Constructing Crashworthiness

The Experimental Safety Vehicle (ESV) Program and the Global Renegotiation of Automobile Safety in the 1970s[1]

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Abstract

The article proposes to take a fresh look at the global ascent of "crashworthiness" as a "dominant paradigm" (Peter Norton) of automobile safety by focusing on the so-called Experimental Safety Vehicle (ESV) program of the early 1970s. Initiated by the U.S. Department of Transport (DOT) and internationalized through the newly created NATO Committee for the Challenges of Modern Society (CCMS), the scheme ultimately came to involve the governments of all major car-producing countries, as well as practically all relevant automobile corporations in the capitalist "West". The ESV program provided a significant boost to automobile safety research and contributed to the professionalization, institutionalization and standardization of the field. It also supplied a platform for a transnational re-negotiation of the distribution of responsibility for automobile safety, in which differences between engineering cultures and user perceptions in North American and Europe/Japan came to the fore. In this context, the experimental prototypes functioned as "evidence objects", which different actors could use to generate and validate technical knowledge, but also to make economic and political arguments. By serving as material anchorage points for a transnational techno-political debate, the ESVs played an important part in shaping the way in which the challenge of "crashworthiness" influenced automobile safety practices worldwide.

Überblick

Der Beitrag untersucht die globale Karriere der „Crashworthiness" bzw. „passiven Sicherheit" als neuem Paradigma (Peter Norton) der automobilen Sicherheit aus der Perspektive des sogenannten ‚Experimental Safety Vehicle (ESV)'-Programms der frühen 1970er Jahre. Initiiert vom US-amerikanischen Department of Transport (DOT) und internationalisiert über das neugeschaffene Committee for the Challenges of Modern Society (CCMS)

1 This article was researched and written within the context of the Deutsche Forschungsgemeinschaft (DFG) Research Group 2448 "Practicing Evidence – Evidencing Practice". I am particularly indebted to Karin Zachmann, who constantly provided feedback and suggestions throughout the process, and Sascha Dickel for his input and help on the theory and (social) practice of prototypes.

der NATO konnte das Projekt letztlich die Regierungen aller Länder mit einer nennenswerten Automobilindustrie sowie praktisch alle wichtigen Automobilfirmen des kapitalistischen „Westens“ zu den Teilnehmern zählen. Das ESV-Programm beschleunigte die Entwicklung spezifischer technischer Lösungen und trug zur Professionalisierung, Institutionalisierung und Standardisierung der Forschung zum Thema automobile Sicherheit bei. Es bot außerdem eine Plattform für die globale Neuaushandlung der Verantwortung für Sicherheit im Straßenverkehr, die Unterschiede zwischen den Ingenieurskulturen und Nutzererwartungen in Nordamerika und Europa bzw. Japan freilegte. Die experimentellen Prototypen selbst fungierten in diesem Zusammenhang als „Evidenzobjekte“, die von verschiedenen Akteuren sowohl zur Datengenerierung und zur Validierung technischen Wissens, als auch zur Untermauerung ökonomischer und politischer Argumente genutzt wurden. Als materielle Ankerpunkte einer globalen techno-politischen Debatte prägten die ESV die Art und Weise entscheidend mit, in der die Idee der „Crashworthiness“ auf globale Praktiken der automobilen Sicherheit durchschlug.

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In June 2019, the 26th International Technical Conference and Exhibition on the Enhanced Safety of Vehicles (ESV) reunited about 1,200 professionals from manufacturers and suppliers, research institutions, government agencies, insurance companies and other interested parties from around the world in Eindhoven, the Netherlands, to discuss the newest developments in automobile safety.[2] Although the conference brought together some of the best-known specialists in the field, arguably one of its biggest attractions was not a human, but a car: with great fanfare, Mercedes-Benz presented its ESF 2019—the acronym stands for “Experimentelles Sicherheitsfahrzeug”, or Experimental Safety Vehicle. The fully functional vehicle was meant to showcase some of the company’s recent developments in automobile safety, particularly relating to what Mercedes referred to as the two “key technologies for the mobility of the future”—electrification and autonomous driving.[3] Unusually for a prototype, however, the purpose of the ESF 2019 was not only to promote a specific vision of the future, but also to draw attention to the past. As the accompanying promotional material emphasized, the new vehicle was merely the latest addition to the “long-standing tradition” of more than 30 ESF models, which

2 Cf. https://www-esv.nhtsa.dot.gov/about.html, accessed April 14, 2020. While the official title of the conference series was changed from “International Technical Conferences on Experimental Safety Vehicles” to “International Technical Conferences on the Enhanced Safety of Vehicles” in 1991, the acronym remains unchanged.

3 Rodolfo Schöneburg, ESF 2019. Experimental Safety Vehicle Meets Automated Driving Mode. ESV Conference 2019, Eindhoven, Paper No. 19-0042, https://www-esv.nhtsa.dot.gov/Proceedings/26/26ESV-000042.pdf, accessed April 14, 2020.

the company had built in the context of various ESV conferences since their beginning in the early 1970s.[4]

From a historical perspective, Mercedes-Benz's choice to advertise its dedication to automobile safety in this way raises a number of questions. Why would a company notoriously proud of its German engineering tradition, reaching back to the very invention of the automobile, go to such lengths to remind its potential customers of a project started by the U.S. federal bureaucracy in 1970? What influence did the original Experimental Safety Vehicle (ESV) program have on the development of automobiles since the early 1970s, and how does it fit in with the oft-described "paradigm changes" in the field during this time? What can the program's history tell us about the way in which these conceptual changes and new regulatory requirements translated into safety practices—not only in the United States, but worldwide? And what role did the experimental prototypes themselves play in this?

As Mercedes seems to implicitly suggest in its promotion of the ESF 2019, there are some parallels between the potentially profound disruptions to our familiar system of automobile mobility widely discussed today and the situation in the early 1970s. In the shadow of that decades' triple crisis of the seemingly unstoppable rise of accident deaths, the increasing awareness of environmental degradations caused by mass-motorization, and the economic disruptions of the first oil price shock, many observers predicted far-reaching changes to what automobiles of the future would look like, and how they would be used.[5] Then, as now, automation was widely considered the ultimate technological solution to most of these problems. In marked contrast to today however, only the most daring technological visionaries of the 1970s would have considered the total replacement of human drivers a viable option for the immediate future.[6] Instead, engineers and officials of

4 ESF 2019: New Safety Ideas for a New Mobility, https://www.mercedes-benz.com/en/innovation/vehicle-development/esf-2019/, accessed April 14, 2020.

5 On the interactions between car culture and the societal changes of the 1970s cf. recently Sina Fabian, Boom in der Krise. Konsum, Tourismus, Autofahren in Westdeutschland und Großbritannien 1970–1990 (Göttingen 2016); Ingo Köhler, Auto-Identitäten. Marketing, Konsum und Produktbilder des Automobils nach dem Boom (Göttingen 2018); for a broader contextualization in (West German) processes of societal change Frank Bösch, "Boom zwischen Krise und Globalisierung. Konsum und kultureller Wandel in der Bundesrepublik der 1970er und 1980er Jahre", Geschichte und Gesellschaft 42, No. 2 (2016), 354–376.

6 While the idea was occasionally mentioned as a sort of utopian solution for the medium-to-long-term, the early 1970s seem to have marked a temporary lull in the production of visions for fully automated personal automobiles; cf. Jameson Wetmore's article in the present issue. Instead, automation enthusiasts during this time appear to have focused on collective (or hybrid private-collective) transport systems, cf. Barbara Schmucki, "Individualisierte kollektive Verkehrssysteme und kollektive individuelle Verkehrssysteme. Die Vision von Neuen Technologien zur Lösung der Verkehrsnot in den Städten in den 1970er Jahren", in Geschichte der Zukunft des Verkehrs. Verkehrskonzepte von der frühen Neuzeit bis zum 21. Jahrhundert, ed. H.-L. Dienel and H. Trischler (Frankfurt a.M. 1997), 147–169.

the time concentrated their efforts on less ambitious versions of partial automation, limiting themselves to the transfer of some selected functions from human users to the machine. Some of the solutions developed in this context are easily recognizable as direct predecessors of today's assisted driving systems, such as anti-lock braking or early radar distance-warning systems. Arguably the most consequential of these transfers of responsibility, however, concerned what Peter Norton has described as the replacement of the "paradigm of control" by the "paradigm of crashworthiness" as the dominant approach to automobile safety.[7] Whereas until the late 1950s most traffic safety measures had concentrated on the driver's responsibility to avoid accidents, subsequently a new approach started to gain ground. Its proponents claimed that it should be incumbent upon the car (and hence indirectly its makers) to protect occupants under all circumstances. Functionally, this also constituted a form of automation, as a vital function of the automobile—the protection of it passengers—which had so far mainly been the responsibility of the human operator, was (partially) entrusted to new technical systems such as crumple zones or passenger restraints.[8]

In the historiography of automobility, the "invention" and establishment of crashworthiness have often been presented as an American story: starting from the emergence of impact biomechanics in the 1940s, to the activities of Ralph Nader and his associates in the mid-1960s, and culminating in the National Traffic and Motor Safety Act of 1966.[9] However, this only provided the starting point for the difficult task of translating the new approach to automobile safety into regulatory standards, establishing new evidence practices and infrastructures for testing, and ways and means of enforcing them.[10] Even more importantly, crashworthiness was never exclusively an American issue. While Peter Norton developed his paradigm model explicitly with a view to "traffic safety in the twentieth-century United States", he suggests that "American patterns were echoed across the Atlantic and perhaps elsewhere"—albeit with

7 Peter D. Norton, "Four Paradigms. Traffic Safety in the Twentieth-Century United States", Technology and Culture 56, No. 2 (2015), 319–334. The redistribution of responsibility (and not least legal liability) implied by this paradigm change is most clearly described by Jameson M. Wetmore, "Redefining Risks and Redistributing Responsibilities. Building Networks to Increase Automobile Safety", Science, Technology, & Human Values 29, No. 3 (2004), 377–405.

8 Cf. the definition of automation quoted in the introduction to this issue.

9 For the "classic" version of this narrative see Joel W. Eastman, Styling vs. Safety. The American Automobile Industry and the Development of Automotive Safety, 1900–1966 (Lanham 1984); for an up-to-date account cf. Lee Vinsel, Moving Violations. Automobiles, Experts, and Regulations in the United States (Baltimore 2019), ch. 3–5.

10 Cf. on this question Jameson M. Wetmore, "Delegating to the Automobile. Experimenting with Automotive Restraints in the 1970s", Technology and Culture 56, No. 2 (2015), 440–463; Lee Vinsel, "Designing to the Test. Performance Standards and Technological Change in the U.S. Automobile after 1966", Technology and Culture 56, No. 4 (2015), 868–894.

potentially significant regional or national divergences.[11] This not only leaves the question of the nature of the connection between the U.S. example and its overseas "echoes" unanswered, but also neglects the fact that the American developments themselves took place in a larger, transnational context.[12] The automobile industry of the late 1960s and early 1970s was already such a highly globalized endeavor that, even in the U.S., which considered itself the motherland of mass motorization, a radical change of safety strategies necessarily implied some amount of trans- and international coordination.

