

BMW's approach to maximize the correct usage of child restraints and number of properly restrained children.

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ABSTRACT

Research Question

In today's society automotive manufacturers have always been more than just vehicle designers and builders. Social and environmental responsibility are a fundamental part, especially considering our customers.

With the addition of many new passive and active safety features, traffic fatalities over the last decades have been significantly reduced. It is however important not to forget the basics and ensure restraint systems are used correctly.

Motivated by reports of low usage of child restraints or high misuse rates of these systems despite numerous campaigns of legal and consumer institutions, a private initiative laid the grounding for a promising idea: Instead of trying to convince adults, why not teach children directly to use the restraint systems correctly?

Method and Data Sources

The primary goal of this initiative was to awaken children's natural knowledge appetite in order to better understand the basic physics and possible consequences of vehicle accidents. Over a number of events and in-school workshops, children aged between 6-10 years were educated in vehicle safety as occupants.

Results

With this additional knowledge it was possible to motivate the children to properly use restraint systems, thereby lowering risks in the event of an accident. After gaining this knowledge children were also more likely to function as role model for friends and even parents. To ensure a lasting effect, a booklet and a short film were especially designed for children. This gave children the additional opportunity to digest the knowledge acquired and to encourage a further discussion with their parents.

Discussion and Limitations

As this initiative received very positive feedback it is now about time to reflect and evolve in a broader approach. We hope to present further ways of rolling out this program to a much wider audience.

The vision is ultimately to further reduce the risk of children being injured in vehicles accidents.

Conclusion

With this initiative a fundamental addition supporting path to all the existing campaigns for parents has been found.

INTRODUCTION

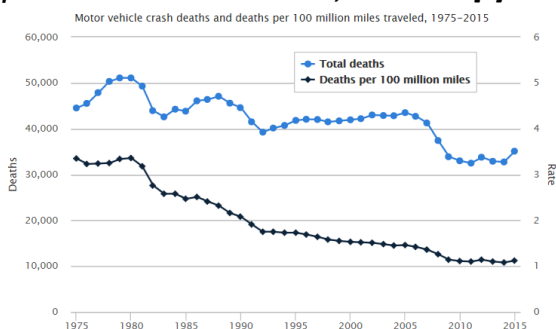
In today's society automotive manufacturers have become more than just vehicle designers and manufacturers. They have evolved to future shaping global companies with the vision to enhance the interaction of individuals, vehicles and services and to develop sustainable mobility concepts. In addition to all these demands, car manufacturers must also be socially and environmentally responsible as it relates to stakeholders especially customers and their families. BMW Group has always taken an active role in reducing future road fatalities, e.g. through the introduction of numerous safety systems. Furthermore, BMW focuses on finding long term solutions which are ideally transferable worldwide and help people to help themselves.

Considering the field of vehicle safety, there have been many major changes in the previous decades: from substantial improvements in passive safety systems to the concept of integrated safety, which combines both passive and active safety systems.

Today's vehicle safety approach not only reduces the risk of injury in the event of an accident, it strives to avoid or mitigate the accident itself or cuts emergency services response time in the case of a serious accident.

The effect of this development is clearly visible in the major reduction of fatalities in the last decades in the U.S. (Figure 1).

Figure 1. Motor vehicle crash deaths and deaths per 100 million miles traveled, 1975-2015 [1]



Regulations and consumer institutes are seeking to improve vehicle safety by covering more and more aspects of road accident scenarios in testing protocols, or by requesting the use of safety features

by the traffic participants, e.g. safety belts, bicycle helmets or child restraints.

The effect of these road safety developments is also visible in the reduction of child motor vehicle traffic fatalities by 45 percent from 1,955 in 2005 to 1,070 in 2014.

Figure 2. Child Motor Vehicle Traffic Fatalities and Child Fatality Rates per 100,000 Child Population, 2005–2014 [2].

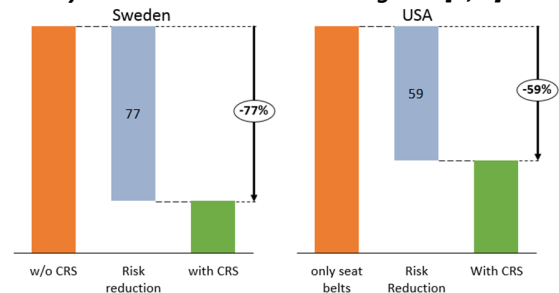


Especially in the case of child safety three main factors have contributed to these decreases:

- The improved safety of vehicles.
- The increasing focus of legislation and consumer test ratings regarding child restraint systems.
- The accompanying education of vehicle occupants to use child restraint systems.

