



# European Road Safety Observatory

Road Safety Thematic Report - Children

This document is part of a series of 20 thematic reports on road safety. The purpose is to give road safety practitioners an overview of the most important research questions and results on the topic in question. The level of detail is intermediate, with more detailed papers or reports suggested for further reading. Each report has a 1-page summary.

The topic “Children” is also addressed in the “Facts and Figures - Children”, presenting more detailed and up-to-date European data in addition to this qualitative analysis.

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## Summary

### Children in road traffic

In Europe, the number of road fatalities among children (defined in this report as persons aged 0-14) has fallen sharply since 2010 and yet, almost 400 children were killed on EU roads in 2020 alone and more than 6000 have been killed over the last ten years. Children are particularly vulnerable road users, which need to be protected (ETSC, 2018). This underlines the importance of the Safe System approach. The Safe System approach is a holistic view on road safety, which integrates the different elements of the traffic system and takes human vulnerability and fallibility into account (European Commission, 2018; SWOV, 2021). Children are still developing the cognitive and physical skills necessary to travel safely in traffic. Because of their small size, children are less visible than other road users and they are less experienced (ETSC, 2022). They can easily become innocent victims in collisions, due to poor infrastructure, inappropriate speed limits or the unsafe traffic behaviour of others such as speeding or drink driving etc. Furthermore, children travel more often as pedestrians or cyclists (vulnerable road users) compared with other age groups and their body shape requires the correct use of specific child restraint systems. Adults, and in particular parents or carers, have a key role in children's participation in traffic. They also make an important contribution to traffic education by teaching children the knowledge and skills they need.

### Countermeasures

The Safe System approach can help to increase the road safety of children. To improve the system all parts of the systems must improve (roads, speeds, vehicles, and behaviour of road users) (European Commission, 2018):

- ensuring that adequate and safe infrastructure is provided for children to walk or cycle safely to and from school, play areas, etc.
- limiting the speed of motorized traffic when vulnerable road users and motorised traffic mix (e.g., 30 km/h in urban areas or school streets, which are closed to most motorized traffic at the beginning or end of school days);
- further development and mandatory equipment of new cars with systems aiming at protecting vulnerable road users (e.g., Intelligent Speed Assistance (ISA), Autonomous Emergency Braking (AEB) with pedestrian and cyclist detection, systems to reduce the blind spot of trucks);
- promoting the (correct) use of protective equipment such as bicycle helmets and child restraint systems;
- education and training of children as well as their parents and carers, to improve safe participation in traffic; awareness-raising of other road users regarding the presence and limitations of children in traffic;
- consistent enforcement of traffic laws and adequate sanctions.

More generally, the responsibility for children's road safety should lie with adults and not with children themselves.

# 1 Highlights

- In the EU, the number of 0–14-year-old road fatalities has fallen sharply since 2010, and yet, 386 children were killed in 2020 alone and more than 6000 have been killed over the last ten years.
- Children have a lower risk of dying in traffic than road users in other age categories.
- Children travel more often as pedestrians or cyclists (vulnerable road users) compared with other age groups.
- Children still lack many cognitive and physical skills to navigate safely in traffic.
- The road safety of children is to a very large extent influenced by adults, and more specifically by parents or other carers, drivers of other vehicles and people taking decisions on road infrastructure and safety measures such as appropriate speeds, safe places to crossroads, etc.

## 2 What is the problem?

### 2.1 What is the definition of a child?

In this report a child is defined as a person younger than 15 (0 -14) years. The same age limit is also used in scientific literature. This age covers the development of a person between birth and puberty. From this age on, a person can fulfil a broader role as a road user and thus also participate in traffic more independently and is considered an adolescent (ETSC, 2018). Children do not form a homogenous group. Age differences are related to different levels of physical and cognitive development. Therefore, children's skills as road users and their transport choices differ widely (DaCoTa, 2012).

### 2.2 Extent of the problem

Over the last decade, road safety for children has improved considerably in almost all European countries. And yet, 386 children were killed on the European Union (EU)'s roads in 2020 alone and more than 6000 have been killed over the last ten years (ETSC, 2022).

