

Appendix B

The Utility of Police Body Armor

Contents

	<i>Page</i>
SUMMARY	23
THE FIREARMS THREAT TO POLICE OFFICERS	23
Police Confiscate More Powerful Firearms, Perceive Increasing Threat	23
The Guns That Kill Police Officers *	23
THE BUYING AND WEARING OF BODY ARMOR	25
Estimating Actual Wear Rate \$..... *	25
Factors Influencing the Wearing of Armor	26
Officers Saved By Armor From Death by Gunfire	29
Saves and Fatal Wounds Per Shooting	30
Is Body Armor a Good Buy?	30

Box

	<i>Page</i>
<i>Box</i>	
B-1. Spending Money , Saving Lives	32

Figures

<i>Figure</i>	<i>Page</i>
B-1. Mix of Guns Confiscated by the Bureau of Alcohol, Tobacco, and Firearms	24
B-2. Types of Guns That Killed Police Officers ,,	24
B-3. Types of Guns Used to Kill Officers	25
B-4. Law Enforcement Officers Killed	26
B-5. Armor Wear Rate and 95-Percent Confidence Bounds	28
B-6. Decline in Torso-Wound Share of Deaths	29
B-7. Saves Recorded by the IACP/DuPont Kevlar Survivors' Club (S.M.)	
v. Saves Estimated by OTA *. *e. * \$.	29
B-8. Armor Wear Rate Estimates Compared	30
B-9. Saves and Fatal Wounds Per Shooting	31

Tables

<i>Table</i>	<i>Page</i>
B-1. Levels of Protection \$. \$. *+.	25
B-2. Location of Officers' Fatal Gunshot Wounds	27

The Utility of Police Body Armor

SUMMARY

Every year, about 60 police officers are killed by gunfire—the majority by handguns. Concealable body armor offers several levels of protection encompassing the full spectrum of the handgun threat. In addition, some vests protect against shotguns and certain rifles. Every year, vests save one or two dozen officers from death by gunfire. If every officer wore a vest, the number of officers saved from death by gunfire might be doubled.

THE FIREARMS THREAT TO POLICE OFFICERS

Police Confiscate More Powerful Firearms, Perceive Increasing Threat

Jurisdictions all across America report an upswing, during the last few years, in the confiscation of especially sophisticated and deadly firearms. These include “assault rifles” and high-powered automatic pistols. Police officers feel they are more threatened by these guns than they were in the past. [102]¹ Some blame the increase on the affluence of criminals involved in the drug trade; others see it as an unfortunate outcome of the move to ban the cheap handguns known as “Saturday night specials.”

One incontrovertible increase in the threat to police officers is the officers’ own guns. Many departments, responding to the heightened firearms threat on the street, invested in more powerful guns themselves, typically replacing .38 Specials with .357s, 9-mm “automatics,” or even larger guns. Because 20 percent of officers who get shot are shot with their own or their partners’ guns, [140] an upgrade of the officers’ weaponry increases the threat they face.

One response to the perception of a growing threat to police officers is the wearing of soft, concealable body armor. Such a protective garment has a soft, padded feel, fits under the officer’s shirt, and is intended to be worn at all times. It is not a “flak

jacket” or bomb squad outfit, worn outwardly and only at times of great threat. Nor does it include rigid metal plates, though many examples include a large pocket into which a rigid plate (perhaps carried in the squad car’s glove compartment) can be placed if a greater-than-expected threat arises. Many officers feel that they owe their lives to the practice of day-to-day wear of soft body armor,² but shooting deaths of officers continue.

The Guns That Kill Police Officers

There is considerable evidence that the perceived threat to police officers posed by high-powered guns is exaggerated. Some of the perception is doubtless founded in newspaper headlines and departmental scuttlebutt, sources that disproportionately report interesting cases and thus overstate the threat from exotic weaponry.

Some officers may, more objectively, base their threat estimate on the statistics of weapons confiscated by their department or nationwide. Even this would exaggerate the threat. For example, the mix of firearms confiscated by the Bureau of Alcohol, Tobacco, and Firearms (see figure B-1), which is presumably representative of those confiscated by local law-enforcement agencies nationwide, is far richer in powerful weapons than is the mix of firearms used in fatal assaults on police officers (see figure B-2), according to information collected systematically from local police departments and Federal agencies by the Federal Bureau of Investigation (FBI), which publishes it. [140] An estimate based on departmental confiscations might be more representative of the threat in a particular jurisdiction but would be “noisy”—prone to error—because of the small sample size.

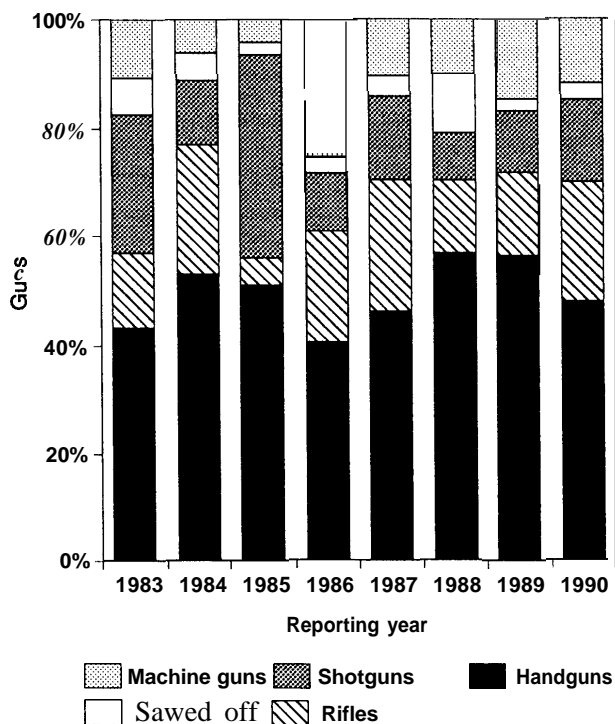
It is plausible that the mix of guns used in all assaults on police might have an even smaller proportion of powerful guns than does the mix of guns used in fatal assaults on police. However, the FBI does not collect comprehensive data on types of guns used in nonfatal shootings of law-enforcement

¹ Numbers in brackets cite references in the bibliography in volume 1 of this report.