As this article will argue, a closer look at the ESV program can help to fill in both of these historiographical gaps. Originally set in motion by the National Highway Traffic Safety Administration (NHTSA) of the U.S. Department of Transportation (DOT) to prepare new national safety standards, the program provided a highly visible public statement of the agency's approach to the concept of crashworthiness. Subsequently extended and internationalized through the North Atlantic Treaty Organization (NATO), the scheme ultimately came to involve not only the governments of the most important industrial powers of the alliance, but also almost all major automobile corporations in the Western world at that time. By enabling—and indeed forcing—these very different actors to directly engage with the NHTSA's ideas, the ESV program was essential for systematizing and institutionalizing the inter- and transnational conversation about automobile safety, creating new forums and institutional structures, some of which, such as the above-mentioned ESV conferences, persist to this day. This did not mean that all those involved necessarily came to share the NHTSA's idea of crashworthiness. On the contrary, as will be shown, the ESV program often highlighted the differences between "American" and "European" (and Japanese) approaches to automobile safety. In some cases, the fierce opposition of some of the international participants also served to modify the U.S. regulators' position on the issue.

Part of the reason why the ESV program seems so far to have largely escaped the attention of automotive historians—with the notable exception of the involvement of two German automakers, VW and Mercedes-Benz[13]—might

11 Norton, "Four Paradigms", 320.

12 Amongst the existing transnational histories of automobility, two in particular stand out: Gijs Mom, Atlantic Automobilism. Emergence and Persistence of the Car, 1895–1940 (New York, Oxford 2015), concentrates on the pre-World-War-II history of automobiles; Ann Johnson, Hitting the Brakes. Engineering Design and the Production of Knowledge (Durham 2009), traces transnational "expert communities" forming around Anti-Lock-Braking (ABS) technology.

13 Heike Weishaupt, Die Entwicklung der passiven Sicherheit im Automobilbau von den Anfängen bis 1980. Unter besonderer Berücksichtigung der Daimler-Benz AG (Bielefeld 1999), esp. 314–356, presents an account of the project from the point of view of Mercedes-Benz; Norbert Stieniczka, Das "narrensichere" Auto. Die Entwicklung passiver Sicherheitstechnik in der Bundesrepublik Deutschland (Darmstadt 2006), esp. 263–318, examines the contribution of both Mercedes and Volkswagen in comparison.

have to do with its performative aspects, which could make it seem more like a fanciful PR stunt than "serious" engineering. This is particularly true for the experimental safety vehicles themselves, which contemporary critics routinely dismissed as over-expensive curiosities that attracted a lot of attention, but were of minimal practical relevance to the improvement of automobile safety. In this article, I will argue that the ESVs, on the contrary, had an essential part in the renegotiation of safety standards: both as interventions in the public discourse, and as specific technical artefacts. I am particularly interested in the functioning of the prototype cars as what I will call "evidence objects", comprising both an epistemic and a discursive dimension. On the one hand, ESVs were used to *generate and validate specific technical knowledge*, for example on the technical feasibility and consequences of certain safety specifications. On the other hand, many, if not all of the prototypes were built with the explicit purpose of *making the case for particular (socio-technical) conceptions* of automobile safety, which were influenced at least as much by economic and political as by technical considerations. As recent works in Science and Technology Studies (STS) have pointed out, this dual nature—as presently existing technical artefacts and representations of an envisioned (socio-technical) future—is typical for prototypes. While their claim to attention rests on their purported status as anticipations of things to come, their present materiality accounts for much of their argumentative force.[14] In contrast to narrative scenarios, which verbally describe specific visions of the future, the fact that prototypes like the ESVs could be physically experienced and materially tested made them much more difficult to argue against – unless one could point to one's own material prototype.[15] In addition, being able to point to an existing object fit very well with the logic of the mass media, making the ESVs a very effective strategic choice to create publicity for visions of a different, safer automobile future.[16]

This article is based on original research conducted in the German Federal Archives in Koblenz (BAK), published sources created in the context of the ESV program itself, and the analysis of a variety of periodicals such as professional journals, motor magazines targeted at a wider public, and general news media in West Germany and the United States. Inevitably, this leads to a tendency to reflect the West German and U.S. points of view more thoroughly than other possible angles. However, this problem is at least somewhat

14 Cf. Ingo Schulz-Schaeffer and Martin Meister, "Laboratory Settings as Built Anticipations. Prototype Scenarios as Negotiation Arenas Between the Present and Imagined Futures", Journal of Responsible Innovation 4, No. 2 (2017), 197–216; Sascha Dickel, Prototyping Society. Zur vorauseilenden Technologisierung der Zukunft (Bielefeld 2019).

15 As Dickel (ibid., 51), points out, prototypes thus function analogously to the laboratory in scientific knowledge production, which likewise promises to back up verbal arguments with material demonstrations.

16 Dickel (ibid., 56), calls this function of prototypes "inszenatorische Objekte" (mise-en-scène objects).

mitigated by the fact that much of the material used is explicitly concerned with matters of international cooperation, and/or includes material produced by program participants from other nations. As far as possible, I have tried to fill remaining gaps by making use of secondary literature. I will proceed in three steps: Firstly, I will outline the origins of the ESV program in the public discussions about the post-war accident crisis and the idea crashworthiness during the 1950s and 1960s, with a special regard to the role of early safety prototypes in the debate. Secondly, I will give a brief account of the original aims and structure of the U.S. ESV project, and its subsequent development into an internationally coordinated, industry-wide research and development effort. Thirdly, I will look more closely at some of the different prototypes built and the arguments developing around them in the framework of the program, before summing up my arguments in the conclusion.

Object(ive) Evidence for Safety: Experimental Vehicles and the Crashworthiness Debate of the 1950s and 1960s

For the industrialized countries of the Western world, the first three decades following the Second World War—Eric Hobsbawm's "Golden Years"[17]—were also a golden age of the automobile. Whereas in the interwar years, private motor cars had remained a privilege of the middle-to-upper classes, especially outside of North America, the combination of rising wages and falling production costs during the post-war "economic miracle" brought ownership within the reach of "ordinary" citizens.[18] With its promises of mobility, personal freedom, and social and economic advancement, in many countries the car came to symbolize the benefits of the new post-war order.[19] However, the democratization of the automobile did not come without costs. Arguably the most visible and most hotly debated side effect of mass-motorization was the seemingly unstoppable rise of the number of deaths and serious injuries caused by automobiles. In the United States, the global pioneer of mass-motorization,

17 Eric J. Hobsbawm, Age of Extremes. The Short Twentieth Century, 1914–1991 (London 1995), 257–286.

18 Following the periodization by Mom, Atlantic Automobilism, the era of "mass-motorization" in Europe and North America can be said to span the years between 1945 and 1975. On the general development of cars and car culture in the 20th century cf. Kurt Möser, Geschichte des Autos (Frankfurt a.M., New York 2002).

19 For the West German case cf. Dietmar Klenke, "Die deutsche Katastrophe und das Automobil. Zur ‚Heils'geschichte eines nationalen Kultobjekts in den Jahren des Wiederaufstiegs", in Moderne Zeiten. Technik und Zeitgeist im 19. und 20. Jahrhundert, ed. M. Salewski and I. Stölken-Fitschen (Stuttgart, 1994), 157–174; for "car culture" in the U.S. cf. Mark S. Foster, Nation on Wheels. The Automobile Culture in America since 1945 (Belmont, CA 2003); Tom McCarthy, Auto Mania. Cars, Consumers, and the Environment (New Haven 2007). For an exploration of the (positive as well as negative) emotive power of automobiles in West Germany and the U.S. cf. most recently Thomas Zeller, "Loving the Automobile to Death? Injuries, Mortality, Fear, and Automobility in West Germany and the United States, 1950–1980", Technikgeschichte 86, No. 3 (2019), 201–226.

yearly traffic fatalities had already reached around 30,000 in 1946. By 1950, they exceeded 35,000, surpassed 40,000 in 1963, and finally reached 55,000 in 1969.[20] While absolute numbers were lower in other countries, their roads were hardly less dangerous. Calculated per registered vehicle or distance travelled, the fatality rates in almost all other highly industrialized nations—be it Britain, Australia, Italy, West Germany, the Netherlands, France, Finland or Japan—were even more appalling.[21] In the one-year span of 1965/1966, over 111,000 people lost their lives in motor vehicle accidents in the then-15 NATO member states, causing the World Health Organization to refer to traffic deaths as "an epidemic spreading around the world from which no country is exempt".[22]

In the immediate post-war years, governmental responses to this problem in most countries were still shaped by the paradigm of "control" or "crash avoidance".[23] This approach, which had first become prevalent in the United States during the interwar period thanks to the efforts of a coalition of automobile clubs, car dealers and the auto industry, held at its core that ensuring road safety meant preventing accidents.[24] This was possible, proponents argued, by keeping three factors under control: the driver, the road, and the car. As drivers (and other human participants in traffic, such as pedestrians) were thought to be responsible for the overwhelming majority of accidents, educating and disciplining them was considered the most important task.[25] To improve the safety of roads, post-war governments invested vast sums of public money into construction programs—even though utopian visions of eliminating accidents through "fool-proof" or even completely automated highway systems ultimately remained beyond reach.[26] The automobile itself initially tended to be the least scrutinized of the three factors. Under the paradigm of control, even fast and powerful cars were not considered dangerous, as long as they functioned reliably and provided some help to their drivers to avoid collisions by

20 U.S. Department of Transportation, Highway Statistics Summary to 1995, table FI-200, https://www.fhwa.dot.gov/ohim/summary95/index.html, accessed April 14, 2020.

21 According to NATO statistics, the yearly traffic death rate per 100 million vehicle miles travelled for 1966/7 ranged from 5.6 for the USA, to 7.0 for Britain, 12.1 for Italy, 13.3 for West Germany and France, and 16.1 for the Netherlands. In terms of yearly deaths per 100,000 registered vehicles, West Germany had by far the worst record with 126.0, compared to 92.5 in Finland, 85.4 in Japan, 78.7 in Australia, 67.7 in France and 54.4 in the USA; cf. NATO Letter 18 (1970), 19f.

22 Ibid.

23 Norton, "Four Paradigms", 326f. Wetmore's "crash avoidance approach" describes essentially the same idea, using a slightly different focus; cf. Wetmore, "Redefining Risks", 380–382

24 Cf. Peter Norton, Fighting Traffic. The Dawn of the Motor Age in the American City (Cambridge, Mass. 2008), ch. 8; for the post-war period Steve Bernardin, "Taking the Problem to the People. Traffic Safety from Public Relations to Political Theory, 1937–1954", Technology and Culture 56 (2015), 420–439.

25 For the (West) German case, Stieniczka, Das "narrensichere" Auto, has therefore described the official approach to road safety between the 1920s and the 1960s as "Strategie des disziplinierten Verkehrsteilnehmers" ("strategy of the disciplined participant in traffic").