Children have the lowest road mortality rate<sup>1</sup> compared to other age groups, and over the last decade this mortality rate has also decreased the most compared to all other age groups (European Commission, 2022). In the EU, there were seven child road deaths per million child population on average over the last three years, compared to 53 road deaths per million for the rest of the population (ETSC, 2022, p.17).

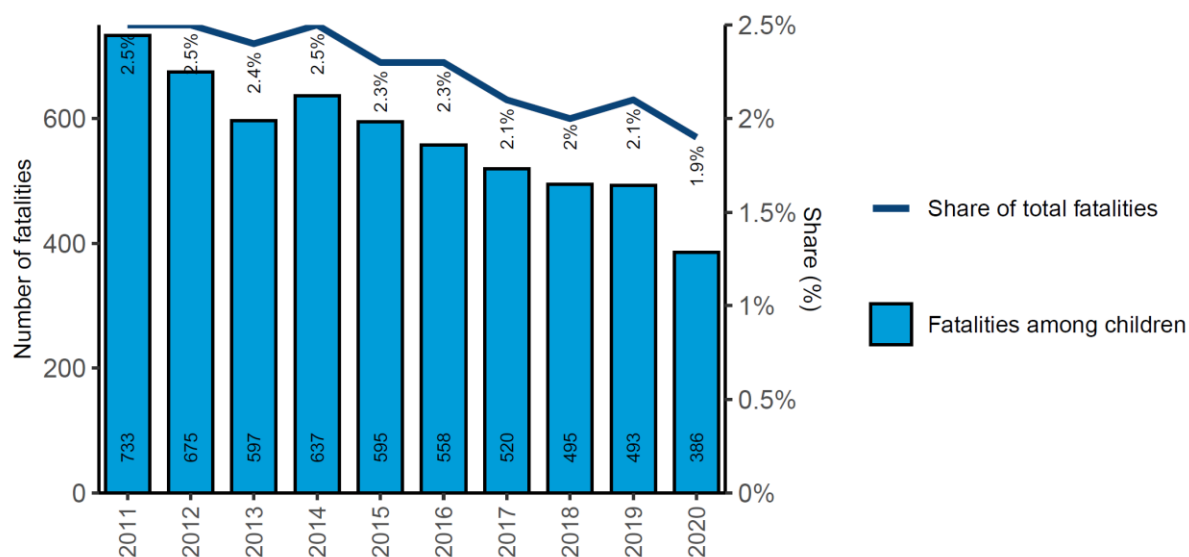
Figure 1 shows the evolution in the number of child road fatalities in the EU between 2011 and 2020. The data is extracted from the CARE database (Community database on

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<sup>1</sup> Number of road fatalities per million inhabitants.

Accidents on the Roads in Europe). The number of road fatalities among children decreased by 47%, from 733 fatalities in 2011 to 386 fatalities in 2020. As the total number of road fatalities was decreasing less rapidly, their relative share decreased slightly from 2.5% to 1.9%. Within the group of children, the largest decrease in fatalities could be observed among the age group of 5-9 year olds (European Commission, 2022).

Figure 1 Evolution of the number and share of road fatalities between 0 and 14 years in the EU27 (2011-2020).



