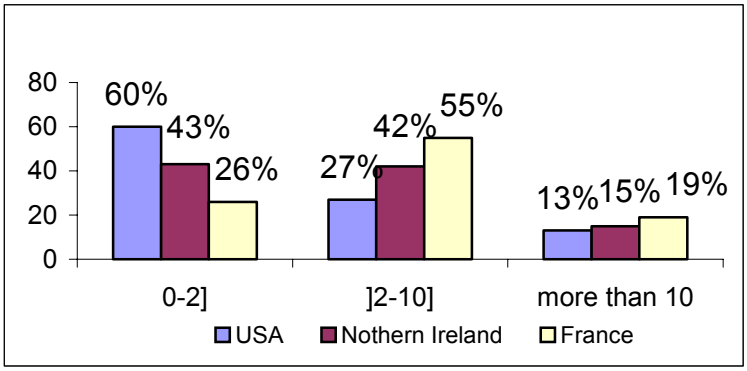

Figure 8: Number of roads crossed and countries

While studying respondent's activity when exposed to roads, differences in exposure patterns can be noticed. French respondents walk more to and from school than in Northern Ireland and much more than in the Southern States of USA. Northern Irish respondents play and walk somewhere (friends, shops, etc…) more than French respondents. In the Southern States of USA, respondent's traffic exposure is mainly due to their playing activity (Figure 9). Respondents that leave school for lunch spend more time on roads and cross more roads during the school term than others ($r = .15$, $p < .001$). Children leaving school for lunch are almost all French. This might be one explanation for higher quantity of exposure overall.

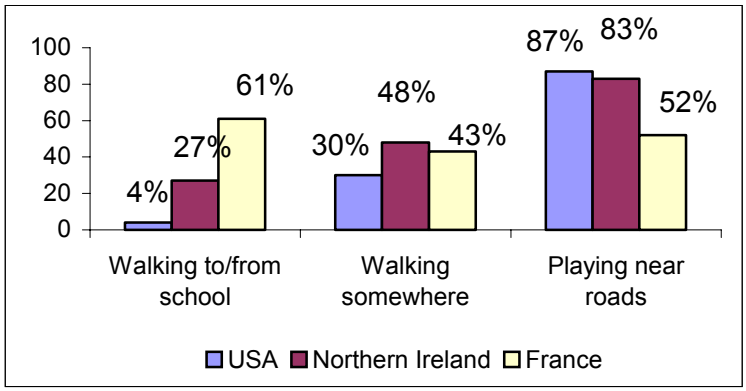

Figure 9: Exposure, activities and countries

Environment

Urban areas (big cities, smaller cities and suburbs) are associated with reduced speed limits, more pedestrian facilities (footpath, traffic lights, traffic calming, pedestrian crossings), but also more parked cars and higher traffic volume. Rural areas or countryside are associated with very few pedestrian facilities and higher speed limits but also with a very low level of parked cars and traffic volume.

Public playing areas with or without fences are common in urban areas and very seldom in a more rural environment.

French respondents are more commonly exposed to housing estates roads, lower speed limits, more traffic lights, more pedestrian crossings and traffic calming but also higher traffic volume, more parked vehicles and less crossing patrols than in Northern Ireland (Table 3). Respondents in the southern States of USA are exposed more to main roads, higher speed, less pedestrian facilities. These findings remain significant after controlled.

Table 3: Roads' characteristics

		USA		Northern Ireland		France	
		N	%	N	%	N	%
Type of roads							
	Main roads	71	53%	153	34%	87	25%
	Local roads	55	41%	195	44%	107	30%
	Housing estate roads	4	3%	71	16%	131	37%
	Cul-de-sac	3	3%	28	6%	29	8%
Speed limits							
	50 mph or over	45	36%	91	24%	30	10%
	Between 30 and 50 mph	56	45%	182	48%	79	27%
	Less than 30 mph	24	19%	105	28%	188	63%
Traffic							
	Vehicles pass occasionally	21	19%	57	17%	41	14%
	1 or 2 vehicles in sight	31	28%	103	30%	79	27%
	Vehicles pass all the time	59	53%	184	53%	171	59%
Footpath							
	Yes	33	29%	228	68%	229	77%
	No	81	71%	107	32%	67	23%
Parked vehicles							
	Yes	63	61%	204	64%	245	85%
	No	41	39%	116	36%	43	15%
Traffic light							
	Yes	29	22%	110	27%	140	42%
	No	102	78%	297	73%	195	58%
Island Refuge							
	Yes	8	6%	92	23%	73	22%
	No	122	94%	315	77%	262	78%
Someone to help to cross							
	Yes	12	9%	89	22%	55	17%
	No	119	91%	319	78%	278	84%
Pedestrian crossing							
	Yes	18	14%	89	22%	213	64%
	No	113	86%	318	78%	122	36%
Traffic calming							
	Yes	23	18%	73	18%	120	36%
	No	106	82%	334	82%	214	64%

There are fewer apartment blocks in Northern Ireland, and less driveways in the Southern States of USA (Table 4). The housing environment in France is associated with some dangerous features such as apartment blocks and driveways (r= .14, p< .01).

