

# THE CHANGING OUTLOOK OF EURO NCAP

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## INTRODUCTION

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ESTABLISHED IN 1997, THE EUROPEAN NEW CAR ASSESSMENT PROGRAMME provides consumers with a safety performance assessment for the majority of the most popular cars in Europe. Thanks to its rigorous crash tests, Euro NCAP has rapidly become the driver of major safety improvements to new cars. After ten years of rating vehicles, Euro NCAP felt a change was necessary to stay in tune with rapid automotive safety developments and to respond to shifting priorities from a consumer and societal point of view. The challenge was to develop a new scheme for rating car overall safety that is plausible, reliable and would be widely accepted by consumers and industry.

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## A NEW RATING CONCEPT

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THE EURO NCAP RATINGS FOR ADULT PROTECTION, CHILD PROTECTION<sup>1</sup> AND PEDESTRIAN PROTECTION have been in common use since 1997 and have become internationally recognised as a reliable indicator of independent consumer information about car safety. Clearly the Euro NCAP ratings have been seen to improve over time, in particular for Adult Protection, as shown in Figure 1.

While this reflects industry's efforts to deliver increasingly safer cars, it also means that the discriminating factor in the rating has been reducing. At the same time, the success in Adult Protection is hiding the less favourable progress in the other areas, for instance Pedestrian Protection, from view of the consumer. Driver assist systems are currently not rated at all, while these systems play an increasingly important role in accident avoidance and injury mitigation for the new generation of vehicles on the market.

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<sup>1</sup> Introduced in 2003.

Considering the above, Euro NCAP decided that the safety performance in adult occupant protection, child occupant protection and pedestrian protection should continue to be published but that the star ratings for those categories should be abandoned in favour of a single overall star rating. Besides the traditional areas of assessment, the single rating should allow the inclusion of driver assist and/or primary safety technologies and allow some flexibility to weigh the contributions of the individual elements into the final score. Although Euro NCAP recognised that there may be challenges with respect to continuity when moving to a new system, a single overall safety rating was considered to provide the simplest and clearest advice to the consumer going forwards. On the basis of these assumptions, it has developed the structure for a new "encompass all" rating scheme as presented hence forth.

THERE WILL BE ONLY ONE SINGLE EURO NCAP STAR RATING for each vehicle selected in the new rating scheme. This rating runs from one up to five stars; only integer values will be used and no "strike-through" stars applied. The rating will be composed from score achieved in four areas of assessment (so called "boxes"): the current three star ratings (Adult Occupant, Child Occupant, and Pedestrian Protection) and the new box Safety Assist. The score in each box is composed of the different tests, like the current star ratings. For each box a total score is normalised with respect to the maximum achievable score available for the box. In this way, the maximum score for each box, and hence the total maximum score, is a constant.

A weighted average is taken from the four ratings of the boxes, where the weights reflect the relative importance of the four boxes. The overall weighted score is then used to generate the star rating by comparing the score with the minimum score required for each star level. The overall star rating can be corrected downwards if any of the individual scores in the four boxes do not meet the minimum required level defined for each box to obtain the overall star rating. These so called balance criteria will ensure that a certain balance between the performances in the four boxes is maintained.

At this time, no balancing is foreseen between the tests inside a box. The current balance between frontal off-set and side impact barrier test is therefore no longer maintained. Instead, capping limits will be introduced relative to the biomechanical limits measured with the dummy. As is the case with the upcoming Whiplash assessment protocol, exceeding a capping limit means that no points are given for this test.

