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TRAFFIC ACCIDENT RESEARCH UNIT

CHILD RESTRAINTS

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DEPARTMENT OF MOTOR TRANSPORT NEW SOUTH WALES

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CHILD RESTRAINTS

I have been asked to speak to you, for the next half hour or so, about "child restraints". The term "child restraints" of course describes the devices that safety engineers have developed. Child restraints give to children the level of crash protection that lap/sash belts give to adult passengers, when their cars are involved in serious crashes. The audience I am addressing today will have no difficulty in understanding the meaning of the term because, like me, each one of you has a special interest in the safety of the children in our community. To the general public however, the term "child restraint" conjures up a picture of a child restrained from becoming a nuisance to the driver and to any other adults in the car. Thus the public at large measures the value of a child restraint by its degree of convenience of use, rather than by its degree of safety.

There is little room for doubting that the failure of child restraints to reach the high level of acceptance achieved in much of Australia by the retracting, automatic-locking lap/sash seat belt, arises from the sheer inconvenience of child restraints. Although there are welcome exceptions, most child restraints that have been approved for their life-saving potential, are seen by the public as difficult to install, difficult to adjust to the child, present problems of release of the child and fail to keep children "out of the hair" of their parents for an adequate length of time.

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It is my intention in this paper to examine both meanings of the term "child restraint". I will review, in the light of our studies of real crashes and of our laboratory research, the safety requirements of successful child restraints. I will, I hope, convince you that Australian child restraints have a proud record of achievement in safety.

I will also review, in the light of our market research and of our observations of the common misuse of child restraints, the convenience requirements of child restraints. I hope to convince you that much needs to be done to improve child restraints so that they are actually and appear to be, simple to install and use, as well as providing their present high degree of crash protection.

Lap/sash belts and booster cushions.

It has long been said of children that they are not simply small adults, therefore children require for their crash protection, something very different from the lap/sash belt.

Like other dogmatic assertions, the assertion that children are not small adults, whilst valid, has been a major stumbling block to the development of new ideas. This is because the assertion is followed by an invalid conclusion. It simply is NOT TRUE that the lap/sash belt is unsuitable for children. What IS TRUE is that car seats designed for adults are unsuitable even for quite big children. When the car seat is corrected from the adult's size to the smaller size of the child, the EXISTING LAP/SASH BELT can be used conveniently, safely and effectively by many children. The "lateral thinking" that produced this illumination of a major part of the child restraint problem was illustrated early in 1977 when, at an International Conference held in Melbourne, I had the privilege of showing photographs of some of the experimental booster

cushions developed by my colleague Derek Cutting and his staff. I show one of these now. This type of L-shaped booster cushion has several features:

It requires no additional straps.

It allows children to use existing lap/sash belts in front and rear seating positions.

It moves the sash strap away from the face, down and back on to the shoulder.

It lowers the lap strap away from the abdomen, on to the lap.

It takes up much of the slack in the belt, making it simpler to tighten around the child.

It stays in place in a crash.

Unfortunately, none of these L-shaped booster cushions, called "chaises" in the Australian Standard, has been approved so far - not for safety reasons - I should add. My next slide shows a simpler booster cushion that has no back, and hence is not so useful as the chaise. In particular, it does not seat the child in a more forward location, and so does not bring the sash part of a front-seat belt back to the shoulder. Moreover, some of these cushions, like the one shown here require the fitment of special straps, in order to stop them from slipping out from under the child in a head-on collision.

I must say that I have a strong preference for our original concept of an L-shaped chaise, and particularly when it is developed to the extent of the one in my next slide, which shows a commercially

* Some had in fact, just been approved, without my knowledge.

available chaise, with contoured cushion and back and side support for the child's head. The small firm producing this device would benefit from some help in meeting the onerous requirements of Standards Association approval.

The ready acceptance by the public of booster cushions is encouraging, in suggesting that they meet the need for convenience. They have however been in service for too short a time for me to be able to claim for them, a high level of protection in crashes. You would then be quite justified in demanding of me, an explanation for my faith in them. This explanation I shall now proceed to put forward for your consideration. It will not be a simple explanation, so I invite your questions, at the end of my prepared speech, so that I can develop in greater detail, the less clear parts of my argument.

To begin with, let me emphasise that we in the Traffic Accident Research Unit are promoting the use of booster cushions primarily for those children who are too large to use conventional child restraints - child seats as they are usually called. This means that the children we are thinking about, are those <u>most like</u> small adults - children 4 years of age upwards - who have at least partially developed the bony skeletal structure capable of accepting the three straps of the lap/sash belt.

Secondly, our examination of the records of crashes in which children - even those below 4 years of age - have worn lap/sash belts, have shown no evidence of injury to the torso from the deceleration forces produced by these belts. On the contrary, the evidence is that the main problem with children wearing lap/sash belts, is that the belts are rarely tightened up sufficiently by their parents, around the children, who may be ejected <u>over</u> any loose belt. This is significant for two reasons. <u>FIRST</u>, Because one of our aims with the booster cushion was to reduce this slack in order to improve crash performance and <u>SECOND</u>, Because this confirms the

results of earlier research which showed that children tend to be ejected over the tops of lap belts and hence require shoulder restraint in order to prevent ejection. This finding about ejection is significant in indicating one important way in which children perform differently in crashes from adults, who invariably tend to eject under a loose belt, and hence require a tight lap belt in order to prevent ejection.