Table 4: Housings' characteristics

	USA		Northern Ireland		France	
	N	%	N	%	N	%
Buildings						
Apartment blocks	68	51%	91	22%	223	62%
Houses	65	49%	322	78%	136	38%
Driveway						
Without a driveway	35	45%	45	13%	19	9%
With a driveway	53	75%	299	87%	203	91%
Playing areas						
Public playing areas (PPA) with fences	26	19%	197	38%	182	49%
PPA without fences	35	25%	70	14%	65	18%
No public playing area	77	56%	246	48%	123	33%

There are very few public playing areas (with or without fences) in the Southern States of the USA and in Northern Ireland compared to France (Table 4).

Traffic attitudes

Generally respondents have safe traffic attitudes (Table 5).

Table 5: Respondents' attitudes to traffic

	USA		Northern Ireland		France		
Always or often :	**N**	**%**	**N**	**%**	**N**	**%**	**Correlation**
Stopping at the kerb before crossing	114	83%	421	90%	329	93%	r= .29 p< .01
Don't look for oncoming vehicle before crossing	21	15%	85	19%	41	12%	r= .06 p< .05
Look one way before crossing	23	17%	61	17%	120	26%	r= .18 p< .01
Crossing between parked cars	56	41%	256	55%	210	59%	r= .08 p< .05
Crossing at pedestrian crossing	64	47%	361	77%	331	93%	r= .18 p< .01
Stopping in the middle of road when crossing	23	16%	128	27%	59	17%	r= .12 p< .01
Walking on the sidewalk	77	57%	432	93%	333	95%	r= .12 p< .01

Girls have safer attitudes than boys concerning stopping at the kerb (r= .11 p< .01) and looking both way for oncoming vehicles before crossing (r= .08 p< .05) (Figure 10).

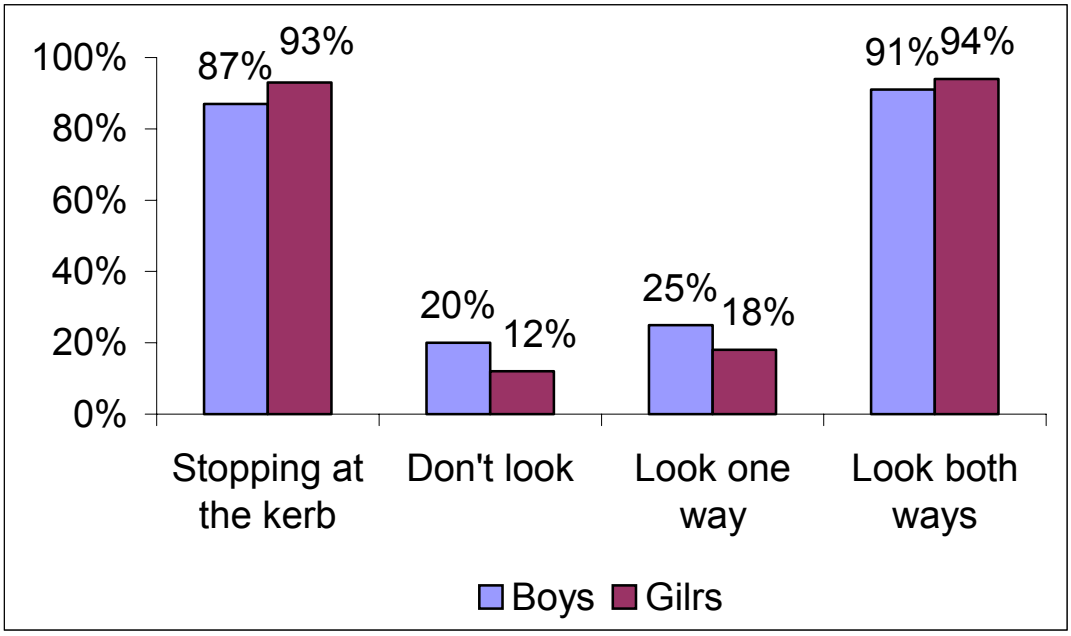

Figure 10: Road crossing attitudes and gender

Respondents from lower socio-economic groups and older respondents have significantly less safe attitudes (Table 6).