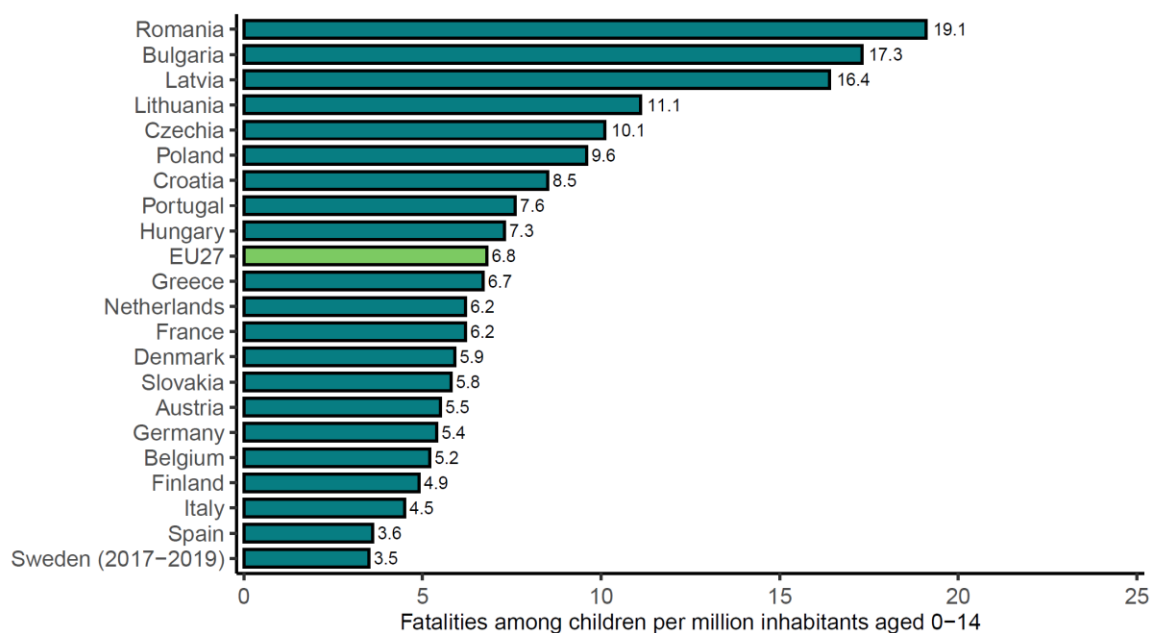
Source: CARE, 2022. Notes: In 2000, mobility was strongly influenced by the COVID-19 pandemic, especially children's mobility due to e.g., home-schooling in many countries. This might partly explain the strong decrease between 2019 and 2020

Unfortunately, children do not benefit from the same level of safety everywhere in Europe.

“Comparison between EU countries gives a different picture depending on the indicator used. According to the mortality indicator (fatalities per million population) the countries in the east of the EU had the worst performance. Most of these countries had a better ranking when using the proportion of children killed within the total number of road fatalities as the indicator. This means that the high road mortality for children in those countries is linked to the high mortality for all road users, regardless of their age. Nevertheless, there were also countries that score above average on both indicators, such as Latvia, Romania and Bulgaria” (European Commission, 2022, p.5)

Figure 2 shows the number of road fatalities per country in the European Union among children aged 0 - 14 years per million inhabitants in this age group (child road mortality rate). The European average (EU27) for the child road mortality rate is 6.8. It is higher in Eastern Europe: the child mortality rate is highest in Romania, Bulgaria and Latvia. Sweden (3.5), Spain (3.6) and Italy (4.5) have the lowest child mortality rate (European Commission, 2022).

Figure 2 Road fatalities among children per million inhabitants aged 0-14 per country in the EU27 (2018-2020).



Source: CARE, 2022. Notes: Ireland and Malta are not included in the Figure because of missing data in the time series 2018–2020; Cyprus, Estonia, Luxembourg and Slovenia are not included in the Figure because of small numbers.

For more details on the extent of the problem, see ERSO publication Facts and Figures - Children (European Commission, 2022).

## 2.3 How do children participate in traffic?

The choice of transport mode for a child is strongly defined by the parent and other carers. In most countries, the main transport modes children are using are: 'being a passenger in a car', cycle, walk or public transport. Children travel more often as pedestrians or cyclists (vulnerable road users) compared with other age groups (European Commission, 2021). In addition, children use public roads not only for travel, but also as a place to play (OECD, 2004). Unfortunately, no comparable data is available on the mobility (exposure) of children in the EU, which makes it impossible to calculate relative risk across the EU (which is the number of deaths and injuries per km or time spent). Nor is it possible to assess whether changes in transport modes might be the underlying factor in the decrease in fatalities among children. "It is easy to achieve low numbers of child deaths when no one rides a bike or walks to school" (ETSC, 2022, p.7). Data from a Belgian study on the mobility behaviour of children (6-14 years old) show that most of the trips by children are made by car (46%), followed by bicycle (25%) and as a pedestrian (19%) (Vias institute, 2019). Data from other (European) countries show generally the same pattern: children and older adults walk most, whereas teenagers cycle most (European Commission, 2021; OECD, 2004).