Studies in Sweden, UK and USA have shown that using appropriate child restraint systems is highly effective in reducing the risk of death or injury for child car passengers in a crash (Figure 3). The usage rate of child restraint systems (CRS) has risen in the last decades to reach nearly 94% in the USA.

Figure 3. Estimated risk of injury reduction for 4 to 10 year old children when using CRS [3, 4].



Despite these improvements in vehicle safety, in 2015 663 children < 12 years (71% of the total motor vehicle related deaths of children) were killed in road accidents as occupants [5]. Motor vehicle crashes remain the leading cause of death and

disability for children age 4 years and older in the United States [6].

RESEARCH QUESTIONS

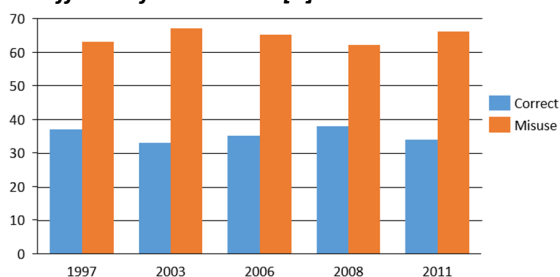
Looking more closely at child motor vehicle accident statistics, one topic catches the eye: the high number of misuse of child restraint systems reported in several studies [7, 8, 9, 12]. It is clear that CRS are only effective if they are properly used.

Misuse in a way that may reduce the safety potential of the child restraint system for the child occupant can be characterized in two categories:

- a) Improper installation of the CRS in the vehicle.
- b) Incorrect restraining of the child in a CRS.

Several studies in recent years have analyzed the rate of misuse of CRS. The European project “Child Advanced Safety Project for European Roads” (CASPER) conducted studies in 3 large cities in Europe (Berlin, Lyon and Naples), which found an average misuse rate of 65% for children in 2011 [7]. Figure 4 shows the average misuse rate observed in European cities in the years 1997-2011. Similar findings are indicated in studies and surveys from UK and USA. In general, it can be concluded that approx. 50% of child vehicle occupants are not properly restrained.

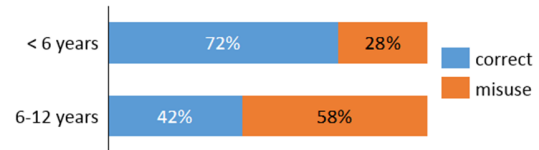
Figure 4. Comparison of misuse rate area based on different field studies [8].



This figure indicates very high potential to decrease the number of injured children by increasing the rate of properly restrained children.

A field study from 2011 conducted by ADAC [9] shows an age dependency of the rate of misuse for children. Only 28% of the younger age group (<6 years) were not properly restrained, whereas a misuse rate of 48% for 6-12 year old children was observed.

Figure 5. Misuse rate for different age groups [9].



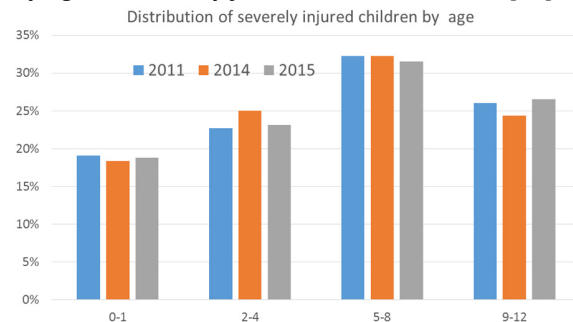
Motivated by these results, an analysis of accident incidences in Germany [11] was conducted. For older children an unchanged higher risk of getting severely injured in an accident was found for the years 2011, 2014 and 2015 (Figure 6).

To summarize:

- Increased vehicle safety and the introduction of regulatory requirements stipulating the use of CRS lead to decreasing numbers of fatalities and injuries for children.
- Misuse of CRS is high, leading to approx. 50% of children not being properly restrained.
- The misuse rate is higher for older children.
- Risk of being severely injured is higher for children at the age of 5-12 years.