² The IACP/DuPont Kevlar Survivors’ Club (S. M.) includes about 1,400 members, over 500 of whom credit soft body armor with having saved them in shooting incidents.

³ Indeed, the National Institute of Justice commends the use of confiscated weapons as an indicator of what vest to buy.

Figure B-1—Mix of Guns Confiscated by the Bureau of Alcohol, Tobacco, and Firearms

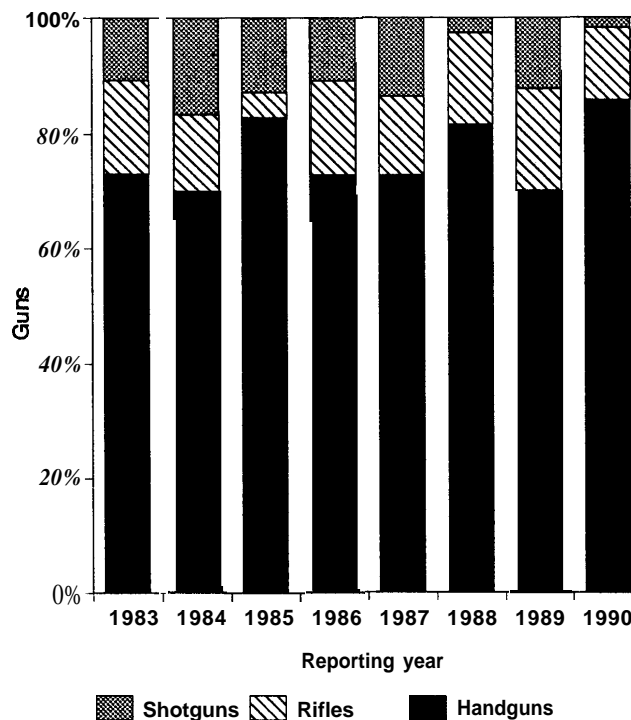


SOURCE: Bureau of Alcohol, Tobacco, and Firearms, 1991.

officers. The Bureau plans to expand its data-collection program to collect such data, if resources permit. [108] Currently, the FBI's annual report, *Law Enforcement Officers Killed and Assaulted*, tabulates reported assaults on law-enforcement officers by type of weapon used but lumps all types of firearms together in a single category. Moreover, the tabulation includes assaults without battery, so the assaults with firearms include incidents in which guns were used only to threaten officers or were fired without hitting them.

Figure B-3 shows the mix of guns used to kill police officers in the United States in recent years, categorized (by OTA) according to the minimum level of ballistic resistance the National Institute of Justice (NIJ) has recommended for protection from the threat. The National Institute of Justice categorizes body armor into levels of ballistic resistance in terms of the gunfire threats it is supposed to withstand (see table B-1). Each level of armor is expected to offer protection against the threat associated with it and with all lower numbered levels of armor. For threats, such as birdshot and buckshot,

Figure B-2—Types of Guns That Killed Police Officers



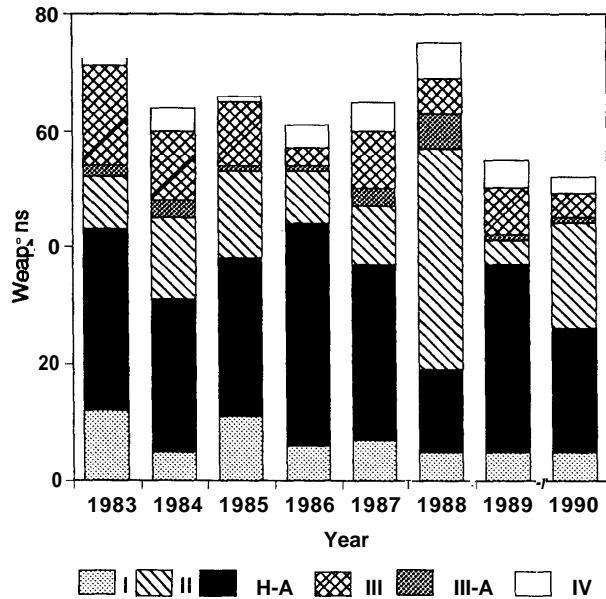
SOURCE: Federal Bureau of Investigation, 1984-1991.

that are not specifically mentioned by NIJ Standard 0101.03 or NIJ Guide 100-87, OTA used the guidelines in National Institute of Law Enforcement and Criminal Justice Standard 0101.01 (1978).

The data reflect only fatal attacks: because an officer is more likely to survive an injury from a lower level threat than from a higher level one, one would expect that the data on killings understate the incidence of low-level shootings. Especially in this light, the continued prominence of threat-level I and II-A killings is worthy of note: anecdotal evidence, surveys based on officer's opinions, and perhaps even tabulations of weapons confiscated from criminals, would have one believe that the threat to the police officer is swinging dramatically towards the high end of the spectrum. The FBI data, however, do not particularly bear this impression out.

