
Known Knowns, Known Unknowns, Unknown Unknowns: The Predicament of Evidence-Based Policy

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Abstract

The authors present a case study examining the potential for policies to be “evidence-based.” To what extent is it possible to say that a decision to implement a complex social intervention is warranted on the basis of available empirical data? The case chosen is whether there is sufficient evidence to justify banning smoking in cars carrying children. The numerous assumptions underpinning such legislation are elicited, the weight and validity of evidence for each is appraised, and a mixed picture emerges. Certain propositions seem well supported; others are not yet proven and possibly unknowable. The authors argue that this is the standard predicament of evidence-based policy. Evidence does not come in finite chunks offering certainty and security to policy decisions. Rather, evidence-based policy is an accumulative process in which the data pursue but never quite capture unfolding policy problems. The whole point is the steady conversion of “unknowns” to “knowns.”

Keywords

evidence-based policy, uncertainty, realist synthesis, legislative interventions, smoking bans

There are known knowns. These are things we know that we know. There are known unknowns. That is to say, there are things that we now know we don't know. But there are also unknown unknowns. These are things we do not know we don't know.

Donald Rumsfeld, Former United States Secretary of Defence, 2002.

Introduction

Rumsfeld's circuitous and circumspect statement on the fallible basis for forward planning won the 2003 “*Foot in Mouth*” award from the Plain English Campaign. Given his confident and

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certain pronouncements on weapons of mass destruction, many commentators might have preferred conferral under a “*Please Practice What You Preach*” award. This paper, however, comes in praise of Rumsfeld’s Dictum. It is a profound distillation of the predicament of evidence-based policy. We live in the “evidence age.” We seek to justify policy decisions on the basis of “known knowns.” The real problem is what to make of the “known unknowns” and the even more troubling “unknown unknowns.” The paper seeks to explore the limits of evidence-based policy when, as always happens, the knowledge base falls short of absolute, indubitable truth.

Let us begin with the basic premise of the evidence movement—the “what works?” agenda and its mission to trade on the benefits of hindsight. Research into the effectiveness of programs and policies is by now quite middle-aged. Interventions have been tried and tried again and researched and researched again. The best way to underpin policy by evidence, the argument goes, is to assemble all previous empirical findings in a particular policy domain in order to synthesize the available lessons on which initiatives and measures are the most fruitful. In its original and still most influential guise, namely, evidence-based medicine, this philosophy led to the creation of an accredited method of systematic review, namely, meta-analysis, and an authoritative agency, namely, the Cochrane Collaboration, all based on that best know and most trustworthy of knowns, namely, evidence culled from randomized controlled trials (Sackett, Rosenberg, Muir Gray, Haynes, & Richardson, 1996).

From this hub in the world of clinical treatments, ambitions spread outward to evidence-based public health, to evidence-based management, to evidence-based policy, to “evidence-based everything.” The very moment interventions pass into these public domains they become more complex, as do the problems they seek to resolve, as are the situations and locations into which they are inserted, and as are the demands on the evidence needed to evaluate them. Box 1 provides a brief outline of the dynamics of modern interventions—and a first taste of the vast evidence requirements (Pawson, 2006).

Box 1. The Dynamics of Complex Social Programs

Programs are active, not passive. Interventions do not work in and of themselves; they only have affect through the reasoning and reactions of their recipients.

Programs have long implementation chains and multiple stakeholders. Recipients are many and varied; reactions to programs thus differ; outcomes are thus generally mixed.

Programs are embedded in complex social systems. Recipients are rooted in different localities, institutions, cultures, histories, all of which shape the fortunes of a program.

Programs are implemented amid the turbulence of other interventions. The policy agenda is delivered through a multitude of interventions, each one interfering with the reception of another.

Programs beg, steal, borrow, and adapt. Practitioners work constantly to improve the delivery of interventions rather than preserving uniformity to meet evaluation and trial requirements.

Programs are the offspring of previous interventions. Social problems are longstanding; interventions evolve to try to combat them; the success of a current scheme depends on its history.

Programs change the conditions that make them work in the first place. An intervention’s success is always time limited since alleviating a problem always involves changing its concomitant causes.

The processes sketched here are not indiscriminate “noise;” they are part and parcel of modern interventions (Davidoff, 2009). And if policy is to be evidence-based, research is needed to accommodate them. The question for the paper is just how much of this fluctuating terrain can be “evidenced?” As the reviewer trawls the databases and search engines for the requisite information will they find enlightenment, or will the research prove lopsided in coverage, uneven in quality and contested in its conclusions? In short, as researchers strive for an empirical grip on the complexity of modern interventions, what is the balance of known knowns, unknown knowns, and unknown unknowns?

Should We Ban Smoking in Cars Carrying Children?