## 3 Children and road safety

### 3.1 Crash and injury risk

The road safety of children is to a very large extent influenced by adults, and more specifically by parents or other carers, drivers of other vehicles and people taking decisions on road infrastructure and safety measures such as appropriate speeds, safe places to crossroads, etc. Children are vulnerable road users which need to be protected (ETSC, 2018) and which underlines the importance of the Safe System approach (European Commission, 2018). Children are still developing the cognitive and physical skills necessary to travel safely in traffic. Because of their small size, children are less visible than other road users and they are less experienced (ETSC, 2022). They can easily become innocent victims in collisions, due to poor infrastructure, inappropriate speed limits or the unsafe traffic behaviour of others such as speeding or drink driving etc.. Furthermore, children travel more often as pedestrians or cyclists (vulnerable road users) compared with other age groups (European Commission, 2021) and their body shape requires the correct use of specific child restraint systems (Schoeters & Lequeux, 2018). In general, children have a lower risk of dying in traffic than road users in other age categories (Pelssers, 2020). Pelssers calculated the risk in Belgium of becoming a fatal victim of a traffic accident according to age and travel mode: per kilometre travelled, the risk of a deadly traffic crash is higher for pedestrians and cyclists than for a car occupant, both for children and for other age categories. The lowest risk is for children travelling as a car passenger or by bus.

### 3.2 Characteristics of crashes and victims

Road fatalities among children differ from all fatalities combined in the following respects (European Commission, 2022):

**Gender.** Among children, more boys than girls die in traffic crashes, but at 61%, the proportion of young boys dying on the road is slightly lower compared to all fatalities (78% male).

**Transport mode.** In general, children travel more often as pedestrians or cyclists compared with other age groups (European Commission, 2021). Compared with all age groups, children are more likely to be killed as pedestrians (32% of all fatalities among children, 20% for all age groups) and as cyclists (13% of all fatalities among children, 9% for all age groups). In some EU countries the proportions of children killed as pedestrians and cyclists are much higher: e.g., in Romania and Greece, more than half of child fatalities are pedestrians; in the Netherlands almost half child fatalities are cyclists. These differences reflect, to a large extent, the mobility behaviour of children although, for example, other factors also play a role such as the safety of the infrastructure. EU-wide, almost half of the fatalities among children are car occupants (46%).

**Time of the crash.** Compared with all road fatalities, fatalities among children occur more often during daytime, with a peak between 12pm and 8pm, both during the working week and at the weekend.

**Location.** In comparison with all road fatalities, children have proportionally more fatalities on urban roads (46% compared to 38%) and proportionally less fatalities on rural roads (45% compared to 54%). Among children, there are relatively more fatalities at junctions (18% versus 13%).

### 3.3 Children's development process

In order to understand the specific vulnerability of children in traffic, it is important to understand the development process of children's skills to participate in traffic (Schoeters, 2018). These skills are determined by their cognitive, sensory and physical development. Children's skills are often related to their age.

#### 3.3.1 Cognitive development

Taking part in traffic independently (e.g., as a pedestrian or cyclist) requires various cognitive skills. One has to understand the traffic rules, recognise risky situations and decide which actions are necessary to remain safe (DaCoTa, 2012). Key skills for safe traffic participation are: concentration, risk perception, and the ability to process a large amount of information in a short time.