26 Cf. Jameson Wetmore's article in the present issue.

sporting features such as good handling, reliable brakes, or adequate lighting, which were later described as "active safety". Since most new automobiles already fulfilled these requirements to a reasonable degree, the auto industry could claim that it bore little responsibility for the horrifying death toll on the roads. As late as 1953, the journal of the West German Automobile Club (ADAC)—while deploring the rising number of traffic deaths—congratulated international automobile companies for successfully improving the safety of their products "year after year".[27]

Over the course of the 1950s, however, the escalating accident crisis started to erode the credibility of the crash avoidance approach. A new generation of safety advocates began to argue that, given the conditions of mass-motorized traffic, the complete prevention of accidents was clearly impossible. However, drawing on the first results in the fledgling field of crash accident research, obtained by a handful of dedicated pioneers in the U.S. since the 1930s, they contended that much more could be done to mitigate the *consequences* of accidents.[28] Automobiles, in particular, had to be redesigned in a way to keep their occupants safe not only during "normal" operation, but also—and especially—in the case of an accident. This would require features such as padded interiors, passenger restraints, or frame structures suitable for absorbing kinetic energy. This new approach, which soon became subsumed under "crashworthiness" or "passive safety"[29], radically shifted responsibility for safety from drivers and government officials (in charge of law enforcement as well as infrastructure) towards the car itself, and hence the automobile industry. As a result, car companies, which had so far largely remained on the sidelines of the traffic safety debate, started to see themselves publicly accused of being "killers", selling products that turned into "death traps" in the case of accidents thanks to sharp-edged "meat cleaver" dashboards, rigid "chicken skewer" steering columns, or doors that sprung open upon impact.[30]

Under increasing public pressure, some car manufacturers in the U.S. and in Europe started to embrace the idea of passive safety and develop new engineering solutions. While in America, Ford tentatively equipped its 1956 models with a "safety package", in Europe, Volvo introduced the three-point

27 Herbert Kuhn, "Ist das Kraftfahrzeug sicher?" ADACM 6 (1953), 314f., all translations by the author.

28 Cf. Amy Beth Gangloff, "Safety in Accidents. Hugh DeHaven and the Development of Crash Injury Studies", Technology and Culture 54, No. 1 (2013), 40–61; Eastman, Styling vs. Safety, 177–208; Vinsel, Moving Violations, 88–116.

29 „Crashworthiness" was the common term in the U.S. The distinction between "active" and "passive" safety seems to have been coined by an Italian engineer in 1964. It was introduced by Mercedes-Benz to German-speaking engineers, while their French colleagues preferred to speak of "primary" and "secondary" safety; Stieniczka, Das "narrensichere" Auto, 46f.

30 „Are Car Manufacturers Killers?", Magazine Digest, 1953, quoted by Eastman, Styling vs. Safety, 220; "Ist das Auto eine Todesfalle? Ein SPIEGEL-Gespräch mit dem Chefkonstrukteur der Opel-Werke, Dr.-Ing. E.h. Karl Stief", Der Spiegel, 4.12.1957, 44–53.

seat belt and Mercedes-Benz the "crumple zone" into their production vehicles in 1959.[31] However, these examples generated public attention precisely because they were seen as exceptional. In general, the industry resisted any drastic changes to their designs and practices, claiming that this would be, firstly, technically too difficult, secondly, economically disastrous, and thirdly, unpopular with customers, who presumably did not care much for safety. "Safety doesn't sell" became a kind of mantra in the industry.[32] When pressed on specifics—as for example representatives of the U.S. "Big Three", General Motors, Ford, and Chrysler, were in a Congressional Hearing in 1956—auto executives resorted to the argument that there was still not enough evidence for the effectiveness of the proposed measures.[33]

To confront what they saw as deliberate foot-dragging on the part of the industry, and to demonstrate to the public that building a "crash-proof" car was actually feasible and practicable, safety advocates repurposed a well-known practice in automobile engineering: constructing experimental prototypes.[34] The first widely noted experimental vehicle with an explicit focus on passive safety was the creation of the Cornell Aeronautical Laboratory, a university-affiliated aviation research center in upstate New York. The Laboratory had been contracted in 1951 by the Liberty Mutual Insurance Company to undertake research into passenger injuries in automobile crashes. Drawing on the results of this work, Cornell researchers developed an experimental "safety car", which was presented to the public in 1957. Extensively remodeling a current Ford production model to incorporate more than 60 safety systems—including some "exotic" solutions such as backwards-facing rear seats, accordion-style doors and control levers instead of a steering wheel—they claimed to have created a vehicle that would allow passengers to survive collisions of up to 50 mph without serious injuries.[35]

31 Cf. Eastman, Styling vs. Safety, 224–232; Heike Bergmann, "Angeschnallt und los. Die Gurtdebatte der 1970er und 1980er Jahre", Technikgeschichte 76 (2009), 105–130; Weishaupt, Die Entwicklung der passiven Sicherheit, 174–180.

32 This oft-repeated conviction seems to have been based largely on the experience of the 1956 Ford campaign. However, its results were far from uniformly negative, as Eastman, Styling vs. Safety, 223–232, shows. For the West German case, Stieniczka, Das "narrensichere" Auto, 186f., argues convincingly that as early as the late 1950s (passive) safety had become a quite persuasive sales pitch, in spite of the industry's claim to the contrary.

33 Eastman, Styling vs. Safety, 242.

34 Prototypes demonstrating different kinds of engineering innovations can be found throughout automotive history, starting with the very first automobiles. In addition, a small number of car models especially emphasizing injury reduction (through padded dashboards etc.) were built in the U.S. in the interwar years, such as the 1926 "Safety Stutz", the 1937 Dodge (with a design influenced by crashworthiness research pioneer Claire Straith), or the 1939 Studebaker; cf. Eastman, Styling vs. Safety, 178–183. However, all of these seem to have been production models (albeit of the more experimental type) rather than "true" prototypes.

35 Ibid., 192f.; Weishaupt, Die Entwicklung der passiven Sicherheit, 106f. The vehicle itself has been preserved and is now on display at The Henry Ford Museum in Dearborn, Michigan;

The Cornell-Liberty car started what can almost be called a fad for safety prototypes. Private enthusiasts picked up on the idea and presented their own, even more idiosyncratic contributions, such as the "Aurora" (1957) or the "Sir Vival" (1958).[36] In 1961, a second Cornell-Liberty Safety Car followed, this time with fewer spectacular novelties and increased attention towards practicability and affordability.[37] The reaction of the auto industry was mostly dismissive. Asked about his opinion on the second attempt by Cornell-Liberty, a spokesman declared that the vehicle did a "fine job of dramatizing the need for auto safety", but would stand little chance of being accepted by consumers.[38] Nevertheless, the prototypes created a considerable amount of public attention: they made the national media in the United States, and were also discussed by automobile publications in Europe.[39] Soon, the European car industry reacted with its own prototype. At the 1963 Turin car salon, Italian car designers Pininfarina showed a demonstration vehicle called the "PF Sigma", which also incorporated a number of passive safety systems patented by Mercedes-Benz. Although the car was not operable, its enthusiastic reception in the specialized press demonstrated the rising popularity of crashworthiness ideas in Europe too.[40] However, as long as the discussion remained confined to media campaigns and did not trigger any legislative or administrative action, this had only limited impact on industry practices.[41]

The situation was very different in the United States, where safety advocates and crash injury researchers started to form strategic alliances with members of the administrative and legislative system in the early 1960s. One result of this collaboration took the shape of a new safety prototype, commis-

cf. Matt Anderson, 1957 Cornell-Liberty Safety Car, https://www.thehenryford.org/explore/blog/1957-cornell-liberty-safety-car/, accessed April 14, 2020.

36 The "Aurora" was created by Father Alfred Juliano, a Catholic priest and automotive design enthusiast from Connecticut; the "Sir Vival" owed its existence to Walter C. Jerome, a high school teacher with an engineering degree from Worcester, Massachusetts. Both cars looked highly unusual, and repeated attempts by their creators to have them manufactured in higher numbers were unsuccessful; cf. Jerry Garrett, "How Ugly? Put a Bag on That Car", New York Times, December 23, 2007; "Last Word in Safety Cars?", Mechanix Illustrated, 1959 (April 1959), 59–61.

37 Eastman, Styling vs. Safety, 193; cf. also Ernst Behrendt, "Survival II. Das Auto, in dem einem nichts passieren kann", ADACM, 14 (1961), 660–666.

38 Quoted by Eastman, Styling vs. Safety, 193.

39 This even included prestigious high-brow magazines: According to Vinsel, Moving Violations, 88, the writer John Updike contributed a piece on the first Cornell-Liberty for the *New Yorker.*

40 Weishaupt, Die Entwicklung der passiven Sicherheit, 108f.; Stieniczka, Das "narrensichere" Auto, 193f.

41 As was for example the case in West Germany, were the responsible authorities proved very reluctant to issue any regulations pertaining to crashworthiness; cf. Stieniczka, Das "narrensichere" Auto, 198f.

sioned this time not by a private entity, but by the State of New York.[42] The "New York Safety Sedan", developed between 1965 and 1967 by another aviation-related contractor, the Republican Aviation division of the Fairchild Hiller Corporation (FHC), constituted a direct precursor to the future ESV program. The large, "tanklike" car (as *TIME magazine* described it) not only shared a number of specific design goals with the later project,[43] but also already pioneered some of their most remarkable technical features, such as energy-absorbing hydraulic bumpers and a periscope for better rear vision.[44]

While the New York Safety Sedan was still in development, a series of events suddenly pushed crashworthiness to the top of the national political agenda.[45] In the summer of 1965, Senator Abraham Ribicoff, chairman of a little-know Senate committee, began a series of public hearings on automobile safety, which unexpectedly turned into a national public relations disaster for the automobile industry. Shortly afterwards, one of Ribicoff's aides, the young lawyer and consumer activist Ralph Nader published *Unsafe at Any Speed*, a book-length indictment of the car industry, which quickly became an international bestseller.[46] On the back of this sudden and decisive swing in public opinion—further aided by the revelation of GM's clandestine surveillance of Nader—Congress passed the National Traffic and Motor Vehicle Safety Act (NTMVSA), signed into law by President Lyndon B. Johnson in September 1966.[47] It created the Department of Transportation (DOT), a federal highway safety program, and the National Highway Safety Bureau (NHSB), which became the National Highway Traffic Safety Administration (NHTSA) in 1970. The latter was given the task to write and enforce Federal Motor Vehicle Safety Standards (FMVSS), with which all cars sold in the United States would have to comply. This included a mandate to "conduct research, testing development and training necessary", notably by "procuring (by negotiation or otherwise) experimental and other motor vehicles or motor vehicle equipment for research and testing purposes".[48] In March 1968, the DOT awarded three contracts for preliminary studies on a federal experimental safety vehicle program. By early 1970, the Department sent out a request for

42 On the central role of the "New York safety scene" in the early crashworthiness movement cf. Vinsel, Moving Violations, 118–127.

43 Such as the survivability of 50 mph frontal and rear impacts, 40 mph side impacts and 70 mph rollovers.

44 Cf. "New York State Safety Car Makes Its Debut", SAE Journal 75, No. 3 (1967), 36–47; "Proposals & Prototypes", TIME Magazine 90, No. 23 (1967), 108.

45 Cf. P. W. Gikas, "Crashworthiness as a Cultural Ideal", in The Automobile and American Culture, ed. D. L. Lewis and L. Goldstein (Ann Arbor 1983), 327–339; Eastman, Styling vs. Safety, 241–250.