Felonious gunfire kills about 60 officers per year; a handful of officers are feloniously killed each year by other weapons, or without weapons. About the same number of officers are killed accidentally as are killed feloniously (see figure B-4). The majority of the accidental deaths involve motor vehicles.

Figure B-3-Types of Guns Used to Kill Officers
(sorted by lowest level of armor expected to stop projectile)



SOURCE: Office of Technology Assessment, 1992, using data from the Federal Bureau of Investigation, 1983-1990.

These data include only sworn law enforcement officers; deaths of other possible civilian users of body armor, such as security guards, do not appear.

THE BUYING AND WEARING OF BODY ARMOR

Estimating Actual Wear Rate

Exact data on body armor sales are treated as proprietary by the manufacturers, but we can make a rough estimate of the number of vests extant in the United States. The concealable body armor industry grosses about \$40 million per year in sales for U.S. civilian⁴ use. [14, 129, 150] Assuming that a vest costs \$400 and lasts for 5 or more years,⁵ 100,000 vests are sold yearly and 500,000 or more are in

Table B-I—Levels of Protection

Level	Threat
I	.22, .25 and .32-caliber handguns, .38 Special lead
II-A	.38 Special high velocity, .45s, low velocity .357 Magnum & 9-mm, and .22 rifles
II	Higher velocity .357 Magnum and 9-mm
III-A	.44 Magnum and submachine gun 9-mm
III	High-power rifle: 5.56-mm, 7.62-mm full metal jacket, .30-caliber carbine, .30-06 pointed soft point, 12-gauge rifled slug
IV	Armor-piercing, .30-caliber rifle bullets

SOURCE: National Institute of Justice, NIJ Standard 0101.03, 1987, and NIJ Guide 100-87, 1989.

useable condition at any one time. Considering that there are about a half a million police officers (not counting other potential users of concealable body armor such as security guards), [78] the industry can supply most of those who could benefit from concealable body armor. These estimates arguably *understate the* number of vests produced because—especially with recent price competition—the average price of a vest may be lower than \$400. They arguably *overstate the* number of vests in use because the business has grown to the \$40 million figure in recent years⁶ and because some vests are replaced before they wear out, owing to a perception that they are insufficient to meet the present threat.

Naturally, some officers are more at risk than others—some work in peaceful small towns and others in the more violent environment of today’s big cities. Departments or individual officers in the more dangerous settings could be expected to be more likely to buy and wear body armor, so we might expect to find more wearers of body armor among those officers who get shot than among the population of officers as a whole.

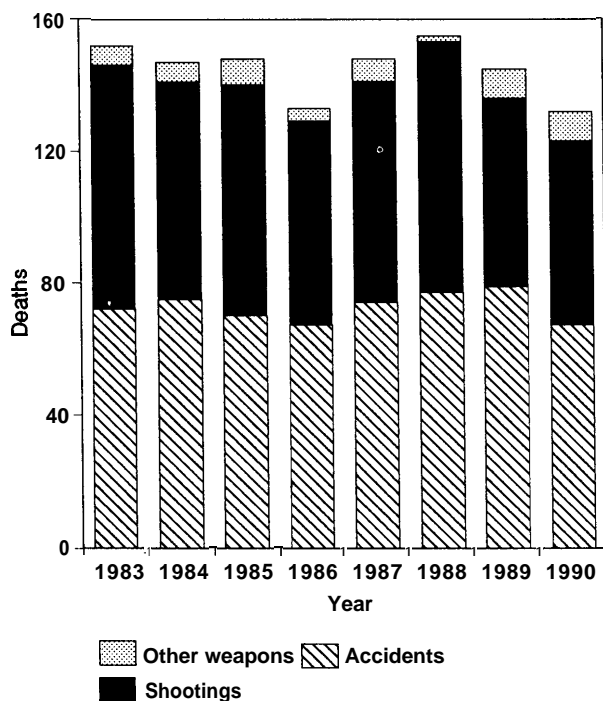
This expectation is borne out by the FBI Uniform Crime Reports (UCR) data. As noted above, there is no systematic collection of the specifics of shootings not leading to the death of an officer. The FBI does report, in conjunction with the locations of officers’

⁴ I.e., nonmilitary. U.S. civilian users of body armor include sworn law enforcement officers, security guards, and others. A few vests are known to have made their way into the criminal world.

⁵ These figures, while chosen for convenience, are roughly correct. Armor prices vary widely according to size, level, and style. Some authorities advocate a “rational replacement policy” that begins to consider a vest for replacement after 5 years of use but recognizes that, with proper care, a vest can last twice that long. [145] Anecdotal evidence suggests that many vests receive improper care.

⁶ NIJ has estimated that the body armor industry grosses \$50 or \$60 million per year and that vests cost \$200. These data would lead to the conclusion that 250,000 to 300,000 vests are manufactured per year, enough to supply every officer with a new vest every 3 or 4 years once the entire force had been outfitted. NIJ’s figures certainly understate the average cost of a vest and arguably overstate the industry’s output of concealable body armor destined for domestic use: foreign sales account for part of the industry’s gross earnings, and manufacturers of concealable body armor also produce body armor of types III and IV as well as a variety of other products such as helmets and helicopter seat cushions.

