

Adult's and Children's Attitudes towards Extra Seat Belts in the Rear Seats

Anna-Lisa Osvalder, Katarina Bohman, Ida Hansson

Abstract There is an increased risk of the shoulder belt slipping off in certain crash configurations, resulting in sub-optimal protection. An extra seat belt would improve the restraint system. The objective of this study was to identify children's and adult's attitudes toward extra seat belts added to the three-point belt in the rear seat of a passenger car. Five focus groups were conducted with 11 Swedish children (8-10 years), and 18 adults. Two concepts were studied, the Backpack with an extra belt over the inboard shoulder, and the Criss-Cross with an extra belt across the torso. The results showed that seat belt usage was not questioned. The three-point belt was experienced as very safe, and extra seat belts were considered to further increase safety. Both concepts were accepted, but Criss-Cross was preferred due to greater perceived safety and comfort. Discomfort occurred in both concepts due to chafing at the neck, extra pressure on the upper body, and reduced ability to move. In conclusion, extra seat belts were in line with children's current attitudes toward car safety, while adults were more hesitant. Increased understanding of user attitudes provides input to future restraint system design, resulting in attractive systems with improved restraint function.

Keywords attitudes, focus group, three-point belt, extra seat belt, rear seat, children

I. INTRODUCTION

Seat belts are an important safety feature in today's vehicles. They contribute to saving lives and reduce the risk of injury in a crash [1]. In certain crash configurations, such as far-side impacts [2-3], oblique impacts [4], and in rollovers [5], the ordinary three-point belt may not be enough to provide protection to the occupant. Also, maneuvers may force the occupant into involuntary postures, which may result in the shoulder belt being far out on the shoulder, or slipping off the shoulder, resulting in sub-optimal restraint conditions [6,7]. These postures may affect injury outcome if a crash occurs after the emergency maneuver. Bohman et al. [8] found that steering maneuvers prior to frontal impacts are a contributing factor in crashes resulting in head injuries among restrained children. Steering maneuver studies of child volunteers [8,9] showed inboard motion of varying extent depending on the size of the child, as well as the restraint system used, frequently resulting in a shoulder belt position nearly or completely off the shoulder. Driving studies [10-13] have shown that children also voluntarily choose non-optimal restraint postures in cars, quite different from how anthropometric crash dummies are positioned in crash tests [14].

Children are the most frequent passengers of the rear seat [15]. The head is the most common severely injured body region among children [16-17]. It is therefore essential that the child remains well restrained during a crash, as well as during pre-crash maneuvers if a collision occurs, in order to reduce the risk of injury. Additional restraint solutions can be used to solve the out-of position problem, as well as the shoulder belt slipping off in oblique impacts, far-side impacts, and rollovers. For example, it has been shown that pre-tensioners can reduce lateral inboard motion during evasive steering maneuvers [18]. Bostrom and Håland [3] presented a supplementary two-point belt across the chest, to be used along with the ordinary three-point belt, referred to as a criss-cross belt. They showed that this restraint system reduced the risk of injury in frontal impacts, far-side impacts, and rollovers for the front seat occupant. Rouhana et al. [19-20] introduced a V-shaped four-point harness, showing risk reduction for thorax injuries in frontal crashes. In the Renault Twizy a

Anna-Lisa Osvalder, PhD, is Professor in Human-Machine Systems at Division Design & Human Factors at Chalmers University of Technology, Göteborg, Sweden (anna-lisa.osvalder@chalmers.se, +46 31 772 1000). Katarina Bohman, PhD, is a Senior Research Specialist at Autoliv Research, Vårgårda, Sweden. Ida Hansson, MSc, is an Industrial Design Engineer, formerly employed at Division Design & Human Factors, Chalmers.

supplementary two-point belt has been implemented, described as a backpack solution [21]. The extra seat belt solutions have shown improved restraint effectiveness in far-side impacts in crash tests, as well as decreased chest loading in frontal impacts [22].

Safety, comfort, and attitudes are important aspects to explore when studying children's and adults' use and acceptance of new restraint systems. Osvalder et al. [23] studied the experienced comfort of two new seat belt concepts, criss-cross and backpack, added to the ordinary three-point belt in the rear seat of a passenger car. In the on-road driving study, 32 participants (children, youths, and adults) travelled one hour with each system including city and freeway traffic. Both restraint systems were accepted and provided participants with an increased feeling of safety. The criss-cross was appreciated for its symmetry, comfort and the perceived feeling of safety. Some participants experienced discomfort because the belts tended to slip toward the neck. The backpack offered easy handling and eliminated shafting to the neck, but some participants experienced discomfort due to the asymmetrical belt geometry, while others found this was reduced over time.

The users' attitudes towards a product can be essential for its success. Products without a good reputation and a positive user experience might have difficulties being accepted by the market. To be able to further develop extra seat belts, there is a need for deeper knowledge about attitudes towards the product, and an increased understanding of what the most important aspects are for success. The objective of this study was to identify and analyze adult's and children's initial impressions of extra seat belts in combination with the ordinary three-point belt in the rear seat of a passenger car, and their attitudes toward them.

II. METHODS

A focus group study was conducted for a deeper understanding of different user groups' attitudes and interests towards extra seat belt usage in cars. The following fundamental questions were explored in the study: Would they want a product like this? Would they use it in their car?