It can be concluded that the higher misuse rate for older children is a primary factor contributing to the risk of this age group to incur severe injuries in traffic accidents as vehicle occupants.

Figure 6. Distribution of severely injured children by age in Germany for 2011, 2014 and 2015 [11].



These findings raise two questions:

- Why is the misuse rate for children between 6-12 years higher than for children under 6 years?
- What measures could be installed to increase the correct use of child restraint systems for this age group?

MISUSE RATE

One possible reason for age-related differences may be found by examining the requirements of regulations and consumer test rating programs (e.g. EuroNCAP, IIHS...), which mainly enforce the use of child seats for infants and toddlers. European vehicle rating programs for example, began addressing the issue of child safety in 2003 by including 18 month and 3 year old children in their protocols. Only recently in 2015/2016 have the protocols been changed to include dummies which represent 6 and 10 year old children. This change was motivated by recent statistics which showed relatively higher risk of injury for 6 to 12 year old children.

Furthermore, educational campaigns on child safety and the correct use of age appropriate CRS play an important role in reducing the misuse rate. These programs are either sponsored by regulatory bodies, consumer institutes or private organizations. Examples of these programs are shown in Figure 7. The majority of educational campaigns are designed for new parents to explain relevant regulations, choice of age appropriate CRS and their correct installation in the vehicle.

Figure 7. Selection of educational programs found by internet query.



Parents are for the first time confronted with buying a CRS with the birth of their first child. At this time the natural protective instinct of the parents is the greatest. Infants and toddlers require and “demand” the protection by their parents more obviously than older children. Children older than 6 years are generally more self-conscious and want to act independently more often. Thus, parents do not watch every step and are accustomed to give more responsibility to this age group. In summary, the reasons for different misuse rates in the two discussed age groups might be found in the concentration of requirements for “more

vulnerable” small children and the orientation of educational campaigns targeted at new parents in combination with the age-dependent treatment of children.

To answer the second question, “which measures might improve this situation?” it is helpful to look at the different types of misuse [10] and some reasoning from parents [13].

Figure 8. Misuse types for booster seats [10]

	CRS non ISOFIX	CRS ISOFIX
Seatbelt over wings of the booster	39	5
Seatbelt under the arm	31	1
Upper seatbelt guide not used	17	0
Seatbelt not used (unrestrained child)	11	1
Backrest not adjusted	8	1
Seatbelt in the back	5	1
Wrong seatbelt buckle used	4	0
Geometrical incompatibility	3	1
Total misuses	156	10
Total children concerned	104	7

The types of misuse shown in figure 8 are found in several studies in Europe and USA. Two groups could be defined:

Group a)

- Misuse including the use of damaged CRS, installation failures (e.g. geometric incompatibility), and use of age-inappropriate seats and incorrect attachment.

Group b)

- Misuse consisting of restraining errors like incorrect belt routing, poorly adjusted seat backs, slack in harness/belt, or the absence of any CRS at all.

Some studies [13] reported on the confidence of the driver or the responsible adult that the seat was installed correctly. The majority responded that they were confident or very confident about the correct use of the CRS. The main reasons given by the drivers to explain the detected misuse were:

- Low attention level to safety (inattention, time pressure, and/or short driving distance).
- The child’s resistance to being restrained.
- Children restraining themselves.
- Problems with the restraint system.

Assuming that parents are aware of the importance of the correct use of restraint systems the majority of the misuse types listed above should be addressed by the existing educational systems. Looking at the high misuse rates in Europe [6] and USA [12] the effect of already existing counter-measures is not noticeable.

When reflecting on the list of misuse types, there might be a better way to tackle at least some causes, if these issues are addressed in a more effective way:

Educate the children (> 5 years) instead of only the adults!

IDEA

Children older than 5 years are well aware of their environment and are beginning to develop self-awareness, which can also be seen in the interaction with their surroundings. They would like to be treated more like a grownup than a child. At the same time this age group still has a natural appetite for knowledge and is eager to understand their environment. Taking this into consideration, the authors believe that this appetite for knowledge should be cultivated and used to explain to the children the physics behind a crash in order to illustrate the necessity and benefit of restraint systems. By approaching the affected population, the types of misuse in group (b) (see figure 8 in previous section) might be mitigated in an effective way.