Figure B-4-Law Enforcement Officers Killed



SOURCE: Federal Bureau of Investigation, 1984-1991.

fatal gunshot wounds, whether or not the officers were wearing vests. [140] (See table B-2.) As one might expect, few officers wearing armor are killed by shots to the upper torso; to date, no officer has been killed when struck on the protected area of a vest by around that his or her vest was rated to stop. The proportion of officers wearing body armor when they get shot can be estimated from the proportion of officers wearing body armor when they died of gunshot wounds in locations *other than the upper torso*.⁷ This proportion initially increased as body armor penetrated the market but has fluctuated between 30 and 40 percent for several years. The sample size introduces some uncertainty, but even the region spanned by 95-percent confidence intervals shows some fluctuation (see figure B-5).

The estimate that 30 to 40 percent of officers wear body armor is low by comparison to survey data. It has been suggested that officers who get caught in

gunfights might be the sort who don't tend to wear their armor. However, one could equally well argue the opposite, that the wear rate of officers who come under fire is greater than that of the population of officers as a whole, either because of some knowledge that a shooting was in the offing, or simply because, as mentioned earlier, officers serving in dangerous areas may tend to wear their vests more than do other officers. In any case, the wear rate estimated from other-than-upper-torso deaths may be termed an "under-free wear rate," to distinguish it from the true average wear rate.

Factors Influencing the Wearing of Armor

Many officers who possess armor do not always wear it. Because armor is rarely shared,⁸ the proportion of officers who wear armor would not be expected to exceed the proportion who possess it.

Comfort

Concealable body armor can be somewhat uncomfortable to wear. Even though some officers claim, in responses to a recent survey, that they want a vest that protects and do not care if it is uncomfortable, [102]⁹ officers who own vests often find reasons not to wear a vest on a particular day. Most of these reasons center on comfort. Wearers (and, especially, nonwearers) commonly cite the armor as "hot," "heavy," "stiff," "chafing," and the like. Complaints about chafing, and to some degree about stiffness and the impression of great weight, can often be traced to a bad fit, or simply to the armor being strapped on too tightly. Armor should be the right size—the front panel should just reach the navel if the officer is to be comfortable when seated. Female officers can expect particular difficulty in getting armor to fit: one body armor manufacturer expressed the view that custom fitting was the only way to guarantee a female officer that her armor would be comfortable.

The complaint that armor is heavy strikes some as minor because the weight is well-distributed (a backpack that weighed only a few pounds would hardly be considered a load at all) and because police officers already carry a number of other heavy items,

⁷ Because armor protects the upper torso, officers who wear armor are under-represented among those who die of upper torso wounds and thus among "officers killed" as a whole. For this reason it is inappropriate to estimate wear rate from the total population of officers killed. [144] Wearers may be slightly over-represented among those who die of non-upper-torso wounds, inasmuch as the armor may block one or more upper torso shots prior to a fatal shot elsewhere, e.g., the criminal keeps shooting until he hits the head.

⁸ "Armor is underwear," as one company phrases its admonition against armor-sharing.

⁹ Cf. reference [23].

Table B-2—Location of Officers' Fatal Gunshot Wounds

	Wound location					
	Head		Upper torso		Lower torso	
	Total victims	Armored victims	Total victims	Armored victims	Total victims	Armored victims
1981	36	6	47	5	3	0
1982	24	5	56	7	2	1
1983	29	10	42	8	3	2
1984	33	13	32	4	1	0
1985	27	8	43	3	0	0
1986	26	6	33	6	3	2
1987	31	13	32	3	4	0
1988	37	15	36	3	3	2
1989	27	9	24	6	6	3
1990	31	11	22	2	3	2
Total	301	96	367	47	28	12

SOURCE: Federal Bureau of investigation, 1987 and 1990.

notably their guns. On the other hand, one could argue that the weight of the vest, taken on top of the weight of all the other things an officer is expected to carry or wear while on duty, is a significant burden. The most salient aspect of complaints about the weight of the vest is that the weight (unlike chafing and even, as we will see below, heat) is directly related to the ballistic performance of the vest. A thicker vest will weigh more and will offer protection against a broader region of the threat spectrum. Insofar as weight lessens comfort, there exists a true comfort-v. -protection tradeoff. However, a pioneering study of influences on wear rate, by the Aerospace Corp., found that wear rate was independent of the areal density (weight per unit area) of armor with an areal density less than about 4.5 kilograms per square meter, but decreased slightly with increasing areal density above 4.5 kg/m² (see figure 7 of vol. 1). Officers' complaints that armor makes them feel hot cannot be attributed to improper fit. Not only is commonly used armor material a good insulator, but also the thickness of the armor blocks the evaporation needed for the body's normal perspirative cooling. Just six plies of fabric, waterproofed or not, are enough to block the evaporation of sweat, so any vest—regardless of level¹⁰ or waterproofing—an block perspiration.

Some officers find that they can lessen the blocking **effect** of the vest by wearing a purpose-made ribbed undergarment, whose vertical ribs hold the vest away from the body and allow circulation of air under the vest.¹¹

Though the added weight of the vest is not much compared to the other clothing and equipment worn by a police officer, the subtracted perspirative area is significant compared to the total area of the officer's skin. The vest imposes a true cost to the officer in terms of his body's ability to cool itself and can be viewed as a "legitimate complaint" about body armor. The Aerospace Corp. found that the strongest influence on wear rate, of those considered, was the Temperature-Humidity Index (THI) defined by the U.S. Weather Bureau. Reported wear rate was higher at times and locations with lower values of the THI (see figure 5 of vol. 1)-e. g., in winter (see figure 6 of vol. 1). [8]¹² The correlation of wear rate with THI was -0.75. Manufacturers presumably feel an incentive to make their products more acceptable in this regard, so vests may eventually improve in their ability to let the wearer keep cool.