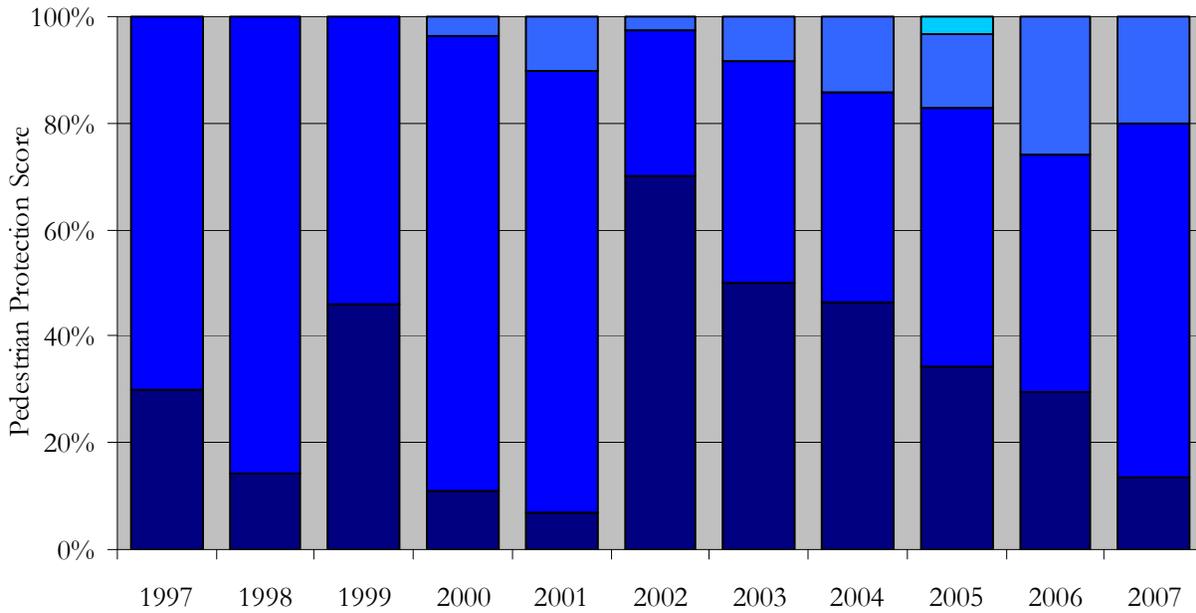
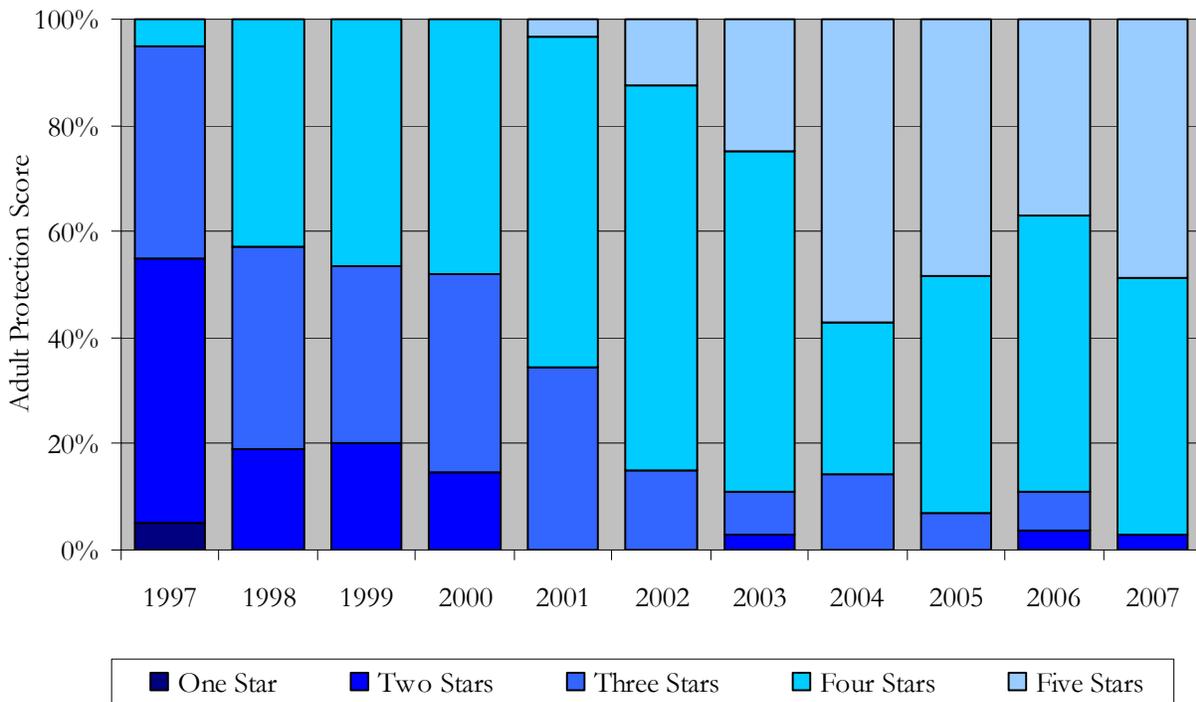