Table 6: Attitudes, socio-economic groups and age

Socio-economic groups:	**Upper SEG**		**Lower SEG**		
Always or often :	**N**	**%**	**N**	**%**	**Correlation**
Walking on the sidewalk	381	96%	216	78%	r= .25 p< .01
Stopping at the kerb before crossing	373	93%	246	87%	r= .13 p< .01
Crossing at pedestrian crossing	355	89%	189	78%	r= .25 p< .01
Age:	**5-11**		**11-15**		
Always or often :					
Crossing between parked cars	146	33%	371	72%	r= .41 p< .01
Crossing at pedestrian crossing	372	85%	380	74%	r= .24 p< .01
Stopping at the middle of the road	33	7%	173	33%	r= .38 p< .01

Respondents in France have significantly safer attitudes than in Northern Ireland and the Southern States of USA except for crossing between parked cars (Table 5).
Many more respondents play in the street in Northern Ireland (r= .22, p< .01) (Figure 9).

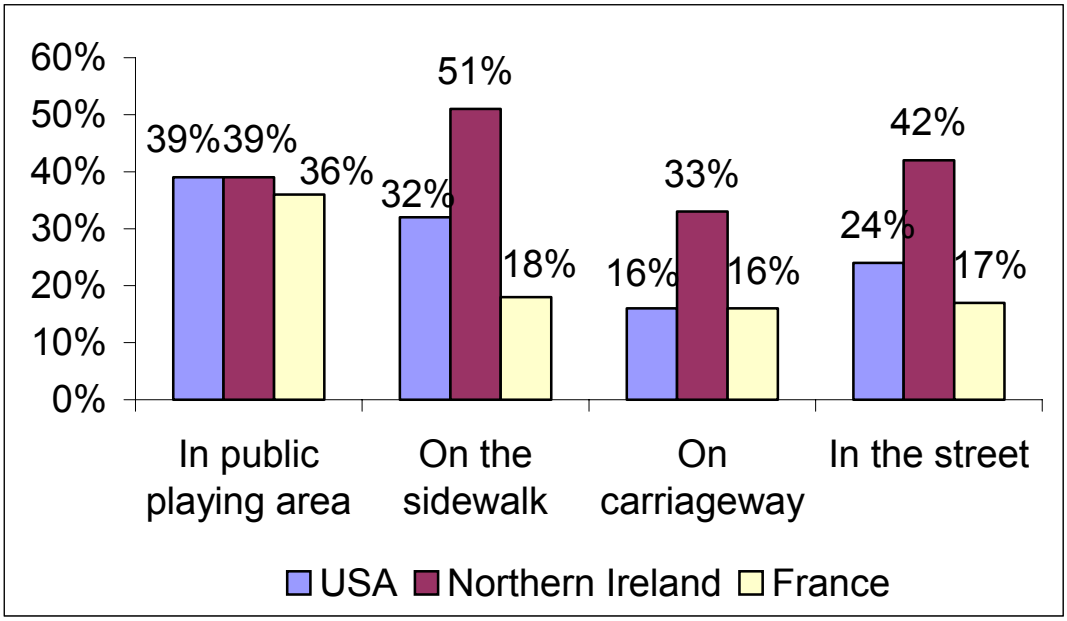

Figure 9: Playing attitudes and countries

CONCLUSION

The general findings of this survey on children's traffic exposure are consistent with previous studies. The traffic exposure of children is not restricted to their walking activity to and from school; many of them use streets as playing areas (Posner et al., 2002). Boys are more exposed especially when playing and children from lower socio-economic groups are more exposed and less accompanied by an adult (Towner et al., 1994, Roberts, Keall et al., 1994). Boys and children from lower socio-economic groups are over-represented in child pedestrian accidents (CAPT, 2001). This might be related to their increased traffic exposure. They spent more time near roads and cross more roads than other children; they encounter more risks to be injured than the others.

Quantity of exposure isn't a plausible explanation for the different child pedestrian accidents rates in France, Northern Ireland, and the Southern States of USA. Respondents in France, which have the lowest child pedestrian death rates, have a higher overall level of traffic exposure. Findings on the quality of exposure are confounding. The road environment has more dangerous features in Northern Ireland and the Southern States of the USA with increased speed and less pedestrian facilities than in France. France, however, has a higher level of kerb parking and a dangerous housing environment with many apartment blocks and driveways. Finally, explanation may be found in playing attitudes of children. There are very few public playing areas in Northern Irelands compare to France. Children commonly play in the street in a dangerous road environment.

The high quantity and poor quality of traffic exposure when children are engaged in playing activity means further research is needed to determine if the pattern of child pedestrian accidents in Northern Ireland is somehow related to their playing activities. Whether or not these accidents happen when the children are playing in the street, measures promoting safer playing activity near roads might have beneficial impact. Such intervention includes the provision of more public playing areas with fences, more traffic calming in residential areas, information campaign aimed at parents to increase adult supervision when their children are playing in the street and road safety education more focus on children playing activity.

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