Focus groups

As a data collection method, focus groups have been used [24] to explore what people think and feel about seat belts, and how they interact with the systems. Focus groups are often used in empirical studies to collect data from actual use and situations. A focus group is a group discussion, or a group interview, with about 6-10 participants and a trained moderator to lead the discussion. The group holds a discussion during a scheduled time (about 1-3 hours including breaks) about a number of predetermined topics presented and guided by the moderator. These topics may relate to the participants' experiences. Photos, models and actual products can be used as discussion prompts. Focus groups enable getting answers from individuals, and how participants explore their viewpoints while being influenced by other participants' opinions of the information presented by the moderator. The strength of the method lies in the fact that what one person says encourages others to make associations based on their experiences of the chosen topic. A drawback of the method is that certain people may come to dominate the group, thereby possibly affecting the result.

To get a complete picture about attitudes towards extra seat belts, both adults and children were included in the study. Adults were included as parents, decision makers, users, and buyers of the systems. Children were included since they are the main user group of protective systems for the rear seat, and are also the primary user group in need of further protection during maneuvers prior to crash. Also, within some years the children will be the decision makers of their own vehicle. Altogether, five focus groups were created, two with children and three with adults. A total of 29 persons between 8 and 61 years of age participated.

Adult participants

Three focus groups were formed with adult participants: Young childless adults, adults with children up to 12 years, and adults with grown children. The group with children up to 12 years of age included current or recent users of child restraint systems. The division of adult participants into three groups was done to avoid arguments that participants were in different phases of life. Variation in age, gender, and family situation between the participants in each group were disparity enough to create dynamic and stimulating discussions about extra seat belts. The adult participants were taken from the university department pool of citizens who had previously volunteered to be part of product evaluation. The only requirement was a driver's license. The

participants were told that they would be part of a focus group regarding safety in cars. No other information was given. The characteristics of the three adult focus groups were as follows:

Young adults: Seven people between 25-33 years participated, including three men and four women. Their driving habits varied from a few times a month to a couple of times a week.

Adults with one or more children between 0-12 years: Four people between 25-46 years participated, one man and three women. More adults had been recruited, but due to late cancellations the focus group had fewer participants. Their driving habits were several times a week.

Adults with grown up children: Seven people between 47-61 years participated, four men and three women. Their driving habits varied from driving every day to occasionally renting a car.

Child participants

Two focus groups were formed with children, one group with six children (1 boy and 5 girls), and the other group with 5 children (2 boys and 3 girls). The children were aged 8-10 years, went to the same school, and lived in a large city in Sweden. Children of this age were selected due to their ability to reliably express themselves verbally, and that this age group often stops using child restraints because they want to feel grown up. When selecting children for focus groups it is preferable that they know each other, making them feel more relaxed and comfortable in expressing their opinions. Furthermore, the numbers of children in the groups were not to include more than six participants, which encourage the participants to take place and be a part of the discussion [26]. Also, children of this age can have problems waiting for their turn to talk. Fewer participants would also decrease distraction during the session in favor of focusing on the topic. The focus group sessions were also held in a room at a leisure center to let the children be in their normal environment.

The children were recruited from an after-school youth leisure center. A teacher selected children she thought would be comfortable in a focus group discussion. Their parents also gave their informed consent to participate by signing an information letter. Travel routines differed whereby some were driven by their parents daily, some participated in a car pool, and some regularly used public transportation.

Extra seat belt concepts

Two extra seat belt concepts, Criss-Cross (CC) and Backpack (BP), were introduced during the focus group sessions and tested in the rear seat in a Volvo V60 passenger car. The extra seat belts were used together with the ordinary three-point belts. The CC concept is an extra two-point seat belt placed across the user's chest, from the opposite side of the three-point belt. Together with the ordinary three-point belt the extra belt creates a cross-shaped harness on the passenger's chest (Fig. 1). The belt outlet was at shoulder level, with the retractor mounted on the rear of the seat backrest. The extra belt is attached to an extra buckle on the outboard side of the user. The BP concept is an extra two-point seat belt placed on the opposite shoulder of the three-point belt in a similar way a backpack hangs over the shoulders (Fig. 1). The retractor was mounted on the rear of the seat backrest and the belt outlet was located nearly centered in the seat behind the upper part of the back. The lower end had a fixed attachment point behind the passenger's inboard hip, and, therefore, no buckle was needed.

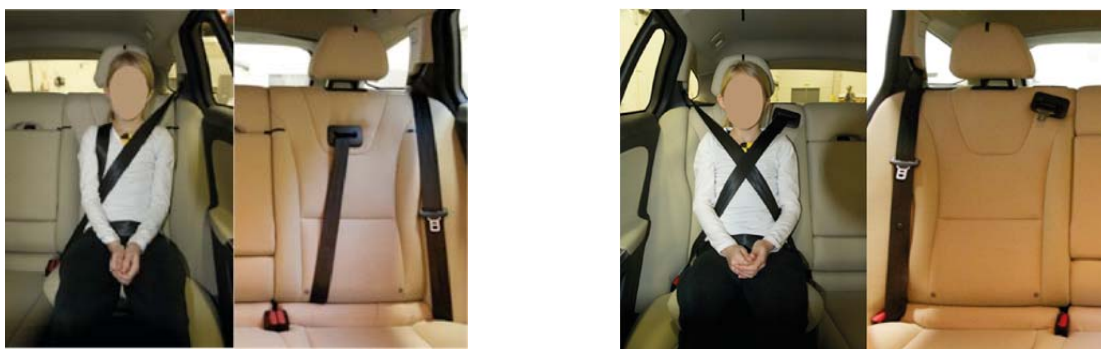


Fig. 1. The two extra seat belt concepts used in the focus group study. To the left, the Back-Pack (BP) and to the right, the Criss-Cross (CC).