The development of children's cognitive skills is not only dependent on their age. The extent to which children are given the opportunity to move about freely on public roads also plays an important role in this development (DaCoTa, 2012). Nevertheless, a classification by age can be informative. The developmental psychologist Piaget established a classification in which four levels of cognitive development are distinguished (Neuman-Opitz, 2008 in DaCoTa, 2012):

1. **Sensorimotor phase (0 to ±2 years):** focus is on developing the coordination of consciousness and movement; great risk, even in relatively safe places; they feel attracted to moving objects (e.g., vehicles); object permanence is not yet fully developed: a vehicle does not exist if it is not visible to the child.
2. **Pre-operational phase (±2 to ±6 years):** children cannot yet empathize with other road users (e.g., they assume that all road users they see can also see them); very easily distracted and cannot concentrate on both playing and traffic.
3. **Concrete operational phase (±6 to ±12 years).** From the age of 6, children empathise more and more with other road users; tangible concepts (e.g., size of a car or distance to school) are no problem; abstract concepts such as time or speed are still difficult; practicing traffic education is useful (no theory yet); still have great difficulty in assessing complex traffic situations.
4. **Formal operational phase (±12 years and older):** From the age of 12, children can think more and more abstractly; they can perceive, assess and avoid risks, understand the complex traffic situations; traffic education at this age can also be taught in theory.

Children's awareness of "safety" and "danger" develops in three stages (ETSC, 2021, p.165):

1. At the age of 5 to 6 years, children already have an acute awareness of danger. They are able to recognise whether they are currently in danger or in safety.

2. An anticipatory awareness of danger, with which children can anticipate that they might run into danger, develops around the age of eight.
3. Prevention awareness, which allows children to develop and apply preventive behaviour, does not develop until around the age of 9 or 10.

### 3.3.2 Development of the senses

Sight and hearing are two fundamental senses for participating safely in traffic. These senses are not yet fully developed in children. Children's ability to oversee a complete event is limited up to the age of 9 (ZEISS, 2017). Their colour recognition is limited until the age of 5 (Limbourg, 2008 in DaCoTa, 2012) and their depth perception until 8 or 9 (ZEISS, 2017). Therefore, young children are less able to estimate the distance between themselves and another object, especially when both are moving. Hearing is not fully developed until the age of 6, but even then, children still have difficulty determining which direction a sound is coming from. Children also fail to hear certain sounds in traffic when they are distracted (World Health Organization, 2007).

### 3.3.3 Physical development

Physically, children are also going through a major development process. They still need to grow, to further develop their psychomotor skills, and their physique is still very different from that of adults. Their physical limitations make them vulnerable road users:

- Their small stature makes them less visible to other road users and also has the consequence that they can perceive less information from the traffic itself (ETSC, 2022; Rijk, 2008; World Health Organization, 2007).
- Their proportionally large head leads to a higher balance point, contributing to a greater risk of head injuries (World Health Organization, 2007).
- Their different body structure compared to adults requires child-specific restraint systems in a car and on a bicycle (Schoeters & Lequeux, 2018).
- Their psychomotor development is still limited and they are still learning to coordinate their perception and movement (Hoekstra & Twisk, 2010).

## 4 Countermeasures

Children are vulnerable road users which need to be protected (ETSC, 2018). The Safe System approach aims at increasing the road safety. It helps to protect children as it puts the focus on human vulnerability and fallibility and aims at improving all layers of a protective system (European Commission, 2018). To improve the system all parts of the systems must improve (roads, speeds, vehicles, protective equipment, and behaviour of road users) (European Commission, 2018), this includes: safer and forgiving road infrastructure, safer speeds, safer vehicle technology, the use of protective equipment such as bicycle helmets and child restraint systems, consistent enforcement of traffic laws, adequate sanctions, and last but not least education and awareness-raising campaigns to promote children's road safety. General outlines of these countermeasures are given

below, but for more detail on current policy recommendations at national and EU levels see the Pin Flash 43 report of ETSC (2022).

## 4.1 Road infrastructure & speed limits

Within the Safe System approach the authorities are responsible for organizing mobility in a way that i.e., vulnerable road users are protected. Children relatively often travel as vulnerable road users (i.e., as a pedestrian or cyclist). Therefore, a road infrastructure that promotes the safety of pedestrians and cyclists is very important.