My third argument for booster cushions and especially for the L-shaped chaise is that we have carried out dozens of crash tests with them in our laboratory and have invariably found them to perform as we predicted.

In short, I believe that all booster cushions that pass the crash tests specified in the Australian Standard, will give good crash performance for children when used with lap/sash belts.

Some of you will no doubt have seen a movie film made by a manufacturer of child restraints, showing a crash test of a competitor's chaise, in which the head comes off the dummy and the remains of the dummy slides under the seat belt. From my remarks about the ejection of children, you will appreciate that this would never happen with a real child. And of course anyone who seriously reports a test with a defective dummy that loses its head, has a credibility problem, if nothing worse. I base my remarks on a careful, frame-by-frame analysis of this film.

Child seats.

For small children, old enough to sit up unaided, child seats have been available for many years. All those approved in Australia perform excellently. In fact it is now fair to say that children in properly fitted and adjusted approved restraints will generally fare even better in a given crash than do adults, in the same vehicle, wearing the best seat belts. It is rare for a restrained child to have anything but a few cuts and bruises, even after a severe crash.

As I have indicated though, proper fitting and wearing of a child restraint is essential, if it is to perform at its best. I am sorry to have to report that child seats (unlike approved booster cushions, which are difficult to abuse) - are more often than not, fitted or worn (or both) incorrectly.

Installation of child seats.

Because the car manufacturers and child restraint manufacturers have been unable to reach agreement on a common form of anchor fitting to be used, the child restraint anchorage points required in new Australian cars since 1975 have received little use (although we should note their use for bassinets to be discussed later). Hence it is now customary for child restraint manufacturers to make use of the lap/sash belts already fitted in the four outer seating positions since 1971, for securing child seats. This is in principle wholly commendable, since it should eliminate installation costs and facilitate transfer from car to car. In practice however there are some difficulties .....

Barrier Devices

Barrier or shield devices are pop ular in America for children. All I can say is that they do not perform very well in our crash tests. I show a slide taken from a high speed movie film, in which we see a dummy being ejected in a side collision.

Rear facing child seats.

The Volvo rear facing child seat requires its own special fittings for installation. It is an excellent seat but care has to be taken to ensure that the harness is worn tightly, to lessen the possibility of child sliding up the seat back in a frontal crash, with the chance of serious injury to the cervical spine.

Protecting the infant.

The greatest problem for car safety engineers is that of providing crash protection for the young infant, too undeveloped to sit up unaided, from its very birth. Yet the greatest opportunity for introducing the concept of crash protection to both child and parent, is presented when the young mother takes her first baby home from the maternity hospital. The abject failure of American designers to meet the needs of mothers was demonstrated recently in a study in Washington, D.C. in which most mothers failed to continue the use of current infant restraints, even when donated and fitted free of charge, with instruction as to their correct use.

Following a study I made in 1968, I came to the conclusion that the only viable infant restraint was a restrained baby basket or bassinet that could readily be used inside or outside the car. In view of the demonstrable lack of a bony structure in the infant, I concluded that the bassinet should be supported in the car in such a manner as to apply the crash forces uniformly on the infant's back, during the most severe (head-on) likely crash. These concepts were incorporated as broad requirements in the Australian Standard E46 published in 1970. They were specified in greater detail in the 1975 revision of the Standard but with two changes. One change permitted the restraint to be located along the longitudinal axis of the car, as in the General Motors Infant Carrier, as an alternative to the common lateral arrangement

of a bassinet. The other change removed the requirement for padding and allowed a net to be used as the restraint.

In spite of all those attempts at meeting the needs of manufacturers, to date none has reached the stage of securing Standards Association approval.

Because of the unwillingness of manufacturers to meet these requirements, the Traffic Accident Research Unit undertook a development programme, with free access by designers to its results, to produce some prototypes. That has now reached the stage at which mass production by one or more manufacturers may be expected early in 1980.

Last year the Traffic Accident Research Unit conducted a 6 month long study of children involved in car crashes. A child was included in the study if he or she was reported by ambulance personnel to have been taken by them after a road crash, to a hospital or doctor for medical examination or treatment. The study covered the whole of New South Wales and was intended to include only children aged less than 8 years. Chief interest centred on the crash performance of any child restraint or adult's seat belt worn by a child.

In the 6 months of the study we received 639 reports of carriage by ambulance of children from road crashes.

It was most disappointing to us to find that in only 35 of these 639 crashes, could we confidently conclude that any child was wearing an acceptable form of restraint. This 5% wearing rate in crashes compares with about 33% wearing rate in normal travel in Sydney. No doubt there are many reasons for this discrepancy, but I think that we are entitled to speculate on three possibilities.