Test procedure

The procedure during the focus groups was slightly different between the children and adults in terms of tasks to perform due to differences in knowledge levels, experience and maturity. The strategy was the same; start the discussion in a phase where the participants knew nothing about the product, and successively include more information about the extra seat belt concepts in the discussion. The intention was to explore the attitudes towards extra seat belts, but to also explore how attitudes changed dependent on how much information they had been given. All five sessions were taped and carried out with the same moderator, who was a trained human factors design specialist accustomed with user studies. All written information on the assignments made by the participants was handed in to the moderator. The moderator also wrote on the white-board and took notes during each session. Each focus group session took about two hours and included discussions about; verbal information given by the moderator, images of concepts, testing of real seat belt prototypes, and individual tasks. First the moderator presented herself and gave a short introduction about the procedure and topic of the day. The adult participants gave a short presentation of themselves, while the children made their own nametags, which also revealed their ages.

The first part of the focus group dealt with the ordinary seat belt. The adults were to individually write 3-5 aspects they considered most important with the three-point belt. The assignment was then followed by a discussion about ordinary seat belts. The children were to describe, one by one, about how often they were driven in a car and if and how they used seat belts and child restraints. They also presented what they thought was good and bad about the seat belts of today. Then, the children were given written individual tasks with five pairs of antonyms describing different feelings applicable for seat belts. They were to choose one of the words from each pair of antonyms; nice/ugly, cool/silly, simple/troublesome, good/bad, comfortable/uncomfortable.

In the second part of the focus group discussion, the idea of extra seat belts was introduced using an oral presentation and PowerPoint slides shown on a wide screen. First a brief explanation was made about the concept of an extra seat belt, using inspirational images showing belt systems in a cockpit, a race car, and on roller coasters. The purpose was to awaken thoughts of being even more secured in the car than today, and to introduce a four-point belt solution instead of a three-point. After this introduction the children, but not the adults, were asked to discuss other ideas about how they could be secured in a car. Then images of the two concepts CC and BP were shown to expand the discussion and bring out new thoughts and opinions. In all groups discussions took place concerning whether the participants would consider such an extra seat belt, what information they would appreciate before using them, which functions the extra seat belt had to fulfil, and how the rear seat should look when extra seat belts were installed.

In the third part of the focus group the actual prototypes were shown and tested. Each group went to the car (Fig. 2), the adults to the university laboratory and the children to the parking lot at the schoolyard. All participants buckled up in both concepts for a few minutes to create their own opinions based on their own experiences. Since it is mandatory in Sweden to restrain children shorter than 135 cm (recommended up to 150 cm) on a child restraint system, all children buckled up on an integrated booster cushion.



Fig. 2. To the left, the passenger car at the university laboratory. To the right, a child participant is testing the BP-concept together with the ordinary seat belt in the passenger car at the schoolyard.

The fourth part of the focus group discussion dealt with the extra seat belt concepts. In each group a discussion was held about what the participants liked and disliked regarding the concepts. They also stated which concept they preferred. The children discussed how it felt wearing them, if they would like to have such

seat belts in their family’s car, and if their parents would like to have them as well. They also performed the task with the five antonyms again, this time for extra seat belts. The adults discussed if they would select extra seat belts as an optimal feature when buying a new car, and if they would consider it valuable in a second hand car. They were also asked to list 3-5 aspects they considered important with extra seat belts. Then they were asked to grade a number of adjectives from 1 to 5 regarding how well they matched extra seat belts in their opinion. The adjectives were: comfortable, troublesome, exclusive, necessary, insipid, simple, boring, valuable, silly, uncomfortable, modern, cool, ugly, and cheap. Finally each adult group were to discuss and agree on the three most positive and the three most negative aspects of an extra seat belt.

III. RESULTS

Different types of results were obtained from the focus group discussions: attitudes towards extra seat belts in general and subjective evaluation of the two extra seat belt concepts CC and BP. The results are divided into two parts; first, results from the three focus groups with adults are shown, then the results from the two focus groups with children are presented.

Results adults

In general, the discussions and comments about extra seat belts did not differ much between the three adult groups. Therefore, the results are presented as a compilation of all adult focus groups. There was a slight difference between the groups for some of the questions, often dependent on their relation to children.

The results from the first part of the focus group were related to the ordinary seat belt as it is today. All adults had clear opinions about this product since it is a product that is very commonly used. They could easily talk about its advantages and disadvantages and how they used the product. All adult focus groups agreed that the most important aspects of the ordinary seat belt were; safety, comfort, adjustability in height, ease of use, rolls in and out easily, remaining untwisted, and not causing choking, chafing, or pain.

The second part of the focus group was a discussion of the concept of extra seat belts. The first response was suspicion and questioning. The spontaneous comments about using something that would secure more than the ordinary seat belt were: How much safer would it be? How would it be adjusted to children/adults? The adults’ spontaneous initial reflections are shown in Table 1.