46 Ralph Nader, Unsafe at Any Speed. The Designed-In Dangers of the American Automobile (New York 1965). On Nader's role cf. especially Vinsel, Moving Violations, 117–143.

47 More precisely, the legislation in question consisted of three separate acts, U.S. Public Law 89-563, 89-564, and 89-670.

48 U.S. Public Law 89-563, Sec. 106 (a).

proposals for the "design, development, fabrication and delivery of a prototype Experimental Safety Vehicle".[49]

Setting (Inter-)National Standards: The ESV Program and Its Internationalization

Apart from its federal purview, the DOT's ESV program initially represented a more or less direct continuation of earlier attempts, especially the Cornell and New York Safety Sedan projects. Its aim was not to deliver a realistic precursor to future production models, but rather to provide the agency with leverage in its extremely ambitious drive to radically reduce—or even completely eliminate—traffic deaths in the U.S. within a decade.[50] To this end, the project had four main objectives: firstly, it would prove the technical feasibility of a much higher degree of passive safety and crash protection, preferably without making too many concessions in terms of driving performance, practicability or aesthetics. Secondly, it was meant to influence public opinion and "stimulate public awareness" of the facts that cars could be substantially safer. This would, thirdly, increase pressure on the automobile industry to invest more in safety research and development, and to speed up the introduction of passive safety features into their production models. Lastly, by testing and examining the resulting experimental vehicles, the project was to generate specific technical data that the agency could use to set new, legally binding safety standards.[51]

To achieve these aims, the NHTSA intended to follow the lead of the recently completed Apollo program and contract private firms from the aerospace and defense sector, working according to government-defined specifications. Free from the constraints of the highly competitive automobile market, they would be able to employ a "total systems engineering" approach, "designing a car from the ground up with safety as a primary goal", instead of a mere "add-on".[52] This would provide the much-needed "quantum jump" in automobile safety, which car manufacturers had been unwilling or unable to deliver. "[W]e are goading the industry", Douglas Toms, the NHTSA's energetic new director, told the journal of the American Society of Automotive Engineers in

49 NHSB, 1969 Report on Activities Under the National Traffic and Motor Vehicles Safety Act (Washington 1970), 142; RFP DOT-OS-00050, "Subject: Experimental Safety Vehicle (Family Sedan)", Feb. 17, 1970, copy in BAK B 108/23073.

50 Cf. People in the News, "Douglas Toms Details Safety Bureau's Goals", Automotive Engineering 78, No. 8 (1970), 83; Robert Brenner, "Opening Remarks", in Report on the First International Technical Conference on Experimental Safety Vehicles. Paris, France. January 25–27, 1971, ed. NHTSA (Washington, D.C. 1971), 6–11.

51 NHSB, 1969 Report on Activities, 141f. These four objectives remained constant talking points throughout the project, which were repeated by NHTSA representatives at almost every presentation and can still be found in the final project summary; cf. Committee on the Challenges of Modern Society (CCMS), Experimental Safety Vehicles Project. CCMS Report No. 23 (1974), 3.

52 NHTSA (ed.), Report on the Third International Technical Conference on Experimental Vehicle Safety. Washington, D.C., May 30–June 2, 1972 (Washington, D.C. 1972), 1/5.

a 1970 interview with remarkable frankness: "If they wanted to, they could make a safer vehicle. We are aiming to show the industry not only how it can be done but that with our modest resources we can have it built."[53]

In June 1970, the NHTSA awarded contracts totaling about $8 million to two project teams.[54] Both consisted largely of established members of the U.S. military-industrial complex and participants of earlier safety vehicle projects. Fairchild Hiller Corporation (FHC), a constructor of military aircraft and the leader of the first team, had worked on the New York Safety Sedan. The second team, led by American Machine and Foundry (AMF)—a diversified industrial conglomerate that produced everything from bowling pins to nuclear reactors—comprised amongst others the Cornell Aeronautical Laboratory.[55] Against the NHTSA's original intentions, they were joined by two of the automobile giants: General Motors (GM) signed a third, additional contract for a nominal $1 fee, and Ford followed with one year's delay in June 1971 under the same conditions.[56] All four contractors were required to deliver fully functional prototypes of a "typical family sedan" in the 4000 lb/ 1800 kg class for inspection and testing, fulfilling a long list of stringent safety requirements with a particular focus on crashworthiness.[57]

According to the NHTSA, the "full size" five-seater family sedan had been chosen because of its "overwhelming popularity" in the United States.[58] However, the large majority of automobiles produced outside of North America belonged to the compact and subcompact classes, which were gaining popularity even within the U.S., as rising import numbers attested. NHTSA officials were well aware that fulfilling stringent passive safety criteria would be substantially harder for smaller cars, since the margins of maneuver in terms of physical space, weight and price were much slimmer. To find new solutions for this model range, if possible without undue expense to the Amer-

53 People in the News, "Douglas Toms Details Safety Bureau's Goals", 83; "The Crash Program That is Changing Detroit. Special Report", Business Week, 27.2.1971, 78–83.

54 In addition to the contracts themselves, NHTSA spent $1.6 million between 1970 and 1974 on testing and similar activities in the framework of the program. By comparison, research expenses related to alcohol and drug use in traffic—another one of the agency's three "priority programs" at that time—added up to about $3.1 million during the same period; cf. NHTSA, Traffic Safety '74. A Report of Activities Under the National Traffic and Motor Vehicle Information and Cost Savings Act of 1972, Washington, D.C., Annex E.

55 Both companies had already been contracted for the ESV preliminary study. The third preliminary contractor, the Digitek Corporation, participated as a subcontractor to FHC. Both groups also included partners from the automobile industry to help with design and styling, Chrysler for FHC and Minicars Inc. for AMF; cf. Albert Schlechter, "The United States 4000 lb. Experimental Safety Vehicle. Performance Specification", in Report on the First International Technical Conference (Washington, D.C. 1971), 26.

56 DOT Press Release, 21.6.1971, BAK B 108/37504. The third major automotive corporation in the U.S., Chrysler, later joined the FHC group as a subcontractor.

57 Cf. "Experimental Safety Vehicles Emphasize Crashworthiness", Automotive Engineering 79, No. 1 (1970), 54–55; "Enclosure 5: Statement of Work", BAK B 108/23073.

58 Schlechter "The United States 4000 lb. Experimental Safety Vehicle", 25.

ican taxpayer, it seemed highly desirable to include small cars and foreign automakers into the project in some form.[59] While the U.S. ESV project was still under preparation, an opportunity to do both of these things arose in a somewhat unexpected institutional context.

In April 1969, President Richard Nixon surprised allies and opponents alike by publicly declaring his intention to endow NATO with a "third dimension". In addition to the alliance's military and political functions, a newly created Committee on the Challenges of Modern Society (CCMS) would work to safeguard the "quality of life" of citizens in the member states.[60] Although the main idea behind CCMS was to strengthen NATO by linking it to the newly emerging field of environmentalism, the Committee interpreted its task to encompass addressing all problems resulting from the "unheeded effects of technological change".[61] "Road safety" became one of the eight original "pilot projects" of the CCMS accredited by the NATO council in February 1970 largely due to the efforts of Daniel Moynihan, Nixon's special advisor on interior policy and one of the "intellectual fathers" of the CCMS, who had been a key-member of the crashworthiness movement since the 1950s.[62] While the CCMS Road Safety project officially consisted of seven separate sub-projects, each "piloted" by a different member of the alliance, the U.S.-led ESV-subproject formed the undisputed centerpiece.[63] At the first Technical Meeting of the CCMS in Brussels at the end of March 1970, Douglas Toms presented the idea of a sub-2000 lb/900 kg counterpart ESV program, to be undertaken by interested member states and contracted out to automobile companies in their respective countries. In exchange, the U.S. would offer technical help with the planning and implementation of such programs, and agree to an extensive exchange of information concerning the results of its own work.[64]

59 "Presentation for the First Technical Meeting of the U.S. Pilot Study on Road Safety. Experimental Safety Vehicles (ESV) Program" [March 1970], BAK B 108/23073.

60 On the CCMS cf. J. D. Hamblin, "Environmentalism for the Atlantic Alliance. NATO's Experiment with the 'Challenges of Modern Society'", Environmental History 15, No. 1 (2010), 54–75; Thorsten Schulz-Walden, Anfänge globaler Umweltpolitik. Umweltsicherheit in der internationalen Politik (1969–1975) (München 2013), 79–152; Evanthis Hatzivassiliou, "Nixon's Coup. Establishing the NATO Committee on the Challenges of Modern Society, 1969–70", The International History Review 38, No. 1 (2015), 88–108.

61 In the words of Daniel Moynihan, quoted by Schulz-Walden, Anfänge globaler Umweltpolitik, 94.

62 Cf. Schulz-Walden, Anfänge globaler Umweltpolitik, 84–86; on Moynihan's role in the "New York safety scene" cf. Vinsel, Moving Violations, 118–124.

63 The sub-projects were: Identification and Correction of Road Hazards (France), Pedestrian Safety (Belgium), Motor Vehicle Inspection (FRG), Accident Investigation (Netherlands), Alcohol and Highway Safety (Canada), Emergency Medical Services (Italy), and Experimental Safety Vehicles (USA); cf. Committee on the Challenges of Modern Society (CCMS), Road Safety Pilot Study. CCMS Report No. 21 (Washington, D.C. 1974).

64 "Presentation for the First Technical Meeting of the U.S. Pilot Study on Road Safety. Experimental Safety Vehicles (ESV) Program" [March 1970], BAK B 108/23073.

On the other side of the Atlantic, initial reactions to this proposal ranged from polite reluctance to active resistance. Representatives of the European automobile industry, who met in Frankfurt in late September of 1970 to coordinate their response, found it hard to imagine that their governments would not resent "attempts to dictate to them on behalf of the U.S. the way in which they or their industries might handle an e.s.v. project".[65] They thought the idea fundamentally unsuited to the structure of the European car industry, and generally seemed at a loss to understand what the U.S. was hoping to gain with such a program in the first place.[66] Since the Europeans felt they could not afford to simply ignore the American proposal, they tried to deflect it with a counter-initiative. The United Kingdom, which already had a very active national automobile safety research agency, the Road Research Laboratory (RRL),[67] took the lead in establishing a "European Intergovernmental Technical Committee on the Development of Experimental Safety Vehicles", later renamed European Experimental Vehicles Committee (EEVC).[68] As an alternative to the U.S.-led project, the Committee proposed to initiate a coordinated research program by a number of European countries; originally the UK, France and Italy, later joined by West Germany, Sweden and the Netherlands.[69] Under the guidance of the RRL, the Committee drew up a long list of "safety components", from which members could pick those they wished to pursue.[70] This not only went directly against Washington's insistence on separate bilateral agreements with each European partner, but was also fundamentally incompatible with the NHTSA's "total systems engineering" approach, much to the frustration of American officials.[71]

However, the "unified front" the Europeans tried to present did not last long. At the previously cited manufacturers' meeting in Frankfurt, there had

65 "2,000 lb experimental safety vehicle. Note of Meeting on Monday, 21st September 1970 in the offices of VDA, Frankfurt", 25.9.1970, BAK B 108/23073.