First approach

Personal experience of the authors shows that if children are confronted with the importance of safety of children in cars (e.g. because of the profession of their parents, or by their teachers in school etc.):

- They are willing to accept the usage of restraints.
- They are proud of being responsible for themselves.
- They want to know more about the background and the possible consequences if restraints were not used in the unlikely event of a crash.
- They want to share their knowledge with their friends.
- They feel responsible for other car occupants and are proud of finding mistakes.

Motivated by these observations a private initiative lead to an educational program with 3rd grade children (Figure 9). The children were taught about vehicle safety in general, the importance of restraint systems and the need to take special care of children as vehicle occupants. Interested and committed parents acted as trainers in the schools.

Figure 9. Contents of the first approach for primary schools.



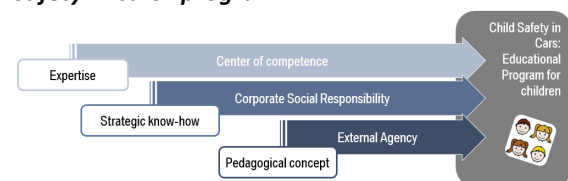
Despite the duration of nearly two class hours, the pupils remained attentive and participated actively in the lessons by sharing their own experiences. The positive feedback from the school teachers as well from the trainers completed the successful first step towards lower misuse rates. After this knowledge was conveyed, it was possible to motivate the children to properly use restraint systems. Additionally, children were also more likely to function as role model for friends and even parents.

Feedback and observed child behavior following the schooling seemed adequate to validate the direct approach concept and deem it worthwhile to follow up on a “professional” level.

Educational program “child safety in cars”

Important feedback gained from the first step was that the core message of the training was not consistently clear enough and to the point. With this feedback and the wish to offer the program on a wider level, the BMW department of Corporate Social Responsibility was approached by the safety experts with their concept. The basic idea was very well received. Together with the communication experts and the support of an external agency specialized in educational programs the “child safety in cars” program was born (Figure 10). The goal was to create a package of supporting media with condensed content which can be communicated internationally on different platforms and in different locations.

Figure 10. Joint actions to create the “child safety in cars” program.



The vision:

Maximize the correct usage of child restraints and number of properly restrained children.

Firstly, a booklet was produced in which the essential physics behind a crash are explained in language and a manner particularly appropriate for children. Readers are made aware of the importance of correct usage of restraint systems. Pupils between 6-10 years are addressed directly with the text and are being taken along with the two protagonists Max (6 years old) and his sister Anna (10 years old) on a drive with their parents.

Figure 11. Booklet "Safety in the car".



An unexpected emergency braking gets the ball rolling and the following questions were answered during the course of the story:

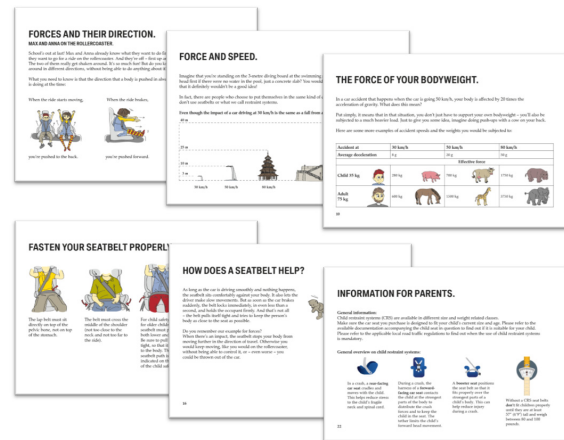
- Why do serious injuries occur even at low speeds?
- Why can't I just hold on when the car brakes?
- What's the right way to fasten a seatbelt?
- Why do we need child seats?

Children learned about the different velocities of pedestrians, bicyclists, trains and even horses. Acting forces and their directions are explained. The interrelation between velocities and forces towards inertial forces are conveyed in a simplified manner.

After the basic physics are explained to the children, they learn about the importance of child restraints and their correct usage.

Throughout the booklet games and experiments motivate the children to interact with their surrounding and include the parents in the process. Finally, important information is given to the parents (Figure 12).