Figure 1: Actual distribution of stars amongst vehicles tested annually over 10 years (N=315). Top: Adult Protection Rating; Bottom: Pedestrian Protection Rating. Note: In June 2002 Euro NCAP changed the way pedestrian impact test sites are selected. The limit values and the way points are awarded also changed.

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## AREAS OF ASSESSMENT

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BELOW THE CONTENT of the four boxes at the introduction of the new rating scheme is presented. At this stage, it is expected that the number of boxes will not change in the foreseeable future yet the content of the boxes may be updated (revised and/or new protocols). In the new scheme, ratings will be year related. Significant changes to the scheme in the future will therefore be introduced at the start of the calendar year with sufficient lead time.

Beyond NCAP is not included in the rating scheme presented, at least until it has taken a more defined shape. In the Beyond NCAP working group, the following alternatives of awarding the new technology were identified: (a) Recommendation only (b) Award (e.g. "Bronze", "Silver", "Gold" medal); (c) Separate stars based on achieved points in the flowchart (d) Include in vehicle new 5-star rating (publish two ratings per car). The last option has major operational and communicational implications, which lead the Rating Group to decide against it at this moment.

As with the old system, the starting point for the assessment is the dummy response data. The sliding scale system of points scoring is used. To limit the discontinuity between old and new rating system, for each test available under the current system, the number and distribution of points available, as well as the upper and lower limits are carried over to the new system, unless indicated otherwise.

### BOX 1: ADULT OCCUPANT PROTECTION (36 POINTS)

THE FOLLOWING TESTS ARE FORESEEN TO ASSESS ADULT OCCUPANT PROTECTION:

- Off-set deformable barrier (ODB) test, based on the current test protocol, limits and points (16 pts.);
- Side impact MDB test, based on the current test protocols and limits. The points distribution remain as currently applied, however, the total number of points is scaled by half (8 pts.);

- Pole test: the optional pole test result will be given more weight. Total points will be awarded based on all measures taken on body regions, identical to the side impact MDB tests, based on equal limits, modifiers and scaled by half (8 pts.). The pole test remains optional and conditional (head protection system is a prerequisite);
- Whiplash neck injury: new test protocol expected to be introduced by the end of 2008. Points are based on geometric assessment of the head restraint position and on dynamic results in three test conditions. Total contribution is set at 4 pts.

For all tests in Box 1 except Whiplash capping on the dummy results of all critical body regions (before application of possible modifiers) will be applied. For frontal impact, the critical body regions are: head, neck and chest; for side impact: head, chest, abdomen and pelvis. In the pole test, only the head result will be capped. All capping limits are equivalent to the lower performance limits. For Whiplash capping will be applied on all of the measured seat performance criteria, based on the so-called “black” (95% percentile) limits. The Seat Belt Reminder assessment, currently part of the Adult Protection Rating, is moved to Box 4: Safety Assist.

#### BOX 2: CHILD OCCUPANT PROTECTION (49 POINTS)

THE FOLLOWING TESTS ARE FORESEEN TO ASSESS CHILD OCCUPANT PROTECTION:

- Dynamic assessment based on 1½ and 3 year old child in CRS in frontal and side impact (12 pts./CRS);
- CRS based assessment, including CRS marking (4 pts./CRS) and CRS to vehicle interface (2 pts./CRS);
- Vehicle based assessment, including airbag warning marking, airbag disabling, provision of three-point belts, the suitability for universal seats, Gabarit, ISOFIX and integrated CRS (13 pts.).