66 Ibid.

67 On the history of the RRL cf. George Charlesworth, A history of the Transport and Road Research Laboratory, 1933–1983 (Aldershot 1987). The RRL seems to have been ardently opposed to the ESV idea from the beginning. Hatzivassiliou, Nixon's Coup, 102, quotes a representative of the Ministry of Transport writing to RRL director D. J. Lyons in February of 1970: "I understand that you had it in mind to try to kill the project at the start, and I certainly would not want to dissuade you from this."

68 Cf. the minutes of the foundational meeting: "Note of conference on the development of ESVs held at the Ministry of Transport, October 14–15, 1970", BAK B 108/23073.

69 Although all EEVC members with the exception of Sweden were also part of the European Economic Community (EEC), and an EEC representative was admitted in 1971, the EEVC was never an official organ of the EEC/EU. It remains an independent intergovernmental organization to this day; cf. www.eevc.org, accessed April 14, 2020.

70 Cf. Bonk: "Reisebericht über die erste Sitzung des European Inter-Governmental Technical Committee on the Development of Experimental Safety Vehicles am 4. und 5. Februar 1971 in Rom", 15.2.1971, BAK B 108/23074.

71 Cf. e.g. "Remarks of Robert Brenner at European Conference on Experimental Safety Vehicles, London, October 14-15, 1970", BAK B 108/23073.

already been rumors that Volkswagen "might be willing to 'go it alone'".[72] The German company had been approached directly by the NHTSA as early as March 1970.[73] Three weeks later, Volkswagen publicly announced its decision to build an ESV in the 2000 lb-range, if necessary at its own expense.[74] This forced the hand of the reluctant West German government. On November 5, 1970, the U.S. DOT and the West German Ministry of Transport (BMV) concluded a Memorandum of Understanding concerning the initiation of an ESV program in the Federal Republic. Even though the German side was still unwilling to commit itself to any promises of financial subsidies,[75] this provided the necessary diplomatic breakthrough. Two weeks later, Japan signed a similar arrangement. Subsequently, the U.S. concluded further bilateral agreements with the United Kingdom and Italy in May 1971, France in October 1971, and finally with Sweden in March 1972.[76]

While negotiations on intergovernmental agreements were still ongoing, the ESV project began to gather momentum within the auto industry. Toyota, Nissan, Honda and Mercedes-Benz announced their participation in early 1971, followed by Volvo and Fiat. In addition, British Leyland, Ford Europe, Opel, Peugeot-Renault, Citroen, Saab, BMW, Porsche and Alfa Romeo all contributed work on "safety subsystems".[77] From a rather limited government-led research project, undertaken by a U.S. regulatory agency in order to prepare the issuing of national standards, the ESV program had grown into a multinational industry-wide initiative. By late 1973, the CCMS estimated that the combined total private and governmental expenditure on the scheme had already surpassed $150 million.[78]

What motivated profit-oriented automobile corporations to participate in the time-consuming and resource-intensive NHTSA scheme—many of them, remarkably, largely or even completely at their own expense?[79] Firstly, the

72 "2,000 lb experimental safety vehicle".

73 "Vermerk Anruf Dr. Lotz (VW)", 18.3.1970, BAK B 108/23073.

74 Günther Brenken, "Der Weg zum Sicherheitsautomobil", Automobiltechnische Zeitschrift (ATZ) 73, No. 5 (1971), 1–9.

75 As an internal memo explained, this was the reason why the agreement deliberately spoke of the development of an ESV "in" (as opposed to "by") West Germany; "Reisebericht Bonk zur ad-hoc-Sitzung des ETC in Paris am 25.&26.1.1971", 28.1.1971, BAK 108/23074.

76 Even more protracted were the negotiations concerning the annexes to the agreements pertaining to the envisioned information exchange; cf. the extensive diplomatic communication on this topic in BAK B 108/23073 to 108/23075. This was a very sensitive issue, since it not only risked divulging proprietary information belonging to participating corporations, but also threatened to run afoul of U.S. anti-trust legislation.

77 Cf. CCMS, Experimental Safety Vehicles Project, 5f.

78 Ibid., 5.

79 Apart from the non-automobile U.S. participants AMF and FHC, Toyota and Nissan were the only companies receiving a substantial amount of public funding for the construction of "full" ESVs in the framework of the project. The United Kingdom, France, Italy and Sweden all made public funds available for research and development work on subsystems.

United States was still the most important market for automobiles in the world by a very large margin; economically crucial not only for North American automakers, but also for a number of their European competitors. This gave U.S. officials a substantial amount of leverage, which they applied liberally to pressure companies into participation. According to a major North American newspaper, the U.S. government "made it clear in the secret negotiations that foreign car makers must cooperate in this 'Experimental Safety Vehicle' program if they expect to continue importing cars into the United States".[80] Volkswagen's decision in particular was at least partly a consequence of the company's unusually high degree of dependence on the U.S. market, where it sold up to 40% of its signature model, the Beetle, in the late 1960s.[81]

Secondly, as the ESV project started to create an increasing amount of public attention and not only trade journals, but also national news media began to take notice of the initiative, the possible public relations effects of (non-)participation became an important consideration.[82] For some companies, such as VW or GM—both of which had been particularly singled out for criticism by Ralph Nader—the project offered an opportunity to repair a somewhat battered reputation on safety.[83] Others, such as Mercedes-Benz or Volvo—who had made technically advanced safety features a central selling point of their relatively expensive cars—felt that they had to live up to their carefully nurtured brand image if they did not want to be overshadowed by their competitors. Not building an ESV would "at least outwardly make the advantage we have in regard to safety appear smaller and smaller", Mercedes' head of development Karl Wilfert argued in a letter to his board members.[84]

Thirdly, participation in the ESV project also constituted an attempt to regain some influence over the safety debate, and even the future form and shape of automobiles more generally. Given the importance of the U.S. as a global automotive trendsetter, *Business Week* reported, the sudden "regulatory barrage" emanating from the NHTSA was "bound to reshape auto design, production and sales more radically than anything that has happened since

80 "U.S. and NATO Seeking Auto Safety", Washington Post, 10.8.1970.

81 On VW's precarious situation in the late 1960s cf. Bernhard Rieger, The People's Car. A Global History of the Volkswagen Beetle (Cambridge Mass. 2013), 233–255.

82 Major news items in the general press included e.g. a 10-page feature in *Business Week* ("The Crash Program That is Changing Detroit. Special Report", Business Week, 27.2.1971), and a title story by the important West German weekly *Der Spiegel* ("Sicherheitsautos. Für Tage ohne Tote", Der Spiegel, 16.8.1971, 86–104).

83 GM's Chevrolet Corvair was the most prominent target of Nader's Unsafe at Any Speed; cf. Nader, Unsafe at any Speed. Nader had also publicly denounced the VW Beetle—designed in the 1930s and hence only partially compatible with more recent safety standards—as the "most dangerous car on American roads"; "Der Volkswagen tanzt Bossa Nova", Der Spiegel, 4.10.1971, 46–60.

84 Quoted by Weishaupt, Die Entwicklung der passiven Sicherheit, 318; cf. Stieniczka, Das "narrensichere" Auto, 263–265.

Henry Ford started up his first assembly line".[85] While U.S. auto executives complained loudly that they had "practically no say" in drafting the new regulation, the problem was even more acute for non-American companies. Not without reason, they feared that new standards based on American-sized cars might put their own, much smaller models at a distinct disadvantage. Some European politicians even started to wonder publicly whether the whole ESV project was not a "veiled form of protectionism", aiming to push European import cars out of the U.S. market.[86] Under these conditions, joining the ESV program in some form could seem like the best opportunity for non-American automakers and their respective governments to make their case to the NHTSA. As early as 1972, a perceptive German motor journalist concluded that "the aim of this almost pan-European safety demonstration" was not so much "image-cultivation" with consumers, but rather "the attempt to stir up the discussion on these [safety standards] issues again by introducing new arguments", in the hope of convincing the Americans regulators to "return to reason".[87] An internal memo by a West German official expressed a very similar idea somewhat more dryly: "Only by consequent cooperation in the development of experimental safety vehicles can evidence be provided that smaller vehicles can also fulfill the requirements made [by the NHTSA] particularly in respect to occupant protection, or that said requirements are objectively unobtainable for technical-physical reasons".[88]

Arguing with Evidence Objects: Experimental Prototypes and the Automobile Safety Debate

The ESV project therefore soon became not only a media event and a technical research and development effort, but also an important forum for the transnational (re-) negotiation of the predominant automobile safety paradigm. The international ESV conferences in particular, attended by both government and industry representatives, were notable for the direct—and at times quite confrontational—exchange of opinions and arguments between the NHTSA, European governments, and automobile companies.[89] In addition to technical

85 "The Crash Program That is Changing Detroit. Special Report", Business Week, 27.2.1971, 78. In Europe, this sentiment was echoed by the German weekly Der Spiegel, which claimed that Douglas Toms "now wields more power to determine the appearance, construction and performance of new generations of automobiles than even the mightiest auto bosses, such as GM president Edward Cole or Fiat boss Giovanni Agnelli, ever had"; "Sicherheitsautos. Für Tage ohne Tote", Der Spiegel, 16.8.1971, 87.

86 Inquiry 407/70 by MEP Glinne (Belgium), 21.12.1970, BAK B 198/23074.

87 Clauspeter Becker, "Zurück zur Vernunft", Auto Motor und Sport, No. 11 (1972), 46. Unless otherwise indicated, all translations by the author.

88 Ref StV 1: „Betr.: Zuwendungen des Bundes an die Volkswagenwerk AG für den Bau und die Erprobung von 40 Prototypen eines Experimentier-Sicherheitsfahrzeugs", 29.2.1972, BAK B 108/37505.

89 In the build-up to the second conference in October 1971, European automakers expected discussions with the NHTSA to become so heated that they vehemently opposed the planned

discussions about safety systems and the performance of the different ESVs, the topics on the agenda also included the progress and general direction of the program, its significance for the future of automobile safety, and its translation into future (national and international) standards and regulations.

The first two ESV conferences, held in January and October 1971, were dedicated largely to the discussion of U.S. specifications and their possible adaption to smaller vehicle classes. As NHTSA officials emphasized, their requirements unequivocally put crashworthiness at the center of all concerns. While a detailed list of "accident avoidance" criteria—from acceleration and handling, to visibility and lighting—was part of the requirements, the purpose of this inclusion was mainly to ensure that the resulting prototypes would not fall behind existing production models in this regard. Some of the requirements regarding passive safety, on the other hand, were "very severe", as even NHTSA officials themselves admitted.[90] Prototypes notably had to be able to withstand frontal crashes at 50 mph into a rigid barrier and a solid pole, 50 mph rear impacts, 30 mph side impacts, and 70 mph rollovers, without allowing intrusions of more than three inches into the passenger compartment. At the same time, maximum body deceleration had to be kept below 60 G for all five passengers.[91] The already challenging assignment was made even more difficult by the additional specification that only "passive restraints, which require no action by the vehicle occupants" were to be used, thus excluding conventional seat belts, which passengers had to actively fasten themselves.[92] This last requirement was a consequence of the NHTSA's 1969 decision to mandate the introduction of air bags or similar "passive restraints" for all vehicles by 1973, in spite of ferocious resistance from the auto industry.[93] Perhaps more than any other specification, it exemplified the agency's intention of replacing human responsibility for safety as much as possible with technological fixes, in order to avoid social and political complications. Although the NHTSA freely admitted that belts might be an effective solution from an engineering standpoint, they argued that it would be impossible to force the American

admission of the press to all sections of conference; StV1: "Vermerk über Gespräch mit VW am 21.9.", 23.9.1971, BAK B 108/37504.