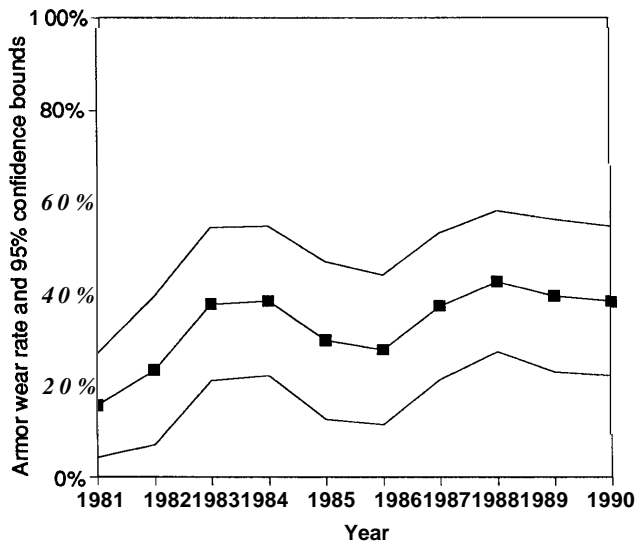
The Aerospace Corp. found the second strongest influence on wear rate was the officer's weight:

¹⁰ The NIJ-prescribed &S@ for a level I vest specified seven layers.

¹¹ Additionally, these garments are made so as to wick perspiration away from the body and evaporate it from the garment's ribs. This effect increases cooling and eliminates the uncomfortable feeling of sweat dripping down one's body underneath the vest.

¹² A more recent study by Strategy Polling Corp. and the John Jay College of Criminal Justice [102] found that self-reported wear rates by front-line officers were lowest in the Northeast (52 percent) and highest in the West (83 percent), with the South (66 percent) and North Central States (69 percent) in between. Wear rates by police management—an indicator of management support for wearing armor—were lower but followed the same geographical pattern, supporting earlier findings by the Brand Consulting Group [22, 23] that management support, including exemplary wearing, would increase wearing by front-line officers.

Figure B-5—Armor Wear Rate and 95 Percent Confidence Bounds



SOURCE: Office of Technology Assessment, 1992.

heavier officers tended to wear their armor less than lighter officers did (correlation with weight: -0.49). The third strongest influence on wear rate was the officer's age: older officers tended to wear their armor more than younger officers did (correlation with age: + 0.39). In contrast, the Brand Consulting Group reported, after surveying smaller samples of officers, that older officers wore armor less than younger officers did. [21, 22, 23] These results may not be inconsistent, because the Aerospace Corp. adjusted for weight in correlating wear with age, which is presumably positively correlated with weight. That is, the Aerospace Corp. found that lighter officers wore their armor more frequently than did heavier officers, but within each weight category, the older officers wore their armor more frequently than did younger officers.

Factors Other Than Comfort

Many factors other than comfort can influence an officer's decision as to whether to wear body armor on a particular shift. These include the perceived level of danger, orders to wear the armor, potential impact on disability or death benefits if it is found that armor was not being worn during an incident, and management support for armor wear.

Notoriously, harm seems to come when one least expects it. Many officers saved by their vests report

that they had no particular feeling of danger when dressing for duty on the day they were shot. [121] In the larger sense, however, the officers and departments that have acquired body armor have done so for a reason: the perception that theirs is a dangerous jurisdiction. Similarly, officers assigned to particular parts of town, to particular shifts, or to duty on particular days of the week, might be more likely than others to wear their armor, even in the absence of any particular knowledge, foreboding, or premonition of danger.

Department-wide standing orders to wear armor are not unheard of. In some ways, it is surprising that mandatory wear is not more widespread: construction workers have to wear their hardhats, and even the National Hockey League has now adopted a helmet rule. It is difficult to assess how fully standing vest-wear orders are obeyed, but one would certainly expect them to have a positive influence on wear rate.

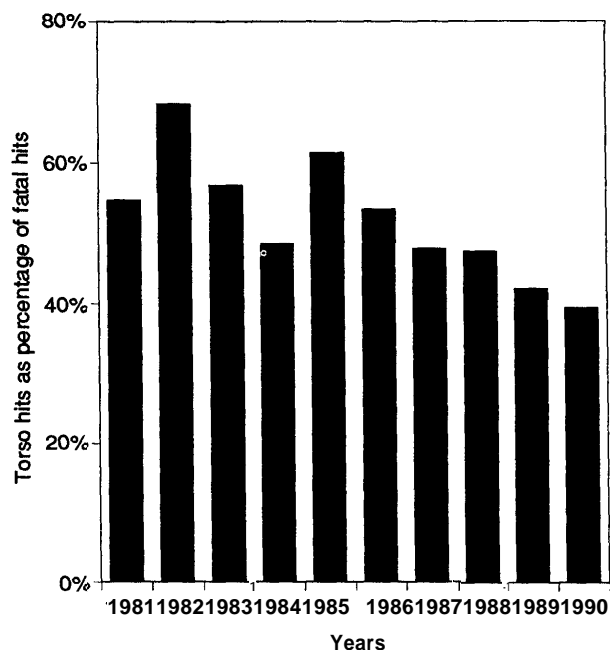
While the nonwearing of a vest, in contravention of standing orders, could be dealt with as a minor uniform infraction, the real sanction for an officer not in compliance with a mandatory-wear policy would be the potential loss of his or her survivors' benefits should he or she come to harm.

Finally, the value of management support for armor wear should not be under-rated. While exhortations, poster campaigns, and the like can sometimes seem "hokey" to those involved, management support for armor wear need not be limited to purchase of the armor. In the long run, and certainly after a "save," a properly managed program of management support for the wearing of body armor will be seen as a meaningful expression of concern for the men and women on the force.