The child protection assessment will be carried out on the basis of the current test and assessment protocols with a maximum number of points of 49. No capping will be applied on the dynamic results. For two-seaters, limited assessment is foreseen, excluding the part of dynamic

assessment. The maximum number of points that can be achieved in this box will be adjusted accordingly.

### BOX 3: PEDESTRIAN PROTECTION (36 POINTS)

THE FOLLOWING TESTS ARE FORESEEN TO ASSESS PEDESTRIAN OCCUPANT PROTECTION:

- Child (2.5 kg) and Adult (4.8 kg) headform impactor testing (24 pts.)
- Legform to Bumper tests (6 pts.);
- Upper legform to bumper and to bonnet leading edge tests (6 pts.)

The pedestrian protection assessment will be carried out on the basis of the current EEVC WG17 based test and assessment protocols with a maximum number of points of 36. No capping will be applied.

### BOX 4: SAFETY ASSIST (7 POINTS)

THE FOLLOWING ASSESSMENTS ARE FORESEEN FOR SAFETY ASSIST SYSTEMS:

- Seat Belt Reminder, based on current functional assessment protocol (3 pts.);
- Electronic Stability Control (ESC); point awarded on the basis of fitment only, see comment below (3 pts.);
- Speed Limitation Devices (SLD); new functional assessment protocol build on ECE Regulation 89 for passive (warning only) and active (intervention) limiters (1 pt.).

In order to qualify for points, the above technologies will need to be part of the (escalating) Basic Level safety specification as described in Car Specification, Sponsorship, Testing and Retesting Protocol, Version 2.2, December 2007 (85 percent standard fitment in 2009 up to 100 percent in 2012). For the introductory year of the new rating scheme (2009), 1 point for ESC can be obtained if, amongst the variants sold, ESC is fitted standard on at least 50 percent and - on top - is available as an option on between 0 and 35 percent. For the “2009” 5 star overall rating however it will remain necessary for ESC to be fitted as standard to at least 85 percent of car sales, or predicted sales, across the model range. For SBR, the standard fitment rate on the different seating positions will be

considered individually. Also, for two-seaters, the SBR points are limited to 2 and therefore the total points in Box “Safety Assist” to 6.

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**CALCULATION OF OVERALL RATING**

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THE WEIGHTED OVERALL SCORE is calculated from the individual box scores using weight factors. These weight factors reflect the relative importance of the four boxes in the final score. Foremost the selection of percentages is guided by real world priorities (societal considerations). At the same time, the number and expected effectiveness (in terms of expected accident and injury reduction) of the protocols in each box are considered. The weight factors need to be fixed at the introduction of the new rating scheme, but may be updated from time to time as priorities change. Two directions have been discussed for the weight factors at time of introduction of the new rating scheme: Option 1: 50%, 20%, 20%, 10% weights for Box 1-4, respectively; Option 2: Equal weight for all four boxes.

The first option gives more credit to Adult Protection over the other boxes initially. This way, the recent addition of Whiplash will have a more noticeable effect on the rating. Child Occupant protection is down-weighted given issues with its effectiveness today. Box 4 is weighted the lowest as it is considered not to be populated to its fullest potential. Moreover, whilst the effectiveness of ESC is recognised, the performance of the specific ESC system will not actually be assessed based on a published protocol as is the case for the other boxes. The second option, giving equal weights to all boxes, avoids such – what one may conceive as subjective - arguments by giving equal weights to all four boxes. Taking the actual effect of both options on the overall rating for the introductory period into account, it has been decided to start the new rating scheme with the weights given under Option 1 for the period of the soft landing (2009-2012).