TABLE I
ADULTS’ REFLECTIONS REGARDING EXTRA SEAT BELTS

Good if simple to use.
Good that you can choose to use one or two belts
Could keep sleeping children in place
Distributes pressure better
The user will feel more restrained, like a prisoner
Just a matter of habit

After the two concepts, CC and BP, had been presented in pictures (Fig. 1) the participants could more easily imaging a user situation and draw conclusions about the product. They said that CC looked more serious and safe than BP. It was difficult to understand how BP should be handled and there could be a risk of the arm slipping out. The impression was that the extra seat belts could cause discomfort to the back if they not were used when seated. Also, the interior look of the car was affected negatively. The BP concept especially spoiled the design of the back seat. When the question was asked about what information they needed to be convinced to choose the extra seat belt as an option when buying a car, all participants first stated safety benefits and proof of this, and then comfort issues. The focus group consisting of adults with children asked why it had to be an optional safety device if safety was improved. It should instead be an ordinary feature. The same discussion took place in the group of adults with grown up children: having extra seat belts as optional would question their value and necessity. If the product was commercialized people would not ask for extra information about its value. On the question of whether participants would use the extra seat belts in a car of their own, the majority said they would try it, at least out of curiosity. They felt that is was hard to argue for not using it when a safety feature existed, especially for their children. However, it had to be easy to handle and use. Those

participants who were more hesitant said that they would not always use them, e.g. not on short trips or when travelling at low speeds. They also said they could easily be forgotten because they were hidden behind your back, and they had no routine for using such systems, and that there were limits for how many safety devices could be in a car. A statement from one of the participants was: *'If you want to exaggerate, you should use a helmet in a car! You get to a point where you think there is a risk in everything you do and you cannot protect yourself enough, so it goes to extremes'*

When they discussed what was required of an extra seat belt the following aspects were raised; does it provide greater safety?, easy handling?, problems with clothing (winter jackets)?, irritating material against bare skin?, adjustable to different body sizes?, won't reduce comfort?, feelings of fear when belted?, should be optional, should be regulated by law. Young adults highlighted safety and comfort issues, and that people would get used to the systems eventually, while the adults with older children were more focused on information and safety regulations.

In the third part of the focus group discussion, the adult participants tested the CC and BP concepts in the car (Fig. 2). After testing they were more positive to the extra seat belts and felt they were more comfortable than expected. Nearly all participants preferred the CC to the BP due to increased perceived safety and comfort issues. The overall impression of the BP was that the participants were surprised that it was different and better than it had looked in the pictures. Most participants from all groups experienced that the CC felt proper and symmetrical, but sensed that the belt tended to slip close to the neck and could provoke a strangling feeling. Apart from that a number of reflections about CC emerged (Table II). Regarding the BP concept participants from all groups thought it was a somewhat strange and unfamiliar concept, mainly due to its asymmetry. They experienced how it pressed one of the shoulders backward asymmetrically, and that it felt like the belt would slip off the shoulder. Apart from that a number of reflections about BP emerged (Table III).

TABLE II
ADULTS' REFLECTIONS REGARDING CRISS-CROSS

Positive aspects	Negative aspects
Feels safe with full body restraint	Feels uncomfortable
Feels like the ordinary seat belt but on both shoulders	Feels a bit restrictive
Good pressure distribution	More steps in the handling procedure
	Difficult to turn and reach when handling
	Confusion with shoulder belt for the middle seat

TABLE III
ADULTS' REFLECTIONS REGARDING BACKPACK

Positive aspects	Negative aspects
Feels more comfortable than it looks	Feels insufficiently restraining
Doesn't irritate	Needs no extra buckle
Feels unconstrained	Feels too close to the neck
	Easy for the arm to slip out
	Hard to understand how to manage it
	Complicated if you do not put on the ordinary seat belt first
	Better for children than for adults

When the adults discussed the selection of extra seat belts as an optional feature when buying a new car they were mostly concerned about cost. Answers varied among participants regardless of group. Those participants without children, or who had adult offspring, were hesitant, since they were not the primary users of the system. But in another phase of life they might have been more interested. Other comments concerned dependency on the price of the car and system, and whether there was evidence that using extra seat belts was safer. It was also mentioned that if the price of the product was too low it would make people question its quality. When the participants listed 3-5 aspects they considered important for extra seat belts most of them proposed *safety, comfort, appearance, user friendliness, and mobility*. The adult group with children also highlighted *practicality/not being in the way*. The groups without children or with adult children also highlighted

adjustability, benefits to children, proper pressure distribution, and suiting one's identity. In Table IV the three most positive and negative aspects of extra seat belts are presented for the three adult focus groups. All groups highlighted increased safety as one positive aspect, and the need for additional handling as a negative aspect.

TABLE IV
RESULTS ADULTS: POSITIVE AND NEGATIVE ASPECTS OF EXTRA SEAT BELT

Focus group	Positive aspects	Negative aspects
Focus group without children	Increased safety Increased experienced safety Added value	How much safety does it really add? More difficulty in putting on seat belts Difficult for older adults
Focus group with children between 0-12 years	Increased safety Comfortable (regards CC only) Good selling point for car dealers	Appearance, cluttered design Contribute to varied degrees of safety for different seats in the car Problem with the locking mechanism for the middle seat
Focus group with grown-up children	Increases the total safety of the car, shows a high sense of responsibility Comfortable Modern	Should be installed as standard in the car; should not be optional An additional task in the seat belt procedure

In Figure 3 the results from the final grading assignment is presented, regarding how well adjectives matched extra seat belts related to all adult participants' (18) opinions. The results show, with a wide margin, that *comfortable*, *valuable*, and *modern*, were the most frequently selected words.