One would expect that, since the introduction of vests in the mid-1970s, the proportion of officers killed by wounds to the upper torso would have gone down. It has, but only very slightly: the small size of the decline can be attributed to the dilution of the vests' effect on upper torso hits owing to the FBI's expansive definition of "upper torso," which includes the arms and part of the neck.¹³ A significant decrease has occurred since 1982 (see figure B-6).

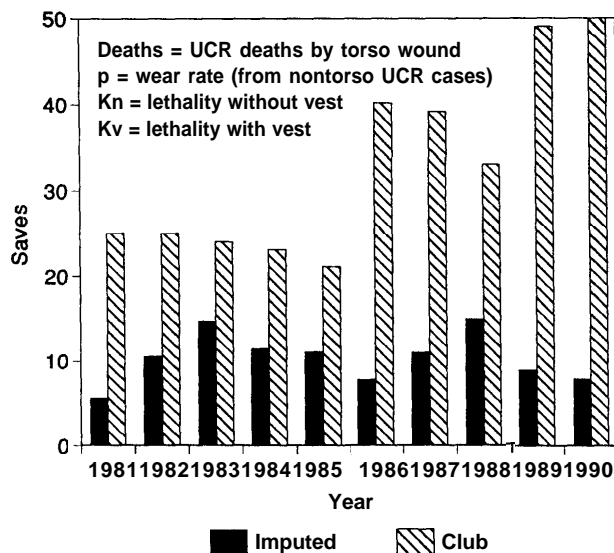
¹³ See reference [140], 1986, p. 14.

Figure B-6-Decline in Torso-Wound Share of Deaths



SOURCE: Office of Technology Assessment, 1992, based on data from the Federal Bureau of Investigation, 1982 to 1991.

Figure B-7-Saves Recorded by the IACP/DuPont Kevlar Survivors' Club (S.M.) v. Saves Estimated by OTA



SOURCE: IACP/DuPont Kevlar Survivors' Club (S.M.), 1991, and Office of Technology Assessment, 1992.

Officers Saved By Armor From Death by Gunfire

Based on body armor's effect in reducing torso wounds, one could estimate that body armor saves about 10 officers per year from death by gunfire.¹⁴ Firms involved in the body armor business collect and publish data on the number of "firearms saves"—instances in which an officer *probably* would have died by gunshot wound were it not for body armor—and report numbers considerably greater than 10 per year (see figure B-7).¹⁵ These numbers exceed OTA's estimate of saves from death by

armor partly because some wearers saved from *probable* death would not have certainly died had they not been wearing armor.¹⁶ In the aggregate, therefore, the set of people counted as saves will be slightly larger than the set of people who would have died had they received the same hits without any vests on.

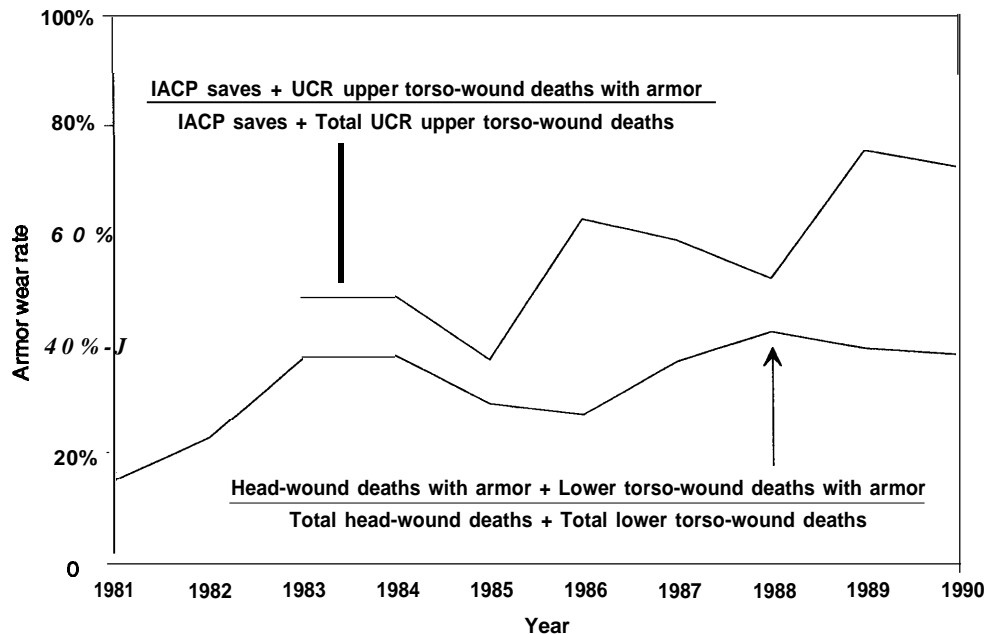
One way to check the validity of the "saves" data reported by industry is to see what wear rate it implies. Those officers saved were hit on the torso; the FBI reports the number of officers killed by hits on the torso (including some additional armor-wearers), and we may make a second estimate of

¹⁴ This estimate is derived is subject to some statistical uncertainty, resting as it does on estimates of K_v and K_n , the probabilities that a torso hit is fatal with and without (respectively) a vest on. In the absence of a break-down, by wound site, of nonfatal hits corresponding to the breakdown of fatal hits provided by the FBI's *Uniform Crime Reports* [140], these quantities must be estimated from the available data (fatal wounds and their sites, and aggregate nonfatal attacks) through the use of various reasonable but not guaranteed assumptions. The principal assumptions are that vest wear acts only to lower the probability that a torso hit will be fatal, does not affect the probability that other hits are fatal, and does not affect the probability that a torso hit occurs in the first place. The resulting K_v and K_n (0.11 and 0.43) seem plausible in light of military studies of wounding and death, although those studies are not strictly comparable because of the different weaponry and projectiles used.