Apply total weighted score against criteria		AT LEAST PERCENTAGE	AT LEAST POINTS
	For five STAR	80%	0.8
	For four STAR	70%	0.7
	For three STAR	60%	0.6
	For two STAR	55%	0.55
	For one STAR	45%	0.45

*Table 2: Total points applied to star values, based on weighting.*

VEHICLES THAT SHOW A POOR PERFORMANCE in one of the boxes may have their star rating restricted to show that they do not provide good all-round protection. There will be a minimum number of points required in each box to achieve a star rating. The following limits are applied after the individual test scores have been rounded:

		ADULT PROTECTION		CHILD PROTECTION		PEDESTRIAN PROTECTION		SAFETY ASSIST
For five STAR	At least	80%	And	75%	And	60%	And	60%
For four STAR	At least	70%	And	60%	And	50%	And	40%
For three STAR	At least	40%	And	30%	And	25%	And	25%
For two STAR	At least	30%	And	25%	And	15%	And	15%
For one STAR	At least	20%	And	15%	And	10%	And	5%

*Table 3: Total points applied to star values, based on balancing.*

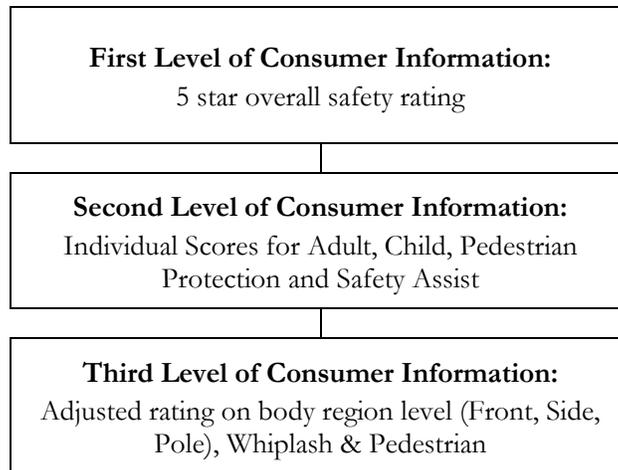
The numbers in Table 2 and Table 3 represent those applied in the final step of implementation, as described further on.

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## COMMUNICATION

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THREE DISTINCT LEVELS of information are anticipated in the new rating scheme (see Figure 2).



*Figure 2: Communications levels in the new rating scheme*

At the top level, the overall 5-star safety rating is published. A new overall rating logo will be designed, which will include the Euro NCAP logo and stars that manufacturers will be able to use in

their marketing and will replace the currently existing guidelines. In the new scheme, ratings will need to be year related and therefore the star rating must, going forwards, always be referred to in conjunction with the year it was released. An updated “date stamp” can only be achieved by (partly) re-assessment or re-calculation of the car.

At the intermediate level, the individual scores in the four boxes will be shown (numerically) alongside logos that are easily recognized by the consumer. To ensure continuity, currently existing logos for the three ratings of adult, child and pedestrian protection will be used at the intermediate level. A new logo for Safety Assist will also be designed and introduced for insertion at this level. At this level, no stars will be used by Euro NCAP nor will the use of stars in expressing the results by third parties be accepted.

At the lowest, most detailed level, the adjusted rating for the different body regions is presented as in today's scheme, in a visual format of coloured segments within a human body outline. This is presented for the driver and front seat passenger in frontal impact and for the driver in side and pole impact. For the pedestrian impact tests, it is presented in the form of coloured dots on the outline of a car front. At this level, additional information will be added regarding the seat performance in the whiplash test, ESC and SLD fitment.

Euro NCAP believes that to ensure the successful introduction of the new Ratings system, a distinct change should be communicated to consumers. In order to avoid confusion, the old and new rating system should not be displayed in parallel in manufacturers marketing material. The new overall rating logo should only be used, although manufacturers may be allowed to quote their scores in adult occupant (in text form) if they wish to.

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## **IMPLEMENTATION**

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FOR A SUCCESSFUL IMPLEMENTATION, Euro NCAP must take into account the time manufacturers may need to integrate changes in their planning. A "soft landing" approach is necessary to ensure that the new rating system does not change scores too dramatically. Too dramatic a change would discourage manufacturers from putting their cars into the new rating system or could create confusion in the eyes of consumers. A step by step approach therefore is proposed that is clear, logical and phased.