Where vulnerable road users and motorised traffic mix, it is important to limit the speed of motorised traffic. ETSC (2022) recommends 30 km/h zones in areas with large numbers of pedestrians and cyclists and near childcare facilities.

Additional measures are for example, the implementation of so-called 'school streets' or 'bike streets'. In 'school streets' the authorities can close the area around school gates to most motorised traffic at the beginning and end of the school day. The 'school streets' are either closed completely for most motorised traffic or the drivers are not allowed to drive faster than on the walking pace. They need to keep the road free for pedestrians and cyclists, give them the right of way and, if necessary, they must stop. The regulations related to 'bike streets' are similar to what was just described but are not limited to school areas or school times. Another measure, which could improve children's road safety is the ban of trucks in inner cities and in particular in school areas at the beginning and end of a school day (between 7:00-9:00 and 15:00-17:00). All these measures need to be combined with public sensibilisation, consistent enforcement and adequate sanctions (Vias institute, 2022).

## 4.2 Vehicle technology

Vehicle safety equipment can help protect driver, passengers, and other vulnerable road users on the road. These systems can focus on speed limitation, collision avoidance, and reducing the severity of collisions.

Examples are:

- Intelligent Speed Assistance (ISA), which helps the driver to keep within the speed limits
- Autonomous Emergency Braking (AEB) with pedestrian and cyclist detection
- systems that reduce the blind spot of trucks.

Many types of vehicle technology are or will become mandatory for passenger cars in the EU. On 6 July 2022 a range of safety systems became mandatory for all new models, including ISA (Intelligent Speed Assist), Lane Keeping Assist, distraction and fatigue detection, and vulnerable road user detection (European Commission, 2019)<sup>2</sup>. From 7 July

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<sup>2</sup> Regulation (EU) 2019/2144 of the European Parliament and of the Council of 27 November 2019 on type-approval requirements for motor vehicles and their trailers, and systems, components and separate technical units intended for such vehicles, as regards their general safety and the protection of vehicle occupants and vulnerable road users.

2024 these safety systems also become mandatory for all new vehicles with existing type approvals.

When children do not travel as independent road users, but as passengers in a passenger car, various types of equipment can also improve their safety. Several studies (Kühn et al., 2019; Roynard & Lesire, 2012; Schoeters & Lequeux, 2018) point out the positive effect of an Isofix system on the correct installation of child restraint systems. Isofix is a system attaching child restraint systems without having to use the seatbelt. The seat is clicked directly into the anchorage holes of the car with anchorage hooks. Since 1 November 2012, Isofix is compulsory on the outer rear seats for type approval of cars (Regulation (EC) No 661/2009)<sup>3</sup>.

## 4.3 Protective equipment

### 4.3.1 Bicycle helmet

When children travel as cyclists, a bicycle helmet can protect them from injuries to the head and brain. In the event of a fall from the bicycle, a bicycle helmet absorbs the impact force on the head by means of an energy-absorbing foam layer (SWOV, 2019b). The hard outer shell distributes the impact of the fall over a larger area and prevents sharp objects from penetrating. The smooth exterior allows the helmet to glide on the ground with little resistance, thus preventing neck injuries. There is widespread scientific consensus about the effectiveness of a bicycle helmet in protecting the head. Wearing a bicycle helmet can be encouraged by campaigns or by making it compulsory. Twelve EU countries have already made it compulsory for children to wear a helmet, including France (under-12s), Austria (under-12s) and Sweden (under-15s) (ETSC, 2020a).