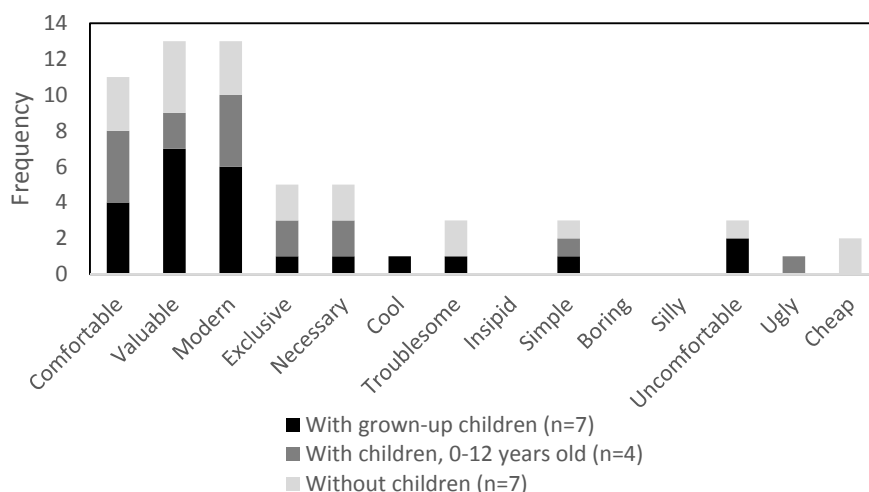


Fig. 3. The most commonly selected words in the word association task for the three focus groups with adults regarding extra seat belts

Results children

The results from the two focus groups with children are presented together since the characteristics (such as age, size, and gender) of the participants did not differ between the groups. The results from the first part of the focus group were related to car travel habits and safety systems used today. A large variety was found among the children. Some liked to travel by car and found it fun, cosy and comfortable, others disliked it and said it was sweaty, uncomfortable, tiresome, and bad for the environment. Some children travelled every day by car while others travelled occasionally in a car pool. Most children travelled in the rear seat on a booster cushion, but a few used the front seat with or without a booster. All children used seat belts. They were highly

convinced that the seat belt should be used, and were also eager to do so. None of them questioned why they had to use it, and were highly aware of its protective effects. They said that their parents were also very consistent regarding their children's use of seat belts. In Table V a summary is shown regarding the children's view of present seat belts. They were not fully satisfied with the system, and discomfort and handling difficulties were especially highlighted. Their proposals for improvement were softer and more elastic material, better height adjustment, and belt attachments over both shoulders. Various colours would be appreciated.

TABLE V
CHILDREN'S REFLECTIONS REGARDING SEAT BELTS OF TODAY

Positive issues	Negative issues
Comfortable to lean on	Chafing on the neck
Protective in a crash	The belt locks and gets stuck
Feeling of safety	Difficulty moving within the belt
	Difficult to buckle up
	Uncomfortable

The results from the third part of the focus group showed that the children were very positive regarding extra seat belts. Increased safety and comfort were the main reasons for this. Most children (9 out of 11) preferred the CC due to a strong feeling of safety, comfort, and appearance. The negative aspect highlighted was difficulty moving. The positive aspects highlighted for the BP concept were also comfort and appearance. Some children stated that it was better than the ordinary seat belt while others did not think it differed from the ordinary seat belt. The negative aspects highlighted for the BP were neck pain, difficulty moving, and a feeling of the extra seat belt slipping off the shoulder. The results from the fourth part of the focus group discussion showed that nearly all children said they would like an extra seat belt in their own cars, and would use it if they did. The main reason for this was safety. Some children thought they might take it off if travelling far, and not use it if in a hurry.

The children also stated that their parents would like the product, since their parents wanted their children to be protected and safe as possible. The majority of the children thought their parents would pay extra for these belts, because it would be safer than just using ordinary seat belts. However, one girl said: *'Yes I think they would pay extra, but only if I agree and say that I will use it'*. In Figure 4 the children's results of the word association assignment of naming antonyms describing feelings applicable to extra seat belts are presented. Nearly all children thought that extra seat belts were cool, simple, good, and comfortable, and eight children thought they looked nice. Compared to the word associations made for the ordinary seat belt (Fig. 5) extra seat belts were perceived as much more positive.

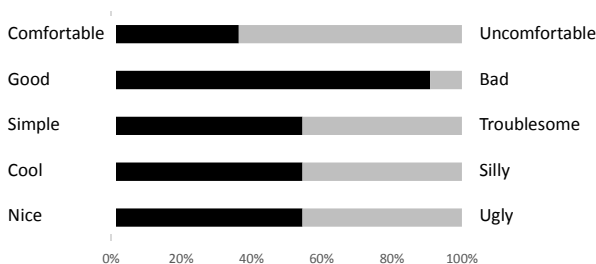


Fig. 4. The results of word association by children, regarding the ordinary seat belt

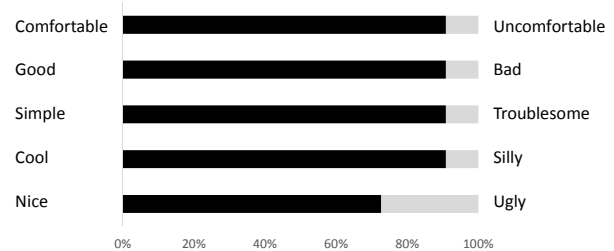


Fig. 5. The results of word association by children, regarding an extra seat belt

IV. DISCUSSION

Seat belts are developed to decrease the risk of injury and fatality. Its protective benefits can be evaluated in crash tests. However, to fulfil its purpose the seat belt has to be accepted and used. Several studies have shown that a common reason behind non-usage of the ordinary seat belt is related to discomfort [27,28]. Other factors influencing the use of seat belts are legislation, enforcement, seat belt reminders, and the user's attitude towards the seat belt [29-33]. In order to reach acceptance from users to add a supplementary belt to the

ordinary seat belt, it is important to understand what motivates or discourages the user's willingness to use such a system, to gain deeper knowledge about how an extra seat belt system should be designed to be attractive, comfortable and easy to use.