The following steps are suggested<sup>2</sup>:

- 2009 - The rating system begins (all components included);
- 2010 - Second stage where the system is more clearly adjusted for imbalance between the boxes;
- 2012 - Final stage where the scheme is fully operational.

This proposal keeps the final overall rating close to the current Adult Occupant protection rating initially and then gradually changes the score by adjusting the weight factors and balance criteria in the rating scheme in two successive steps. The criteria in the first year are chosen such that those manufacturers that have made efforts in areas such as pedestrian protection will also be recognized within the new overall rating i.e. at least 2 star pedestrian score to receive a 5-star overall rating, 1.5 star pedestrian for 4-star overall. These 5/4-star balance criteria are increased to 2.5/2 and 3.25/3 stars pedestrian score for the years 2010 and 2012, respectively. For the Box Safety Assist no soft landing is foreseen and the thresholds are chosen such that a 5 star overall rating can only be achieved with standard ESC fitment.

An alternative approach is to introduce the new rating system with "2012" weights and balance criteria from the onset, but publish the old ratings in parallel. Starting with a low profile, the soft landing in this case would be provided by increasingly putting more emphasis on the overall rating in the years to come. This "By communication only" approach has not been further pursued.

During the soft landing period, the numbers in Tables 2 and 3 will be applied step by step in the following way:

<b>YEAR 2009</b>		OVERALL WEIGHT	ADULT PROTECTION	CHILD PROTECTION	PEDESTRIAN PROTECTION	SAFETY ASSIST
For five STAR	At least	70%	75%	70%	25%	60%
For four STAR	At least	55%	60%	55%	15%	40%
For three STAR	At least	45%	30%	30%	10%	25%
For two STAR	At least	35%	25%	25%	5%	15%
For one STAR	At least	20%	15%	15%	0%	5%

*Table 4a: Total points applied to star values, based on weight and balancing (2009).*

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<sup>2</sup> Whiplash assessment is introduced by the end of 2008

YEAR 2010		OVERALL WEIGHT	ADULT PROTECTION	CHILD PROTECTION	PEDESTRIAN PROTECTION	SAFETY ASSIST
For five STAR	At least	75%	80%	75%	40%	60%
For four STAR	At least	60%	65%	60%	25%	40%
For three STAR	At least	50%	35%	30%	15%	25%
For two STAR	At least	35%	30%	25%	10%	15%
For one STAR	At least	25%	20%	15%	5%	5%

Table 4b: Total points applied to star values, based on weight and balancing (2010).

YEAR 2012+		OVERALL WEIGHT	ADULT PROTECTION	CHILD PROTECTION	PEDESTRIAN PROTECTION	SAFETY ASSIST
For five STAR	At least	80%	80%	75%	60%	60%
For four STAR	At least	70%	70%	60%	50%	40%
For three STAR	At least	60%	40%	30%	25%	25%
For two STAR	At least	55%	30%	25%	15%	15%
For one STAR	At least	45%	20%	15%	10%	5%

Table 4c: Total points applied to star values, based on weight and balancing (2012 onwards).

The effect of this step by step application on the rating has been studied of a number of cars in the Euro NCAP database (Phase 16 onwards, 2005+, N=139). In order to create a "representative" database, the existing data were enhanced with the additional pole test results (all regions other than head), an estimated Whiplash performance based on the APPO data set, an assumed ESC fitment rate (ESC = 100% for all cars except super mini's and city cars, 50% for super mini's and 0% for city cars) and an assumed SLD fitment rate (SLD = 80% for all cars except super mini's and city cars, 40% for super mini's and 0% for city cars). The exercise focuses on current 5-star Adult Protection and 4-star Adult Protection cars (total of 127 out of the 139 cars). In this example, the 50/20/20/10 weighting factors were applied. Table 5 and Figure 3 show the effect of the new rating scheme for current 4 and 5 star cars in adult protection, if the 2009, 2010 and 2012 criteria would be applied respectively.