90 "Second Specification Discussion. Crashworthiness", in Report on the First International Technical Conference on Experimental Safety Vehicles, 123.

91 100 G were allowed for peaks of less than 3 milliseconds; cf. "Experimental Safety Vehicles Emphasize Crashworthiness", Automotive Engineering 79, No. 1 (1970), 54–55; "Enclosure 5: Statement of Work", BAK B 108/23073. Other specifications included bumpers that would allow impacts of up to 10 mph without damage to the body of the vehicle.

92 Schlechter, "The United States 4000 lb. Experimental Safety Vehicle", 34.

93 Cf. Jameson M. Wetmore, "Implementing Restraint. Automobile Safety and the U.S. Debate over Technological and Social Fixes", in Car Troubles. Critical Studies of Automobility and Auto-Mobility, ed. J. Conley and A.T. McLaren (Farnham 2009), 111–126; Wetmore, "Delegating to the Automobile".

public to use them.[94] "It is a lot easier to deal with the world auto industry, where you're dealing with dozen-and-a-half manufacturers, than it is to deal with millions of people", Douglas Toms was quoted in *Business Week*.[95]

This approach presented European and Japanese participants with serious technical difficulties, given the significantly smaller margins in terms of space, weight and cost available for smaller vehicles. Perhaps even more importantly, it also went against their basic understanding of automobile safety and their conception of responsibility on the road. The West German automobile industry trade association (VDA), for instance, who had received the task of "translating" the U.S. specifications for their respective national 2000 lb ESV programs, flat out refused to adopt the "passive restraints only" rule, which a Volkswagen representative called a "ridiculous" requirement.[96] Trying to explain this decision, the leading West German automotive engineering journal *ATZ* observed that "[t]he main differences concern the responsibility of the driver and the occupants. In Europe, we are of the opinion that the driver is responsible for his vehicle and his conduct in traffic, whereas in the USA it is assumed that, even in case of a grossly negligent attitude on the part of the driver, complete protection for him and his occupants must be assured."[97] Concerning the respective attitudes to passive safety, a German motor magazine claimed, "Europe and America are still separated by much more than an ocean".[98]

Fig. 1: ESVs by AMC (left) and Fairchild during NHTSA-mandated tests, carried out at Dynamic Science testing ground in Phoenix, Arizona, in the presence of Secretary of Transport John A. Volpe. Source: NHTSA brochure in BAK 108/37505

94 An additional factor making this approach even more attractive was the structure of the U.S. government: safety standards could be set centrally, whereas traffic legislation and enforcement were largely devolved to local authorities, presenting federal agencies with what one official called an "infinite morass" of legal problems; "Second Specification Discussion", 122.

95 "The Crash Program That is Changing Detroit. Special Report", Business Week, 27.2.1971, 78–83.

96 Second Specification Discussion, 127–128.

97 Wolfgang Rosenau and Ulrich Seiffert, "Zukünftige Gesetzesvorschriften bezogen auf die ESV-Spezifikationen", Automobiltechnische Zeitschrift (ATZ) 74, No. 4 (1971), 166.

98 Becker, "Zurück zur Vernunft", 47.

The NHTSA hoped to provide material evidence for the feasibility of their approach with the presentation of the four American ESVs. They were first introduced to a wider public at the third ESV conference, held in the early summer of 1972 within the framework of "transpo '72", a special transport-related trade show in Washington, D.C. Although the show offered a plethora of spectacular attractions—such as levitating trains, driverless mass transit systems and the "world's largest air show"—the ESV prototypes seem to have created quite a stir: according to Douglas Toms, the pavilion displaying them was the "most heavily attended of all the exhibits".[99] While GM and Ford's vehicles looked outwardly more conventional than the AMF and FHC, which sported some obviously "experimental" features such as rooftop periscopes, all four U.S.-ESVs shared a number of common characteristics. In order to meet the ambitious deceleration and intrusion requirements, they were designed around reinforced frames and heavy-duty bumper systems, making them unusually large and heavy even by American standards.[100] In spite of using a number of uncommon materials and techniques partly borrowed from aerospace engineering, such as high performance steels, fiberglass, and aluminum honeycomb structures, none of the four managed to stay within the maximal weight allowance, with the AMF weighing as much as 5800 lb (2600 kg).[101] In addition to airbags, they relied on extensive interior padding

Fig. 2: Visitors at the 4th ESV Conference in Kyoto in 1973 inspect the GM ESV. Source: NHTSA, Report on the Fourth International Technical Conference on Experimental Vehicle Safety (Washington 1973), 652

99 Report on the Third International Technical Conference, 1/9.

100 While AMF and FHC used large hydraulic bumper systems for high-speed impacts, GM and Ford opted to work with more conventional deformable-metal structures for impact energy absorption, using smaller hydraulic cylinders only to fulfill the "10 mph no damage" requirement.

101 Cf. NHTSA (ed.), Report on the Second Technical Conference on Experimental Safety Vehicles. Sindelfingen, Germany. October 27–29, 1971 (Washington 1971), 2/3–2/63;

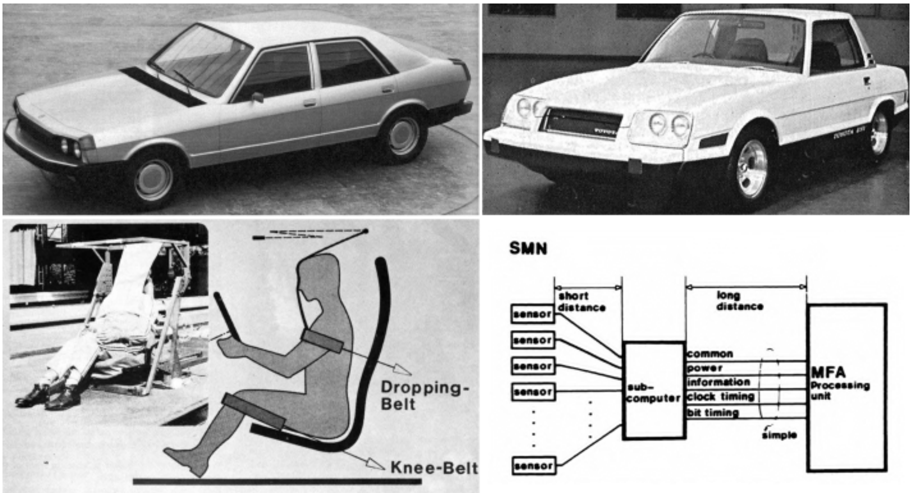

Fig. 3: Experimenting with new designs and technical solutions. Top: Volkswagen ESVW I, praised by one German motor journal as "evidently the world's most beautiful ESV" (left); Toyota ESV (right). Bottom: VW experiment with a "drop net" passive restraint system (left); diagram showing Toyota's "single wire multiplex network" (SMN) feeding the computerized malfunction analyzer (MFA) (right). Sources (counter-clockwise from top left): Report on the Fourth International Technical Conference (Washington 1973), 111; ibid., 109; NHTSA, Report on the Third International Technical Conference (Washington 1972), 2/242; ibid., 2/240

in order to keep the occupants in place during crashes without violating the passive-restraints-only specification. This induced the British government representative to quip in his conference speech that they looked "like a cross between a tank and a padded cell".[102]

By contrast, the non-American entries presented at the same occasion covered a much wider range of shapes, sizes and approaches.[103] Volkswagen and Toyota came closest to the NHTSA's original idea of the international ESV program, working to revised versions of the American specifications centrally issued by their respective national trade associations.[104] Both firms invested substantial amounts of financial and personnel resources into com-

"Experimental Safety Vehicles. U.S. Designs and Innovations", Automotive Engineering 80, No. 9 (1972), 30–37.

102 Report on the Third International Technical Conference, 1/15.

103 For an overview cf. "Experimental Safety Vehicles. Where Do We Go From Here?", Automotive Engineering 80, No. 8 (1972), 19–27; Heinrich Hontschik, "Forschung am Sicherheitsauto. 1. Bericht über die 3. Internationale Technische Konferenz über Experimentier-Sicherheitsfahrzeuge", ATZ 74, No. 9 (1972), 365–372.

104 While generally following the American requirements, these adaptions were somewhat more generous in particular points, such as the intrusion specifications or the possibility to use active restraints, cf. Brenken, Der Weg zum Sicherheitsautomobil, 1–9; VDA, "Technische Anforderungen für Experimentier-Sicherheits-Personenkraftwagen", 21.12.1970, BAK B 106/23074; NHTSA, Report on the Second Technical Conference, 2/87–2/88.

pletely new vehicle designs in the 2000 lb/900 kg class.[105] The results largely delivered the desired safety performance, albeit with some compromises in design: while VW replaced the airbags with a "passive belt" system, Toyota settled for a two-seater to have larger crumple zones.[106]

Mercedes and Volvo presented substantially larger cars, opting not to work according to "European" specifications, but to try to fulfill the original NHTSA requirements for a self-defined weight class in-between the "American" and "Euro-Japanese" models. At over 5 meters in length and over 2100 kg (4630 lb) in weight, the Mercedes in particular almost matched the American models.[107] At the same time, the two companies strongly emphasized the close link to the existing safety technology of their production models, which they argued were already almost able to reach the U.S. design goals, or could be made to do so with relatively minimal effort.[108] Fiat and Honda covered the low end of the weight spectrum, setting out to construct ESVs in the 1500 lb/650 kg range. Given the severe problems expected due to the very limited amount of weight and (deformable) space available, their contributions did not promise to reach any clearly defined crashworthiness goals, but rather aimed to explore what level of passive safety could reasonably be reached within the size, weight and price constraints of this class.[109] British and French participants did not strictly speaking produce ESVs at all, but stuck with the

105 According to Stieniczka, Das "narrensichere" Auto, 311, Volkswagen invested 100 million DM (approx. $39 million) in the ESVW I; the costs of the Toyota ESV project were estimated at 2 billion yen ($7 million); cf. Noriyoshi Uno, "Application of Research Results to Standards. Future Activities Japan", in Report on the Fifth International Technical Conference on Experimental Safety Vehicles, ed. NHTSA (London, Washington, D.C. 1974), 995f. The Nissan ESV was equally built to centrally issued specifications in a similar weight class (2500 lb/1250 kg), but was based on a production model and specifically emphasized closeness to production models; cf. Yoshio Serizawa, "The Nissan Motor Company", in Report on the Second Technical Conference on Experimental Safety Vehicles, 2/89–2/93.