The overall results from this study showed that seat belt usage was not questioned at all, and the three-point belt was experienced as very safe, and nearly always used despite it sometimes causing discomfort. Specifically children, but adults too, showed positive attitudes towards extra seat belts. Nearly all participants, due to greater perceived safety, comfort and symmetry, preferred the CC extra belt.

The results also showed that the most important aspects for success for adults were to understand the safety benefits of the system, and to ensure comfort for all users. For children the need of extra seat belts was not questioned at all, in spite of perceived discomfort due to chafing at the neck, extra pressure on the upper body, and reduced ability to move. They were also convinced that their parents wanted them to use extra seat belts to further increase safety. Figures 4 and 5 show that the children had more positive feelings related to the extra seat belt than to the ordinary seat belt. This can be explained by that they only tested CC and BP for a couple of minutes compared to that they have used the ordinary seat belt a couple of years. Their excitement of the test situation and the new idea of extra seat belt might also have affected their attitudes.

The adult participants' attitudes regarding extra seat belts changed during the focus group session. At first, when they had only received verbal information about extra seat belts, they asked many questions and demanded explanations. They were a bit hesitant toward the idea of extra seat belts, and avoided taking a stand on the matter. When they were shown pictures of the two extra seat belt concepts, they expressed themselves more freely. Instead of continuing to ask questions for clarification they created their own opinions. They also seemed to pick out their favourite concept only when studying the pictures. However, they wanted proof that the extra seat belts added extra safety that the ordinary seat belt could not provide. Testing the actual concepts gave the participants a more positive experience of extra seat belts, but also an increased understanding of comfort and handling issues. This shows that only verbal descriptions of new safety products lead to limited understanding and poorer results than when physical concepts are tested in real environments.

The strong safety tradition in Sweden was noticeable among both children and adults included in this study. Also, young adults seemed very safety minded, and like the children, they were more positive to use the extra seat belt for safety reasons. However, the older adults pointed out the need for information and regulations in order to use the extra seat belts. In a study dealing with seating positions of future highly automated cars [37], the test participants were asked about their attitudes regarding extra restraint systems that would allow them to rotate or recline their seats. The results showed that it was obvious to the children that extra restraints were needed. They were almost surprised by the question, while the adults said they would accept it if it was needed.

The rapid technological progress during the last 25 years has made a big impression on children and younger adults, the so-called Millennials born between 1980 to the present [34]. Millennials are the most diverse, educated, socially conscious, and tech-savvy group in the world. This generation will be the most influential, distracted, and finicky demographic when it comes to technology use. In the next ten years 40% of all new vehicles will be sold to them. Therefore it is important to examine this group's needs, demands, attitudes and acceptance of new products, and take their opinions into account when developing new safety systems. In addition Millennials belong to a generation that has educated their older generation [34], especially regarding new technologies. Another example of this is the use of protective systems in sports, e.g. bicycle helmets, ski helmets, or safety equipment for horseback riding. In the US, ski helmet use has increased from 40% to 80% between 2006 and 2016. Among children 17 years or younger, the corresponding numbers are 49% to 89% [35]. If children start to use extra seat belts at an early age they might continue to use them when they grow older as a form of habit, as has been shown for safety equipment in sports. The adults in the focus groups also proposed this: that it would probably become a habit and obvious to use extra seat belts just as the ordinary seat belt of today, at least for safety minded people.

Already today, advanced driver assistance systems are common in newer vehicles, for example automatic emergency break systems assisting the driver in critical situation. In the future's highly automated vehicles, the advanced driver assistance system will steer or brake if needed when trying to avoid a crash. Many of today's crashes would be avoided by using this technology. However, crashes will still occur, and pre-crash maneuvers prior crash may be present, which results in that the occupant may move, resulting in a sub-optimal restraint situation [7,8]. Adding an extra seat belt to the ordinary seat belt is one approach to ensure that the occupant remains well restrained during a pre-crash maneuver. Also, an extra seat belt may help keep the occupant well restrained due to voluntarily movement when the occupant chooses postures different from ideal crash dummy positions. Besides, extra seat belts have shown having a thorax injury reducing effect [36]. However it is

important that the extra seat belt is designed in such a way that the three point belt always is used, no matter if the occupant buckle up the extra seat belt or not. Legislation, such as UN R16 [38], requires a design of the seat restraint to ensure that the ordinary seat belt will be buckled up prior to the extra seat belt.

This study was limited to a discussion of seat belts in the rear seat. However, several participants pointed out that if this is an improved restraint system compared to the ordinary seat belt alone, it should be available for all seats in the vehicle, including the front seat, for both adults and children. Another aspect pointed out was that extra seat belts should be a standard feature in cars. This again highlights how an important safety system should be available to all passengers.

The advantages of focus groups as data collection method is that the loose structure and group dynamic makes it possible to get different information to interviews and is particularly suitable in an evaluation or design process. The strength lays in the fact that what a person says invite other people to make associations based on their experiences of the theme. Often relatively few people provide a sufficient basis to gain an understanding of their wishes, requirement and problems. The focus group provides subjective and almost exclusively qualitative data since the respondents are few.

Testing the concepts in real driving situations during a longer period of time has also been done in a previous study [23], which provided the participants with an increased feeling of safety for both CC and BP. The results also showed that when the 32 participants (children, youths and adults) had been traveling for a longer period of time (one hour) they were more satisfied with the systems than after the first initial 20 minutes [23]. That study also showed that the BP concept solution was preferred by nearly half of the participants after one hour ride, which shows that real environment testing is important and can change people's initial mind.