2005-2007 ADULT PROTECTION RATING	2009 OVERALL RATING	2010 OVERALL RATING	2012 OVERALL RATING
5-Star: 60 (100%)	5-Star: 18 (30%) 4-Star: 23 (38%) Other: 19 (32%)	5-Star: 4 (7%) 4-Star: 38 (63%) Other: 18 (30%)	5-Star: 0 (0%) 4-Star: 7 (12%) Other: 53 (88%)
4-Star: 67 (100%)	5-Star: 3 (4%) 4-Star: 19 (29%) Other: 45 (67%)	5-Star: 0 (0%) 4-Star: 15 (22%) Other: 52 (78%)	5-Star: 0 (0%) 4-Star: 4 (6%) 3-Star: 63 (94%)
4 & 5-Star: 127 (100%)	5-Star: 21 (17%) 4-Star: 42 (33%) Other: 64 (50%)	5-Star: 4 (3%) 4-Star: 53 (42%) Other: 70 (55%)	5-Star: 0 (0%) 4-Star: 11 (9%) Other: 116 (91%)

Table 5: Effect of "soft landing" demonstrated on 4 & 5-star cars (N=127).

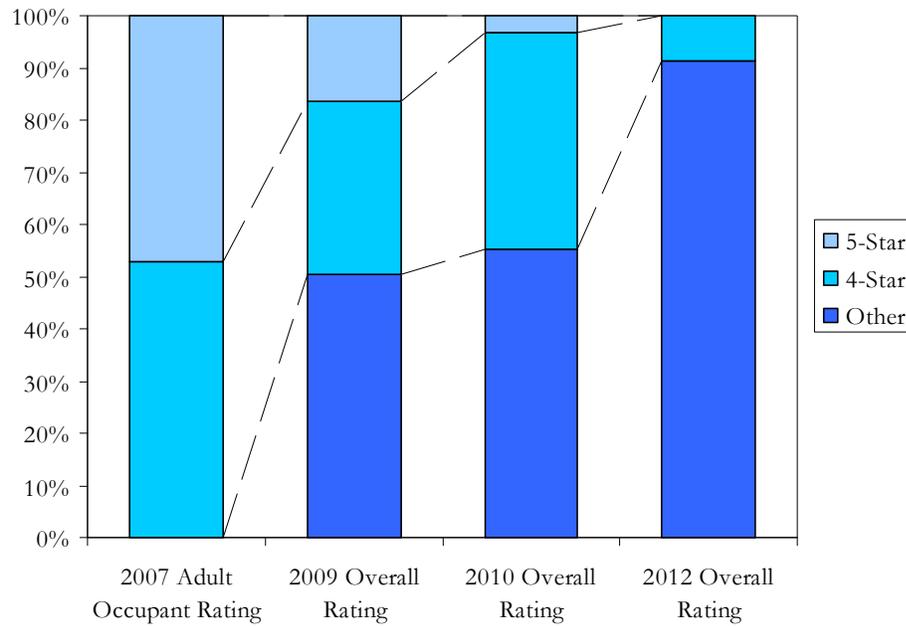


Figure 3: Effect of "soft landing" demonstrated on 4 & 5-star cars (N=127). Data in Table 5.

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## CONCLUSIONS

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THE NEW EURO NCAP OVERALL RATING to be introduced in 2009 is the first safety rating that will combine the performance in adult occupant protection, child occupant protection, pedestrian protection and safety assist functions into one single, easy to comprehend, result for the consumer. By applying weight factors and balance criteria, the new rating promotes all-round performance on all four areas of importance. The new rating scheme embodies the changing outlook of Euro NCAP on safer cars, preserving the driving force on the market for future improvements and protecting the consumer interest.

THE NEW RATING SYSTEM provides more flexibility and adjustment capabilities than the previous system. It is important that a process is put in place to monitor its effectiveness and plan further changes to the system in the upcoming years. As part of this process, real world and societal priorities, legislative development, technical feasibility of new protocols and costs of implementation must be considered. Due to its importance, the Euro NCAP must take direct control of this process of refinement and future updates based on a strategic roadmap. Industry consultation as part of this process will be essential.