¹⁵ Though manufacturers recognize that demand for their vests stems from the firearms threat, and supply separate data on firearms saves alone, they report all instances in which body armor arguably saved an officer from death or serious injury. Recent yearly totals amount to over 100 saves per year: one tally records a total of over 1,350 saves to date. About two-thirds of these saves, however, are not of officers attacked with firearms: they include officers involved in serious auto accidents and officers attacked with all manner of other weapons, including knives. Makers of concealable body armor emphasize that their product is not intended to, and cannot be expected to, offer protection against slashing or stabbing weapons. NIJ calls attention to a death from a stab wound incurred in the course of an ill-advised armor demonstration. [145] However, such armor has deflected such attacks in many instances.

¹⁶ Even a doctor's statement that death would probably result had not the victim been wearing a vest allows for some chance that the victim would have lived anyway.

Figure B-8-Armor Wear Rate Estimates Compared



SOURCE: Office of Technology Assessment, 1992.

under-fire wear rate from this figure. It is somewhat higher than the estimate made from the non-upper-torso wounds, which is not surprising in that the industry's estimate of "saves" inevitably includes some officers who would have lived anyway (see figure B-8). In 1990, it is consistent with the 1990 wear-rate survey data.

Saves and Fatal Wounds Per Shooting

Another way of looking at the effect of body armor is to consider the number of saves and fatal wounds per shooting. Using FBI data and either the OTA estimate of saves or that provided by the body armor industry, one may calculate the chances that a shooting incident will result in a save, a fatal shot to the head, a fatal shot to the upper torso, or a fatal shot to the lower torso (see figure B-9).

The saves as estimated by OTA are defined as saves from gunshot wounds that *would have been fatal* and therefore displace fatal upper torso wounds. The saves recorded by DuPont are saves from gunshot wounds that *probably would have been fatal* and therefore more than displace fatal upper torso wounds. A save or a fatality occurs in roughly 10 to 15 percent of shooting incidents, a save or a fatal upper torso wound occurring about 10

percent of the time: years with more saves have correspondingly fewer fatal upper torso wounds. There is no particular indication that widespread use of body armor is leading criminals to adopt a policy of shooting at officers' heads. Indeed, such a policy would probably not be productive, from the criminals' standpoint [even assuming he or she will not later be held to account for the shooting], in that aiming for the head would increase the percentage of shots that miss the target altogether.

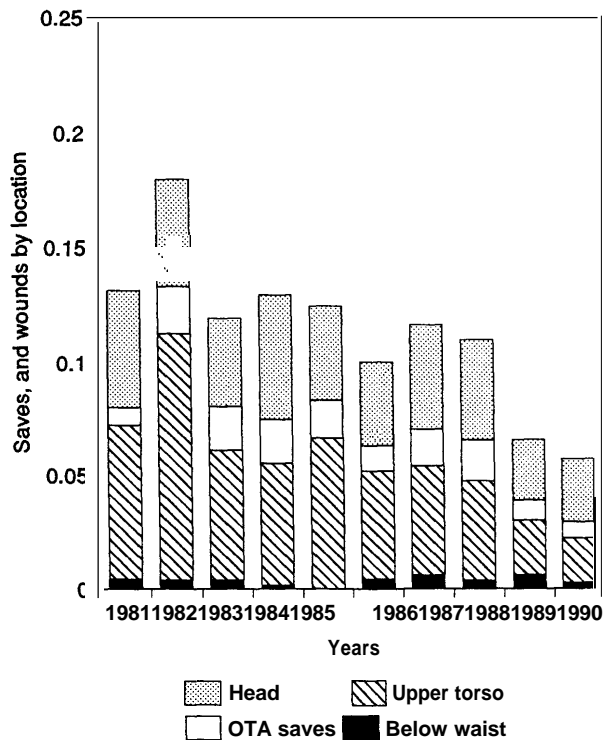
Is Body Armor a Good Buy?

Certainly an officer and his or her family will retrospectively consider a vest to have been a good buy after it has accomplished a save. But is body armor a wise choice for every officer, or for society as a whole? The preceding sections show that body armor costs society \$40 million each year. *What is the return on this investment, in economic terms?*

Currently, the wearing of armor saves 10 to 20 officers per year from death by gunshot wound. It is problematical in principle to estimate the value to society, in monetary terms, of each life saved (or anything else¹⁷). It is simpler to estimate the cost of each death. [76]

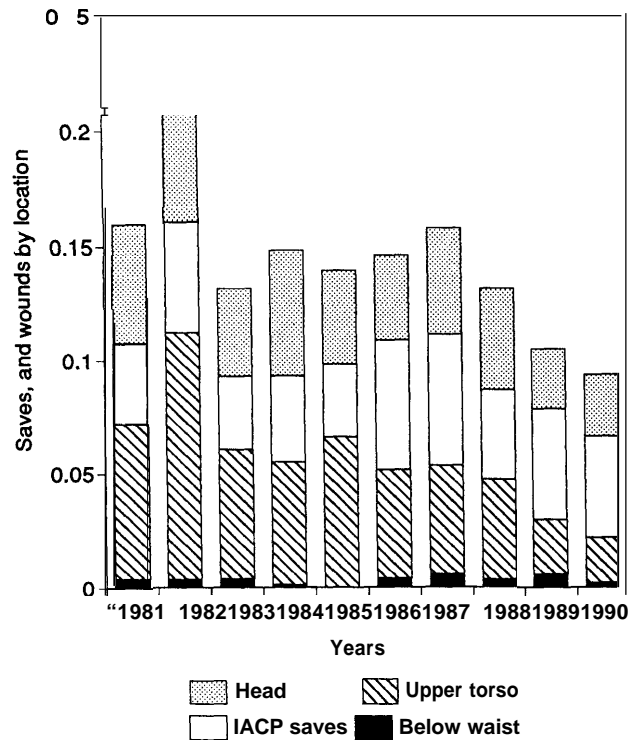
¹⁷ See Kenneth Joseph Arrow, *Social Choice and Individual Values* (New York, NY: Wiley, 1963).