Limitations

The present study was performed in Sweden, which has one of the world's highest seat belt usage rates. Swedish people have a generally high safety consciousness level. The strong safety tradition in Sweden was noticeable among both children and adults included in the study. The possibility to generalize these results are limited, and there is a need to conduct similar studies in other countries, to broaden the knowledge of how new safety system can be designed to attract people from various parts of the world.

Due to circumstances out of control, only four adults and only five children were able to attend their focus groups at the scheduled time. However, the low turnout did not influence either the adults nor the children's creativity and willingness to discuss the subject compared to the groups with more participants. Since it is a qualitative study the aim is to get a richer description of an issue and understanding of a few individuals perspectives and the result should not be used for generalization.

V. CONCLUSIONS

The focus group study has provided information about adults' and children's attitudes towards extra seat belts including a brief evaluation of two extra seat belt concepts. The following specific conclusions were drawn from the study:

Seat belt usage was not questioned. The three-point belt was experienced as very safe, and always used despite sometimes causing discomfort.

Children specifically, but also adults, showed positive attitudes toward extra seat belts. The main reason for motivation of using extra seat belts was increased safety.

The children were more focused on safety issues than adults, who were a bit hesitant about the need for further restraint systems. The adults stated that the real safety benefit with extra seat belts needed to be presented, and that it should be a standard feature in the car, not optional.

The main reasons stated for not using extra seat belts were discomfort, a feeling of being trapped, and that the seat belt system was harder to apply. To achieve improved comfort it is important to design the extra seat belt together with ordinary seat belt as one system.

The criss-cross extra belt solution was preferred by nearly all participants, due to greater perceived safety, comfort, and symmetry than the backpack solution.

The overall conclusion was that the motivation for using extra seat belts was highly safety related. For children the need is obvious, while adults need further information to be convinced of their benefit. Both children and adults highlight the need of high comfort in order to motivate the use of extra seat belts.

VI. ACKNOWLEDGEMENT

Thank all the participants, the school-teacher and the children's parents who let them participate in this research study. This work was partly financed by FFI, VINNOVA, the Swedish Transport Administration, Sweden.

VII. REFERENCES

- [1] Kahane C. Fatality reduction by safety belts of front-seat occupants of cars and light trucks. *DOT HS 809 199, NHTSA Technical Report*, Dec. 2000. Retrieved 2017 03 15
- [2] Tylko S, Bohman K, Bussieres A. Responses of the Q6/Q6s ATD Positioned in Booster Seats in the Far-Side Seat Location of Side Impact Passenger Car and Sled Tests. *Stapp Car Crash Journal*, 2015;59:313-35.
- [3] Bostrom O, Haland Y. Benefits of a 3+2-point belt system and an inboard torso-side support in frontal, far side and rollover crashes. *Int J Veh Saf*. 2005;1:181–199.
- [4] Saunders S., Parent D, Ames E. NHTSA oblique crash test results: vehicle performance and occupant injury risk assessment in vehicles with small overlap countermeasures. *Paper presented at 24rd International Technical Conference on the Enhanced Safety of Vehicles (ESV)*; June 8–11, 2015; Gothenburg, Sweden.
- [5] Funk JR, Cormier JM, Bain CE, Wirth JL, Bonugli EB, Watson RA. Factors affecting ejection risk in rollover crashes. *Ann Adv Automot Med*. 2012;56:203-11.
- [6] Bohman K, Arbogast KA, Boström O. Head injury causation scenarios for belted, rear-seated children in frontal impact, *Traffic Injury Prevention*. 2011 Feb;12(1):62-70.
- [7] Stockman I, Bohman K, Jakobsson L. Seatbelt pre-pretensioner effect on child sized dummies during run-off road events. *Traffic Injury Prevention* (In press), 2017.
- [8] Bohman K, Stockman I, Jakobsson L, Osvalder AL, Bostrom O, Arbogast K. Kinematics and Shoulder Belt Position of Child Rear Seat Passengers during Vehicle Maneuvers. *Ann Adv Automot Med*. 2011;55:15-26
- [9] Baker G, Stockman I, Bohman K, Jakobsson L, Osvalder AL, Svensson M, Wimmerstedt M. Kinematics and shoulder belt engagement of children on belt-positioning boosters during evasive steering maneuvers, *Ann Adv Automot Med*, (Submitted) 2017.
- [10] Arbogast KB, Kim J et al. Naturalistic driving study of rear seat child occupants: Quantification of head position using a Kinect™ sensor. *Traffic Inj Prev*. 2016 Sep;17 Suppl 1:168-74.
- [11] Andersson M, Bohman K, Osvalder AL. Effect of booster seat design on children's choice of seating positions during naturalistic riding. *Ann Adv Automot Med* 2010;54: 171-180.
- [12] Jakobsson L, Bohman K, Stockman I, Andersson M, Osvalder A-L. Older children's sitting postures when riding in the rear seat. *Paper presented at: IRCOBI Conference*; September 14-16, 2011; Krakow, Poland.
- [13] Osvalder AL, Hansson I, Stockman I, Carlsson A, Bohman K, Jakobsson L. Older Children's Sitting Postures, Behavior and Comfort Experiences during Ride – A Comparison between an Integrated Booster Cushion and a High-Back Booster. *Paper presented at: IRCOBI Conference*, 2013, September 11-13, Gothenburg, Sweden.
- [14] Bohman K, Andersson M, Osvalder AL. A comparison of children's sitting postures during drive and the HIII 6y seating position – in two different high back booster seats. *8th International Conference Protection of Children in Cars*, Munich, Germany, 2-3.Dec. 2010.
- [15] Kent R, Forman J, Parent DP, Kuppa S. Rear seat occupant protection in frontal crashes and its feasibility. *Proc. of 20th Enhanced Safety of Vehicles Conference*. Lyon, France, 2007.
- [16] Arbogast KB, Chen I, Durbin DR, Winston FK. Injury risks for children in child restraint systems in side impact crashes. *In International Research Conference on the Biomechanics of Impact*, Graz, Austria Sep, 2004;25-36.
- [17] Durbin D, Elliott M, Winston F. Belt-positioning booster seats and reduction in risk of injury among children in vehicle crashes. *JAMA*. 2003;289:2835-40.
- [18] Bohman K, Jakobsson L, Stockman I. Retention of rear seat occupants during evasive steering maneuvers – effect of seatbelt pre-pretensioner. *14th Int. Conference on Protection of Children in Cars*, Munich, 2016.
- [19] Rouhana SW, Bedewi PG, Kankanala SV, et al. Biomechanics of 4-point seat belt systems in frontal impacts. *Stapp Car Crash J*. 2003;47:367–399.
- [20] Rouhana SW, Kankanala SV, Prasad P, Rupp JD, Jeffreys TA, Schneider LW. Biomechanics of 4-point seat belt systems in far side impacts. *Stapp Car Crash J*. 2006;50:267–298.
- [21] Bostrom O, Gabler HC, Digges K, Fildes B, Sunnevang C. Injury reduction opportunities of far side impact countermeasures. *Annu Proc Assoc Adv Automot Med*. 2008;52:289–300.
- [22] Bostrom O, Motozawa Y, Oda S, Ito Y, Mroz K. Mechanism of reducing thoracic deflections and rib strains