### 4.3.2 Correct use of child restraint systems

The safety of children as car passengers can be increased when the proper use of child restraints improves. As mentioned earlier, both the non-use of child restraint systems and the incorrect installation and use of a seat increase a child's risk of serious injury in a crash. Better use of child restraints can be achieved through education and awareness, legislation and enforcement, and user-friendly technology (Schoeters & Lequeux, 2018):

- Education and awareness-raising campaigns can inform parents and carers about how to choose a suitable child restraint system and how to install it. Furthermore, they can highlight the importance of (correct) use of child restraints for a child's safety.
- Legislation can impose requirements on manufacturers regarding the user-friendliness of child restraint systems. For example, the use of Isofix, which reduces the chance of incorrect use, is already compulsory on the outer rear seats

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<sup>3</sup> Regulation (EC) No 661/2009 of the European Parliament and of the Council of 13 July 2009 concerning type-approval requirements for the general safety of motor vehicles, their trailers and systems, components and separate technical units intended therefor.

for type approval of cars by Regulation (EC) No 661/2009<sup>4</sup>. Baby seats and child seats with straps that are homologated by the UN R129 standard must always be installed using Isofix.

- Strengthening police checks increases the chance of being caught not using or incorrectly using child restraint systems.
- To encourage the use of child restraints, the EU Directive 77/388/ECC categorises child restraints as an essential product to which Member States can apply a reduced VAT rate. This measure makes the purchase of a new child restraint more affordable and can avoid using second-hand seats that may have already been involved in a crash (ETSC, 2018).
- Technical adaptations to child restraint systems can improve their user-friendliness.

#### 4.4 Consistent enforcement and adequate sanctions

Consistent enforcement of traffic laws and adequate sanctions are basic requirements to implement the Safe System approach. All mentioned legal regulations in the chapters above need to be enforced and infractions must be sanctioned. This is about general traffic law infractions (e.g., speed controls, driving under influence of alcohol or drugs, not respecting street signs, driving a car without technical control or insurance, etc.) as well as specific legal regulations related to children's road safety. Those are e.g., the correct use of child restraint systems, the use of lights on a bike in the dark, not using a hand-held mobile phone while cycling, not crossing the streets when a traffic light is red, cycle next to the cycle lane, cross the street next to a pedestrian crossing. Furthermore, police officers play a role in sensitization and traffic education of children.

#### 4.5 Education and awareness-raising

Traffic education includes any form of education aimed at teaching and improving the knowledge, insight, skills and attitudes necessary to participate safely in traffic (SWOV, 2017). Although traffic education can be used for all road users, it plays an important role in the development of children as traffic participants. Both the content and the methods of traffic education are strongly dependent on the age of the children. Providing good quality traffic safety and mobility education is one prerequisite. The LEARN! Key Principles and the LEARN! Manual provides recommendations and examples of good quality traffic education (ETSC, 2020b, 2021).

In addition to formal education, which takes place mainly at school, informal education also plays an important role, including practice, gaining experience in daily traffic, and learning from the behaviour of others. Parents play a vital role in informal education (Hoekstra & Twisk, 2010): they need to be made aware of this and educated how to best fulfil this role (SWOV, 2019a). Thus, the parents themselves are also an important target

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<sup>4</sup> Regulation (EC) No 661/2009 of the European Parliament and of the Council of 13 July 2009 concerning type-approval requirements for the general safety of motor vehicles, their trailers and systems, components and separate technical units intended therefor.

audience for traffic education and awareness-raising campaigns. Furthermore, the influence of peers should be emphasized in this context, especially for teenaged children (e.g., Dodd et al., 2022; Icenogle & Cauffman, 2021).

It is also important to make other road users aware of the presence and limitations of children in traffic. More generally, it is recommended that the responsibility for children's road safety should lie with adults and not with children themselves (ETSC, 2018).

## 4.6 Participatory approach involving children & research

Last but not least, the importance of a participatory approach in developing policy measure is highlighted. Children should be involved in the development of these measures. It is important that children are heard and that their opinions and needs are well understood (bottom-up approach). Initiatives such as the YOURS Academy of the Global Youth Coalition for Road Safety ([claimingourspace.org/yours-academy](http://claimingourspace.org/yours-academy)) are good examples of organizations which give children and teenagers a voice in road safety planning. Furthermore, research and i.e., explorative qualitative studies can help to understand children's perceptions and opinion and can as such support the public debate on this topic.

## 5 Further reading

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