Figure B-9-Saves and Fatal Wounds Per Shooting



Left: Saves as estimated by OTA, 1992.

SOURCE: Office of Technology Assessment, 1992.



Right: Saves as recorded by the IACP/DuPont Kevlar Survivors' Club (S.M.), 1991.

The tangible cost to society of a police officer's death may be in the neighborhood of \$1 million or more. The average officer killed has about 10 years of service, [140] suggesting that she is about 30 years old at the time of his or her death. A death benefit of \$100,000 is paid by the Justice Department. Local jurisdictions may also pay substantial benefits. Many officers leave young widows who receive their husbands' pensions for decades. A woman receiving her late husband's salary of \$25,000 per year for 40 years receives a million dollars, though the annuity cost to the department is perhaps half that figure. In addition, some survivors sue departments for damages, alleging wrongful death. [145]

The direct and indirect costs of the memorial service for an officer slain in the line of duty are considerable. They sometimes include a day's pay for officers who attend as an official duty; this alone

may exceed a million dollars. For example, the funeral of slain New York Police Department Officer Hector Fontanez was attended by 9,000 officers from as far away as Washington, DC.¹⁸

The training of a new officer costs another \$25 to 50 thousand and produces only a rookie; another 10 years' salary must be paid to produce a seasoned officer with 10 years' experience.

Spending \$40 million to save 10 to 20 officers therefore seems like a reasonable choice for society to make purely on the basis of dollars saved, let alone lives saved (see box B-1). In addition, another 20 or so officers escape serious injury (these are the officers logged as saves even though their wounds would not have been fatal—though we can estimate their number statistically we cannot say which vest-wearing victims of shooting they were) and thus avoid thousands of dollars in hospital payments

¹⁸ Sarah Krulwich, "New York Buries Two Killed in the Line of Duty," *New York Times*, Sept. 17, 1991, p. A1, and Sara Lyall, "2 Funerals: Day of Pain And Anger," *New York Times*, Sept. 17, 1991, p. B3.

Box B-1—Spending Money, Saving Lives

The statement of policy issues such as those surrounding police body armor often evokes the response, “No amount of money is too great to spend when lives are at stake--this is what we pay taxes for.” Though no Administration would set an explicit ceiling on the expenditure allowable to save a single human life, two important facts combine to create implicit ceilings:

1. Almost any endeavor to save lives by spending money faces increased costs with each successive life saved.^a In the case of body armor testing, for example, increased accuracy and reproducibility could always be gained by spending more time and money.
2. Other means of saving lives are competing for the same dollars.

Taken together, these facts lead to a situation in which the further pursuit of a particular life-saving endeavor will cost more per life saved than does some other endeavor. At that point the government would ideally stop trying to save lives the expensive way and shift the unspent dollars over to the program that saves lives the cheap way: more lives will be saved for the same dollars. In this way, competing means of saving lives through government programs create implicit ceilings on the size of any one way of doing so. In practice, the number of lives saved per dollar is difficult to compute, so the suggested calculation is only done in the most approximate of senses.

^a **Indeed, almost** any endeavor to do anything faces increasing costs as it grows, or what economists call “diminishing returns to scale.”

as well as a great deal of pain and suffering. Finally, the wearing of vests saves some officers from death by nonfelonious, nonballistic threats (chiefly automobile accidents)-upwards of 50 officers per year by one count. [16, 17, 18] These calculations suggest that, even in a strict cost-accounting sense that assigns no cost to human suffering, loss of life, or bereavement, the purchase of concealable body armor for police officers is a “good buy” for the officers, the departments, and for society as a whole.

Armor might have been an even better buy than the foregoing analysis indicates, if armor has, or attains, an average service life greater than the 5 years assumed and is properly cared for during its service life. In this case, the annual benefits estimated might be obtained in the future at a lower annual cost than the recent annual cost. A continued decline in the prices of the least expensive models would further reduce the annual cost to society for reaping the current annual benefits.

Although spending \$40 million per year saves 10 to **20** officers per year from being shot to death, and may save at least as many more from other hazards, doubling the annual expenditure for armor would not double the saves, because most officers in large jurisdictions (including the most dangerous ones) report that they already own armor. [102] Buying each officer two vests would not double the reported ownership rate (nor the reported wear rate), and those who don’t own armor may be those least at risk.

However, if the wear rate is 30 to 40 percent, it could be at least doubled and possibly tripled, in principle. This would not increase saves in proportion, because those who wear armor least may be those least at risk. It is unrealistic to expect, and perhaps unwise to desire, universal wearing of armor,¹⁹ Nevertheless, there is a clear potential for increasing wear rate and, thereby, saves.

¹⁹ Undercover officers, whose deaths account for a considerable fraction of the total, cannot be expected to wear armor; if the armor were detected, it would expose them.