106 Cf. Ernst Fiala, "The Volkswagen ESV", in Report on the Third International Technical Conference on Experimental Vehicle Safety, 2/200–2/215; Jiro Kawano, "Outline of the First Prototype and Experimental Study", in ibid., 2/240–2/249.

107 For an overview over the the specifications of different Mercedes ESVs cf. Weishaupt, Die Entwicklung der passiven Sicherheit, 345–350.

108 Cf. Hans Scherenberg, "The Development of the ESV As Seen By Daimler-Benz", in Report on the Second Technical Conference on Experimental Safety Vehicles, 2/67–2/72; Rolf Mellde, "The Volvo ESV", in Report on the Third International Technical Conference on Experimental Vehicle Safety, 2/129–2/133. While Mercedes worked with a modified production model, Volvo presented what it claimed was the result of its own independent ESV program started in 1969.

109 Cf. G. Puleo, "Consequences on the Design of an Economy Car", in Report on the Second Technical Conference on Experimental Safety Vehicles, 2/111–2/113; Hideo Sugiura, "Occupant Protection of 1,500 lb ESV", in Report on the Third International Technical Conference on Experimental Vehicle Safety, 2/250–2/256. In addition to the 1500 lb vehicle, Fiat also conducted similar experiments on 2000 lb and 2500 lb models, making it the only participant to provide ESVs in three different weight classes; cf. Oscar Montabone, "The Fiat Technical Presentation", in ibid., 2/157–2/184.

Fig. 4: ESVs in different size and weight classes. Top: Fiat 1500 lb ESV (650 kg) and Mercedes-Benz ESF 13 (2100 kg), the smallest and the largest of the non-U.S. ESVs on show at the Transpo ’72 exhibit. Bottom: Fiat 1500 lb ESV after crash-testing (left); result of a frontal crash at 71 mph between Ford LTD (left) and ESVW II. Sources (counter-clockwise from top left): NHTSA, Report on the Third International Technical Conference (Washington 1972), 2/176; ibid., 2/182; NHTSA, Report on Sixth International Technical Conference (Washington 1976), 247; NHTSA, Report on the Fourth International Technical Conference (Washington 1973), 93

“Experimental Safety Subsystems” (ESSS) approach developed for the EEVC, arguing that this would provide better chances for the quick incorporation into regular production. To prove the point, British Leyland showed two production models equipped with a number of new safety systems for presentation purposes. With features such as radar distance warning, self-levelling headlights or alcohol screening testers, the focus lay mainly on active safety, which was presented as “reflect[ing] safety ideas consistent with European thinking and future legislation on vehicle and passenger safety”.[110]

From the start, a considerable part of the work undertaken by Europeans and Japanese in the context of the ESV program was in fact targeted mainly at *disproving* the practicability of the NHTSA’s approach and destabilizing the potential evidence provided by the American ESVs. While almost all participants initially pronounced themselves highly optimistic about the technical feasibility of the requirements, they went to considerable lengths to cast doubt on their economic viability. Fiat, Honda, Citroen and Opel all began their respective ESV activities with detailed studies on the substantial increase in size, weight, and cost even a partial fulfillment of the specifications would mean for their small production models.[111] Probably the most meticulous calculations

110 Ibid., S/10.

111 Cf. Puleo, “Consequences on the Design of an Economy Car”, 2/111–2/113; Sugiura, “Occupant Protection of 1,500 lb ESV”, 2/250–2/256.; Maurice Clavel, “Why Citroen Chose 1,500 lb. Vehicle for its Studies and Experiments”, in Report on the Second Technical Conference

were presented by Volkswagen, who attempted to quantify the cost-benefit ratio of different forms of active and passive restraints, and even of different numerical values for particular requirements. VW's engineers concluded that some of the impact tests required, such as the 50 mph rear impact, contributed unduly to cost increases while providing relatively little safety benefit, and that all forms of seat belts were much more cost-efficient than airbags.[112] Consequently, European industry representatives, such as Mercedes board member Hans Scherenberg, started publicly demanding laws mandating the use of seat belts—which were still not even part of the standard equipment in many of the company's models at this point.[113]

Secondly, the NHTSA's critics questioned whether the new road traffic system likely to result from the agency's approach was desirable in the first place. The crashworthiness requirement of the American specifications, a Citroen engineer warned darkly, would "unequivocally doom, to the point of eliminating, the small, low-range European car".[114] In Europe, with its narrow city streets and lower average wages, this would be socio-economically disastrous, potentially undoing the gains of mass-motorization and making the automobile once more "the prerogative of the few well-off classes".[115] In accordance with the growing general awareness of environmental issues, the fuel consumption and pollution associated with overly large cars also became an increasingly important argument. "Exhaust emission, as a major social problem, is equally as important as the safety problem now", opined a Honda representative in 1973.[116] Furthermore, "tank-like" vehicles such as the American ESVs might even lead to a decrease in safety on (non-American) roads: when colliding with small cars or pedestrians, their weight and bulk would make them particularly dangerous to the other parties in the crash—a

on Experimental Safety Vehicles, 2/135–2/142; Karl Brumm, "The Opel Conception of an ESV in the Low-Weight Class", in ibid., 2/72–2/77.

112 Ernst Fiala, "General View About Progress and Problems Concerning ESV", in Report on the Second Technical Conference on Experimental Safety Vehicles, 2/65–2/67; Hermann Appel, "Benefit/Cost Analysis for Evaluation of ESV Impact Tests. Proposal for Reduced Rear End Impact Speeds", in ibid., 3/5–3/9.

113 Hans Scherenberg, "Progress of the ESV Development at Daimler-Benz", in Report on the Fourth International Technical Conference on Experimental Vehicle Safety, ed. NHTSA (Kyoto, Washington, D.C. 1973), 83–94, 84. On the German discussion on seat belts cf. Bergmann, "Angeschnallt und los".

114 Clavel, "Why Citroen Chose 1,500 lb. Vehicle for its Studies and Experiments", 2/135.

115 Ibid.

116 Kiyoshi Kawashima, "The Present Development Status of the Honda ESV", in Report on the Fourth International Technical Conference on Experimental Vehicle Safety, 73. Environmental aspects and the development of a "low pollution power system" had been part the ESV program since its inception. The complex history of its actual implementation goes beyond the limits of this contribution. For a first orientation, cf. Schulz-Walden, Anfänge globaler Umweltpolitik, 117–119.

problem for which the French delegation introduced the subsequently much-debated concept of "vehicle aggressiveness".[117]

Thirdly, European and Japanese, but also American corporations argued that the specifications and tests prescribed by the NHTSA were not representative of actual conditions on the roads. General Motors, for instance, prominently described their ESV activities not as an attempt to increase traffic safety, but merely as "a study in meeting the Department of Transportation requirements".[118] The ESV program, in other words, constituted an extreme example of the phenomenon Lee Vinsel has described as "designing to the test".[119] On whether the outcome related at all to "normal" traffic, GM claimed to be agnostic: "Our car is designed for very specific crash test situations. The relationships of our test data to highway crashes is unknown."[120] European participants in particular expended a lot of effort to prove that the specified test conditions did not allow wider conclusions about actual safety performances.[121] There was little sense in forcing companies to construct prototypes that could withstand frontal collisions into a fixed barrier at 80 kmph, they reasoned, when the overwhelming majority of crashes happened between two cars and at an offset angle.[122] Using accident statistics, the German Association of Automobile Insurers (HUK) calculated that 90 percent of injuries occurred at "equivalent test speeds" of less than 60 kmph, thus making higher speed requirements unnecessary.[123] Another major source of uncertainty were the

117 G. Chillon, "The Importance of Vehicle Aggressiveness in the Case of a Transversal Impact", in Report on the First International Technical Conference on Experimental Safety Vehicles, 81–84; Claude Berlioz, "Comparison of the Aggressiveness of Different Vehicles and the Safety They Afford", in Report on the Third International Technical Conference on Experimental Vehicle Safety, 2/4–2/9; Phillippe Ventre, "Homogenous Safety Amid Heterogenous Car Population?", in ibid., 2/39–2/57.

118 William Larsen and John Rosenkrands, "The General Motors Corporation. ESV Development Report", in Report on the Second Technical Conference on Experimental Safety Vehicles, 2/27–2/48, 2/48.

119 Vinsel, "Designing to the Test".

120 Larsen and Rosenkrands, "The General Motors Corporation. ESV Development Report", 2/48.

121 They were attacking, in other words, the Achilles heel of all testing, namely the "similarity relationship" between the testing situation and the actual working of the technology; cf. Trevor Pinch, "'Testing – One, Two, Three… Testing!'. Toward a Sociology of Testing", Science, Technology, & Human Values 18, No. 1 (1993), 28f.

122 Claude Berlioz, "Distribution and Gravity of Collisions as a Function of the Damaged Part of the Vehicle and the Obstacle Hit", in Report on the Second Technical Conference on Experimental Safety Vehicles, 2/129–2/135; Claude Prost-Dame, "Critical Review of ESV Program Technical Trends and Future Resulting Legislation", in Report on the Third International Technical Conference on Experimental Vehicle Safety, 2/63–2/64.

123 Max Danner, "New Investigations of HUK Accident Research", in Report on the Fourth International Technical Conference on Experimental Vehicle Safety, 147–153; Max Danner and Klaus Langwieder, "The Frequency of Corresponding Vehicle Damage in Crash Tests and Actual Accidents", in Report on the Fifth International Technical Conference on Experimental Vehicle Safety, 421–426.

unstandardized and still rather primitive dummies used in the tests, whose fidelity to the human body was at best questionable—especially since tolerance levels of the human body were still only very imperfectly known.[124] Before hastily imposing near-impossible crashworthiness standards on manufacturers, car companies argued, more cost-benefit analyses, more accident data, and more biomedical research were sorely needed.[125]

In response, the NHTSA acknowledged the experimental nature of large parts of their requirements, promised to consider the presented evidence, and signaled its willingness to compromise on certain numerical values and specifications—without however abandoning their fundamental dedication to ambitious crashworthiness targets, which they considered the cornerstone of the project.[126] When it became clear during the third ESV conference that the fundamental "reorientation" the European and Japanese participants had hoped to extract from the Americans was not forthcoming, the discussion turned increasingly confrontational.[127] At the same time, the first results obtained from crash tests made clear that not one of the non-U.S. vehicles would manage to fulfill the NHTSA requirements completely—not even the large and heavy Mercedes.[128] For symbolic as much as technical reasons, the 50 mph/80 kmph frontal impact specification became a particular bone of contention. If the Americans truly meant to stick to this requirement, Fiat boss Vittorio Montanari was quoted as saying, "we have nothing more to talk to each other about".[129]

Having failed to modify the U.S. specifications in the manner they had wanted, most of the non-American participants subsequently simply gave up on their ambitions to fulfil them, and reoriented themselves towards self-defined design goals they considered more "realistic". This shift clearly materialized itself in a "second generation" of ESVs, shown at the fourth and fifth ESV conferences in 1973 and 1974. For instance, the three West German prototypes presented at the latter occasion—the Mercedes ESF 22, the Volkswagen ESVW II and

124 Willi Reidelbach, "The Shortcomings of Anthropomorphic Test Devices", in Report on the Second Technical Conference on Experimental Safety Vehicles, 3/57–3/59; M. A. Macauley, "The Dynamics of Dummies", in ibid., 3/59–3/61.