Figure 12. Extract from the Booklet "Safety in the car".



The most effective way to transfer knowledge to children has been found to be direct dialogue. Therefore, as a second step a short workshop (30-minutes) was designed to be held at educational institutions or within the scope of special events. The contents are closely related to the booklet. The concept was to create a lively dialogue between trainer and children. Hands-on exercises or experiments engage the audience as actively as possible.

To ensure a lasting effect and to give the children the additional opportunity to digest the knowledge acquired, the booklet is given to the children to take home with them.

First experiences at event days for children in Munich validated the concept and showed the presentation duration to be suitable for the anticipated target group (Figure 13).

Figure 13. Impressions of workshops held at action days.



Finally, a short (5 minutes) animated film has been produced for use at dealers, action days or other occasions. The film also reflects the contents of the booklet.

All three parts, the booklet, the workshop material and the short movie form the "child safety in cars" bundle.

DISSEMINATION

Remembering the reason to create the described social initiative, it is important to reach as many children as possible, not only in Germany but all over the world.

Considering accident statistics and safety cultures in other countries (Figure 14), it is suggested a communication program as detailed in this paper may well be a very effective way to facilitate a new awareness of vehicle safety in people from childhood onwards.

Figure 14. Road traffic fatality rate for children 19 and under, by country, 2010 [14]



The start has been made in Germany: BMW Group already partners with many educational institutions, e.g. Deutsche Museum Munich (one of the world's oldest museums of science and technology), the Bavarian traffic and safety control and many more. In October 2017, teachers will be schooled as trainers by BMW experts to be able to integrate the "child safety in cars" program in the traffic education for 3rd grade pupils. Workshops will be held during the course of event days for school children. And of course BMW employees as parents will continue to pass along the message to their children and their classmates in schools.

The way to approach other countries depends on the local possibilities: it is in discussion to pilot the intended approach in the USA. The idea is to engage dealers and automotive clubs to organize actions days or go to schools as trainers. Currently BMW is in discussion with the BMW Car Club of America Foundation. BMW North America is already supporting as the main sponsor the "Street Survival Teen Driving Safety Program". Since 2002, this program educates teens across the U.S. to become safer and smarter drivers [15]. Based on this common sense, BMW is aiming to discuss either an extension of this already existing road safety

program or to install a totally new program for younger children.

Additionally consumer test rating institutes and police officers may also show interest to play a role in disseminating the message. Ideally also legal or regulatory bodies could take on responsibility to further awareness.

Currently the bundle is available in German and English with either metric or US units. Further languages (e.g. Spanish, French, Polish and Russian) are planned but depend on the initiative and willingness to pursue the program in the countries in question.

LIMITATIONS

The real influence of this new approach has not yet been validated using studies or data analysis, as the effect will take time to show up in any statistics. But based on common sense and very positive feedback received so far from professionals, trainers and of course children it is expected to offer worthwhile potential.

CONCLUSIONS

In summary, it can be stated that with this initiative, a fundamental supporting path to existing communicative safety campaigns for parents has been initiated. The direct approach to educate children in vehicle safety in this manner may forge a path to a new safety culture worldwide.

REFERENCES

- [1] <http://www.iihs.org/iihs/topics/t/general-statistics/fatalityfacts/overview-of-fatality-facts>, IIHS website.
- [2] FARS 2005-2013 Final File, 2014 ARF; Population – Bureau of the Census
- [3] Jakobssen, 2005,
- [4] Durbin, 2000
- [5] Traffic Safety Facts 2015, DOT HS 812 271
- [6] Centers for Disease Control and Prevention https://www.cdc.gov/motorvehiclesafety/child_passenger_safety/index.html
- [7] P. Lesire et al, ESV 2013
- [8] G. Müller, 2013
- [9] ADAC, 2011
- [10] Roynard et al, 2013
- [11] Statistisches Bundesamt, Kinderunfälle im Straßenverkehr 2011-2015
- [12] Results of the National Child Restraint Use Special Study 2015, DOT HS 812 142
- [13] Roynard et al, 2014
- [14] Safe Roads-Safe Kids Study, Global Road Safety for Children, 2014, <https://www.safekids.org/blog/spotlight-global-road-safety-kids>
- [15] <http://www.bmwccafoundation.org/about/programs/driver-safety-program/>