- using supplemental shoulder belts during frontal impacts. *Paper presented at 23rd International Technical Conference on the Enhanced Safety of Vehicles (ESV)*; May 27–30, 2013; Seoul, Republic of Korea.
- [23] Osvalder AL, Hansson I, Bohman K.. Children's and Adults' Comfort Experience of Extra Seat Belts When Riding in the Rear Seat of a Passenger Car. *Traffic Inj Prev*. 2015.16 Suppl 2:S46-51.
- [24] Stewart D.W. & Shamdasani P.N. Focus Groups Theory and Practice. *Sage*, Newbury Park, California, 1990.
- [25] Kitzinger, J. (1994). The methodology of Focus Groups: the importance of interaction between research participants. *Sociology of Health & Illness*, 16(1), 103-115.
- [26] Rabiee, F. (2004). Focus-group interview and data analysis. *Proc of the Nutrition Society*, 63, 655-657.
- [27] Begg D., Langley J. Seat belt use and related behaviors among young adults, *Journal of Safety Research*, Vol 31, No 4 pp 211-220, 2000.
- [28] Fockler SK, Cooper PJ. Situational characteristics of safety belt use. *Accid Anal Prev*. 1990 Apr;22(2):109-18.
- [29] Kim S., Kim K, Personal, temporal and spatial characteristics of seriously injure crash-involved seat belt non-users in Hawaii, *Accident Analysis and Prevention*, 35, p 121-130, 2003.
- [30] NHTSA: Safety belts and rural communities, 2003 report, The facts to buckle up America, *NHTSA*, DOT HS 809 731, May 2004..
- [31] Reinfurt D., Williams A., Wells J., Rodgman E., Characteristics of drivers not using seat belts in a high belt use state, *Journal of Safety Research*, 1996: 27:4:209-215.
- [32] Nichols JL1, Tippetts AS, Fell JC, Eichelberger AH, Haseltine PW The effects of primary enforcement laws and fine levels on seat belt usage in the United States. *Traffic Inj Prev*. 2014;15(6):640-4.
- [33] Lie A, Krafft M, Kullgren A, Tingvall C. Intelligent seat belt reminders-do they change driver seat belt use in Europe? *Traffic Inj Prev*. 2008 Oct;9(5):446-9. doi: 10.1080/15389580802149690.'
- [34] AutoTrader.com, The next generation car buyer Millennials – What you need to know, retrieved 2017 03 01 [https:// https://oemsolutions.agameautotrader.com/wp-content/uploads/2013/05/Millennials-Next-Gen-Car-Buyer.pdf](https://oemsolutions.agameautotrader.com/wp-content/uploads/2013/05/Millennials-Next-Gen-Car-Buyer.pdf)
- [35] NSAA, National Ski Areas Association, Helmet usage and safety fact sheet, retrieved 2017 03 29 https://www.nsaa.org/media/275601/Helmet_Fact_Sheet_9_1_16.pdf
- [36] Mroz K, Bostrom O, Pipkorn B, Wismans J, Brolin K. Comparison of hybrid iii and human body models in evaluating thoracic response for various seat belt and airbag loading conditions. *In International Research Conference on the Biomechanics of Impact (IRCOBI)*; Hannover, Germany, Austria September, 2010.
- [37] Jorlov S, Bohman K, Larsson A. Seating Positions and Activities in Highly Automated Cars – A Qualitative Study of Future Automated driving Scenarios. *International Research Conference on the Biomechanics of Impact*, 2017. (Submitted).
- [38] United Nations Regulation 16 (UN R16). /ECE/324/Rev.1/Add.15/Rev.8. 2014. Accessed 5th of June 2017. <http://www.unece.org/?id=39139>