FIRST, although many children may be found restrained during the relatively short journeys in Sydney, they are allowed to get out of their protective devices on the longer journeys in which they are much more likely to be involved in serious crashes. SECOND, children living in the country where restraints are not readily available, are those involved in serious crashes, and THIRD, the use of child restraints prevents children from being casualties requiring ambulance transport.

As I said, our chief interest was in finding out how good was the crash protection provided for children by approved seat belts or child restraints. In our series of 639 crashes, 20 children aged 4 years or less wore a proper form of child restraint, 1 baby was in a restrained bassinet, and 37 children in the 1 to 10 age group wore adult 's seat belts, a total of only 58 children properly restrained out of probably a 1000 or more.

Some 16 of the child restraints claimed to comply with one of the Australian standards. Among these 16 children, 12 had non-serious injuries scoring 2 or less on the Abbreviated Scale. 4 children had more severe injuries, as described below.

CASE 19C

In a head-on crash with a light truck, involving gross damage to her vehicle and deep intrusion, a 2 year old girl in a Safe-N-Sound Mark 7 child seat received severe injuries to arms and legs. The restrained female driver received multiple rib fractures.

CASE 36D

In a car-to-car head-on crash involving severe damage to her car, an 8 months old girl in a Safe-N-Sound KL seat sustained severe injuries to arms and legs, mainly because the seat had been installed wrongly. Both front seated adults, properly restrained, died of multiple injuries.

CASE 370 (i).

After the campervan in which she was restrained by a Safe-N-Sound KL child seat, rolled over, a 4 year old girl received deep facial lacerations, as did the restrained driver.

CASE 35E.

A 3 year old girl died of brain and other injuries after her Safe-N-Sound X4 child seat broke away from its mounting brackets under the collision forces from luggage in the boot of the car. The restrained driver died of chest injuries.

These four cases indicate that children generally come off no worse, if not better than adults, even in very severe crashes.

Some 37 children wore adult's seat belts. Of these, 30 received injuries no more severe than AIS.2. The following were the 7 exceptions:-

LAP-SASH BELTS

CASE 32C A small girl wore a lap/sash belt with the sash under her arms. She was seated at the entry point of an impacting car and died of injuries to neck, thorax and abdomen.

CASE 3D A 7 year old boy wore a lap/sash belt when the car he was in was hit on the remote side. He had a contused left lung and kidney and fractured pelvis. The restrained driver received a fractured skull and an unrestrained child dies of head injuries. A dog passenger also died in the crash.

CASE 4C A car left the road and hit an embarkment. A 4 year old girl in a loose lap/sash belt died of a fracture of the cervical spine because the sash was in contact with her face.

CASE 23D A car was hit on its side by another car and rolled. A 7 year old boy in a lap/sash belt was impacted through the side of the car and received a fractured clavicle.

LAP BELTS

CASE 36E In a car-to-car collision involving severe damage to her car, a 4 year old girl wore a lap belt and sat on 2 cushions. She died of fractures to her skull, spine, ribs and arm. Both adult front occupants, properly restrained, died of multiple injuries.

CASE 21E A car left the road and collided with a so-called "guard rail". A 7 year old boy wearing a lap belt received a lacerated forehead and fractured clavicle. The other occupants received negligible injuries.

CASE 7E A 5 year old boy was ejected from his loosely worn lap belt when the car he was travelling in rolled over. He died of a fracture of the cervical spine. The other occupants only sustained minor injuries.

So the lap belt did not perform very well at all. I recommend that lap belts should not be used by children unless child harness straps have been added, which is easy in the centre rear seats. A booster cushion improves this system still further.

Two of the lap/sash belts would have been more effective had they not been worn very loosely. The other two lap/sash cases involved very severe crashes in which survival with no injury was probably impossible in current cars.

Statistics.

Ray O'Dowd tells me that in the last year (1978/79), some 20 child passengers aged 8 years or less were killed on Queensland roads and probably about 400 injured.

One in ten car passengers who died were aged 8 years or less.

I would estimate that this road toll could be halved by the correct use of child restraints and adult belts with booster cushions.

Human Factors.

In summary, we have a wonderful group of life saving devices that will work in all but a few major crashes, but only a minority of parents have bought them, and even fewer use child restraints all the time.

We have conducted over 1000 group discussions with parents and children, in order to try to find out why this is so. As a result, we developed the booster cushion in order to help the child who gets too big for a child seat.

We are now looking at child seat design, with a view to improving their acceptability by parents. This is very difficult research, because we have to attempt to understand, not only the physical difficulties of child restraint use, but also the misapprehensions and misconceptions many people seem to have.

Laws.

Finally, I will venture an opinion on the value of laws requiring the fitting and wearing of child restraints.

Compulsory fitting is simply not yet feasible, because there are too many problems still to be overcome.

A law requiring the wearing of existing restraints seems likely to improve wearing rates, so is to be commended. There should however be generous exemptions, because of the many real or imagined difficulties that parents encounter.

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26th October, 1979.