125 Cf. the proposals for a "new orientation of the ESV program" by Hans Scherenberg, "ESV Development at the Daimler-Benz A.G.", in Report on the Third International Technical Conference on Experimental Vehicle Safety, 2/191–2/192.

126 Cf. Albert Schlechter, "Summation and Concluding Remarks", in Report on the Second Technical Conference on Experimental Safety Vehicles, 5/3–5/4; Albert Schlechter, "United States ESV Program Status", in Report on the Third International Technical Conference on Experimental Vehicle Safety, 2/281–2/289.

127 This expectation was probably most clearly formulated by Mercedes; cf. Scherenberg, "Progress of the ESV Development at Daimler-Benz", 83.

128 Cf. Scherenberg, "Progress of the ESV Development at Daimler-Benz", 2/186–2/193.

129 "Noch keine Chance für das Sicherheitsauto", Welt am Sonntag, 7.4.1973, in BAK B 108/37506. Cf. also Montanari's almost equally sharp critique during the conference discussion session: Report on the Third International Technical Conference on Experimental Vehicle Safety, 3/11.

the Opel OSV—were all built to relatively lenient 65 kmph frontal-collision requirements. Even more importantly, all were modified versions of the respective companies' newest production models, the S-Class, the Golf/Rabbit, and the Kadett.[130] From the highly experimental and disruptive "idea cars" of the early program period, ESVs had transformed into more conventional industry prototypes, blending almost seamlessly into "normal" market-oriented research and development efforts on new production models.[131]

At the same time, however, the fifth ESV conference, which marked the official ending of the original "first phase" of the ESV project, can also be understood to mark the amalgamation of the "European" and "American" approaches to automobile safety. Taking place in London, the center of the initial European "resistance" to the U.S. approach, the meeting was notable for the formal integration of the EEVC into the ESV framework.[132] Accordingly, the conference allocated the majority of its technical sections to topics such as "accident analysis and data collection", "human tolerance levels and use of dummies", "effectiveness of safety measures" and "interactions of driver and vehicle", cost-benefit-analysis, and "application to production cars."[133] Echoing earlier criticism from the auto industry, NHTSA officials concluded in their closing report that "the existing ESV specifications, taken as a whole, result in designs of questionable near-term practicality", mainly because all of the tested designs suffered from "weight increases on the order of 20–30 percent".[134]

In light of the first oil crisis and growing environmental concerns, this trade-off seemed increasingly untenable. Already in early 1973, the NHTSA had therefore announced a follow-up initiative, the so-called Research Safety Vehicle (RSV) project.[135] Aimed at producing cars in the "intermediate" 3000 lb/1350 kg class, the program abandoned the almost exclusive focus on crashworthiness and primarily sought "to address the problems of minimizing fuel consumption, controlling urban congestion and pollution, and maximizing

130 W. Rixmann, "Deutsche Experimentier-Sicherheitsfahrzeuge (ESV) 1974. 1. Bericht von der 5. Internationalen Technischen Konferenz über Experimentier-Sicherheitsfahrzeuge, Juni 1974 in London", ATZ 76, No. 10 (1974), 333–339.

131 The term "idea car" was originally coined by GM for their ESV; cf. J. W. Rosenkrands, "Experimental Safety Vehicle – Phase Two. Designed and Developed by General Motors", in Report on the Third International Technical Conference on Experimental Vehicle Safety, 2/257. However, it soon caught on as a description of the whole program; cf. DOT News, "Remarks by U.S. Secretary of Transportation John A. Volpe at Crash Test of Experimental Safety Vehicle, Phoenix, Arizona, April 18, 1972", BAK B108/37505.

132 "The Future for Car Safety in Europe. A Report of the EEVC", in Report on the Fifth International Technical Conference on Experimental Vehicle Safety, 24–54.

133 Cf. Report on the Fifth International Technical Conference on Experimental Vehicle Safety

134 Vincent Esposito, "Status Report on Experimental Safety Vehicle Development Programs. United States", in Report on the Fifth International Technical Conference on Experimental Vehicle Safety, 12.

135 Cf. Gene Manella, "Remarks on 3,000 Pound ESV Specification", in Report on the Fourth International Technical Conference on Experimental Vehicle Safety, 541.

resource conservation as well as safety."[136] Asked in a high-profile interview by *Der Spiegel* in late 1973 whether his company would consider participating in the new program, Scherenberg, Head of Development at Daimler demurred, confessing to a "certain weariness regarding the question whether to build even more experimental cars". Instead, he expressed his hope that other factors such as human behavior, the roads and traffic rules would soon return to the fore: "One cannot always hold the automobile responsible for lack of safety."[137]

Conclusion: ESVs and the Construction of New Automobile Safety Practices

Given the gradual abandonment of its original aims, especially after the turning point in 1972, it is perhaps not surprising that many participants ultimately considered the ESV program at best a dubious investment, if not a costly failure. While the enormous amount of financial and personnel resources spent had led to some "new experiences and knowledge", according to Mercedes-Benz, the main insight derived from the program was that the kind of passive safety performances demanded were "technically imaginable, but do not lead to a result in step with actual practice."[138] Indeed, the project's most immediate outcome had arguably been to disprove the practicability of a "pure" crashworthiness approach. Rather than universally spreading the new paradigm, the ESV program could therefore be said to have been involved in limiting its full implementation, and perhaps even prefigured the partial return of the "old-fashioned emphasis on driver responsibility" that Peter Norton has observed for the 1980s.[139]

However, such an interpretation would overlook the significant contribution of the ESV program to the changes in the theory and practice of automobile safety in the 1970s, especially outside the United States. Firstly, the scheme was clearly successful in its attempt to "stimulat[e] public awareness" for the benefits of the new approach. Although crashworthiness was not a new concept in the participating states by the late 1960s, public exhibitions of prototypes and in particular the extensive reporting on various aspects of the program in the (specialized and general) media greatly increased the visibility of the

136 Esposito, "Status Report on Experimental Safety Vehicle Development Programs. United States", 13. On the finished RSVs, presented at the seventh ESV conference in 1979, cf. Donald Struble, "Status Report on Minicar's Research Safety Vehicle", in Report on the Seventh International Technical Conference on Experimental Safety Vehicles, ed. NHTSA (Paris, Washington, D.C. 1979), 63–75; G. J. Fabian and G. Frig, "Status Report on Calspan/Chrysler Research Safety Vehicle, in ibid., 104–131. Volkswagen, the only non-American participant in the preliminary phase of the program, was not awarded a contract for the second phase.

137 "'Was ist ein Mensch wert?' Daimler-Benz Entwicklungschef Scherenberg über Sicherheitsautos", Der Spiegel, 10.9.1973, 68–84.

138 Presse Information ESF-Konferenz in London, 1974, quoted Weishaupt, Die Entwicklung der passiven Sicherheit, 352.

139 Norton, "Four Paradigms", 329.

issue, thus putting public pressure on the automobile industry.[140] Secondly, the ESV program also had a direct impact on research and development. It provided a significant boost to the development of a number of new technical solutions and systems, such as the airbag, and expedited the improvement of others, such as crumple zones or seat belts. Arguably even more important was, thirdly, the project's effect on the institutionalization and standardization of safety research—for instance through the establishment of international organizations and networks such as the ESV conferences or the EEVC, both of which are still highly relevant to the field today. In addition, many of the participating automobile companies enlarged, updated, or even newly created testing facilities and safety engineering departments, providing the basis for making crashworthiness an important consideration in standard research and development practice. All of this contributed to the substantially improved safety record of the new generation of automobiles entering the global market after 1974—even if some features demonstrated in experimental prototypes were not widely available in production models before the late 1980s.

While it would be simplistic to consider the global changes in automobile safety practices as nothing more than an extension of the American development abroad, the United States did play an important role as a pacesetter in this development. As Lee Vinsel has pointed out, U.S. regulations on crashworthiness were never quite as rigorous and effective as those on air pollution—much to the disappointment of safety advocates.[141] In comparison to its European counterparts however, such as the notoriously pusillanimous West German BMV, the NHTSA's much more proactive and confrontational approach stands out as notably impactful. From this perspective, the ESV program provides a remarkable example of how, in the age of economic globalization, one national regulatory agency—armed with sufficient market might, favorable public opinion, and a sense of mission—could force a highly powerful and prestigious industry to change its ways. By stressing the importance of NHTSA as the main driving force, I do not mean to imply that the ESV program simply constituted an imposition of a U.S. model of automobile safety on America's reluctant allies. On the contrary, one of the main motivations for international governments and non-state actors to join was precisely the potential opportunity to influence the NHTSA's position, and thus future national U.S. standards. In the resulting transnational negotiation process, the differences between engineering cultures and mobility systems in North American and Europe (respectively Japan) quickly became apparent—and were at times arguably even over-emphasized in the attempt to find a politically palatable argument to avoid regulations. The substantial divergences in the approach to crashworthiness between the NHTSA and most of the other ESV participants—notably includ-

140 For a summary of the project's public relations achievements cf. CCMS, Experimental Safety Vehicles Project, 7.

141 Vinsel, Moving Violations.

ing the U.S. auto industry—did not vanish over the course of the program. However, the project forced many participants to engage much more closely with the idea and practice of crashworthiness than they had done before. In return, the detailed interventions and arguments brought forth by industry representatives were not without resonance on the NHTSA's policy – even if the agency's abandonment of its maximalist position on crashworthiness cannot be explained by European protests alone.

This transnational (re-)negotiation of automobile safety in the framework of the ESV program was made possible by the Experimental Vehicles as material artefacts. Not only were their technical specifications and design goals, their performance characteristics, and their physical limitations the object of heated arguments. It was also through the ESVs that participants argued about what should count as a "safe" car, who was responsible for safety, and how and to what degree it should be enforced. The experimental prototypes were thus evidence objects in a twofold sense: on the one hand, they served as laboratory objects to produce data, try out technical assumptions, and generate the detailed knowledge necessary to set standards and issue regulations. On the other hand, the experimental vehicles were interventions in a normative argument between competing visions of the (automobile) future, specially constructed to illustrate certain ideas and points of view, and imbued with political agendas, economic interests and cultural significance. In both respects, the materiality of the ESVs was crucial to their efficacy, making new arguments and ideas much harder to dismiss out of hand and forcing opponents to engage with them in detail. The ESVs therefore functioned as a sort of boundary object, bringing together a variety of entities and institutions with different interests and (national) backgrounds in a transnational, techno-political discourse.[142] However, while the ESV program certainly contributed to the internationalization and professionalization of the discussion about the future of automobile safety, this also came at a price: private consumers and safety activists, who had pioneered the use of experimental prototypes for the promotion of crashworthiness in the 1950s, were virtually absent from ESV conferences. This is a pattern that one should take care not to repeat. While the fact that decisive action by one (national) regulator can make a (global) difference should serve as an encouragement in the current discussions on the safety of (autonomous) automobiles, a viable way of including users also needs to be found.

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142 Susan Leigh Star and James R. Griesemer, "Institutional Ecology, 'Translations' and Boundary Objects. Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology, 1907–39", Social Studies of Science 19, No. 3 (1989), 387–420.