The paper suggests an answer to these grand challenges via a humble case study. We draw here on a review recently carried out by the authors on the potential effectiveness of a law banning smoking in cars carrying children (Wong, Pawson, & Owen, in press). This paper presents a brief selection of key findings. The focus, however, is to provide a social science perspective on what statisticians call the “uncertainty” of the evidence and what philosophers think of as the “decidability” problem.

Legislative interventions carry all the complexity described in Box 1. In particular, they have a long implementation chain, which means that successful laws need to navigate the competing sensibilities of law makers, pressure groups, enforcement agencies and, in this instance, parents, smokers, and nonsmokers. A massive range of assumptions, ideas, or what are sometimes called “program theories,” lies behind them (Rogers, Hacsí, Petrosino, & Huebner, 2000). Successful laws have to be justified, designed, drafted, publicized, rendered unambiguous and made enforceable. An abbreviated list of some of key pitfalls worthy of interrogation in comprehensive review is presented in Box 2. The catalogue is organized under four main questions, each one carrying a sample of critical subissues that need to be “evidenced” in order to warrant the claim that there is a sound empirical foundation for the intervention.

Box 2. Testing Questions of the Efficacy of a Ban on Smoking in Cars Carrying Children

1. Is the severity of the problem sufficient to justify a law?
 - 1.1. Does exposure to secondhand smoke (SHS) in cars leads to ill-health?
 - 1.2. What toxicity levels are encountered in a car when cigarettes are smoked?
 - 1.3. Does ventilation make a difference?
 - 1.4. Are the toxicity levels comparable to other risky environments?
 - 1.5. How does the potential harm compare to formally approved air quality standards?
2. Is there likely to be public support for such a law?
 - 2.1. What is the overall magnitude of support for such a law?
 - 2.2. What are the levels of support among smokers?
 - 2.3. What is the motivation behind public support?
 - 2.4. Does endorsement depend on the extent and success of previous smoking bans?
3. Is there likely to be effective pressure group opposition to the ban?
 - 3.1. Has the tobacco lobby opposed this particular ban and will they do so in future?
 - 3.2. What is the broader strategy behind tobacco company opposition to smoking control?
 - 3.3. How does the “smoke-free” lobby interpret and respond to tobacco industry tactics?
4. Is the law enforceable?
 - 4.1. What are the main barriers and facilitators in discharging the law?
 - 4.2. What is the optimal enforcement strategy?



Figure 1. The secondhand-smoke causal chain: from dose to response.

As we shall see, such a catalogue has to capacity to extend and extend; answering one question will often trigger several more (cf. Stake's call that the responsive evaluator should allow key concerns to emerge and enlarge; Stake, 1980). The concept map in Box 2 serves, nevertheless, as a credible starting point for this paper, rehearsing some typical bones of contention upon which evidence has to adjudicate. Put simply, in order to offer an evidence-based recommendation that such a ban will work, a review would need to discover: (a) significant evidence about risk and harm, (b) substantial information on positive levels of public support, (c) credible data on muted levels of lobby group opposition, and (d) trustworthy research that the law is enforceable.

In other papers, the authors have pursued all of the questions in great empirical detail (Pawson, Wong, & Owen, 2011; Wong, Pawson, & Owen, 2011). An account of the review method, realist synthesis, may be found elsewhere (Pawson, 2006). It is also appropriate here to acknowledge some of the intellectual forebears of our approach in the foundational work on realist evaluation by Henry, Julnes, and Mark, (1998) and on theory-driven evaluation by Weiss (1995). And, by way of demonstrating that there is nothing new under the sun, we also recall pioneering work in the 80s and 90s on "prospective evaluation synthesis" by Chelimsky and colleagues, which remains one of the most potent attempts to propel evidential reviews into the policy process (Chelimsky, 1995).

The purpose of the present paper is to pursue Rumsfeld's Paradox—his vacillation about the extent to which policy prognostication can be settled by empirical enquiry. Faced with a deep-seated problem and with an intervention that is complex in structure, intricate in its implementation, contested among interest groups, and difficult to enforce—to what extent can the evidence be decisive in guiding policy?

Is the Severity of the Problem Sufficient to Justify the Law?

"The dose makes the poison" (after Paracelsus 1567).

There is now a substantial, accumulating body of evidence on the dangers of subjection to SHS, much of it summarized in the U.S. Surgeon General's Report: *The Health Consequences of Involuntary Exposure to Tobacco Smoke* (U.S. Department of Health and Human Services, 2006). Vast as his report is (24.5 MB to be precise) the Surgeon General has nothing to say about the health impact of the microenvironment inhabited by the child cocooned with a smoker in the cabin space of the car. The review thus begins by hunting evidence on this very specific known unknown. Figure 1 represents the causal chain and predicament of primary researchers (and their secondary reviewers) in trying to determine the risks involved.

First is the matter of the pollutants under study. SHS is a complex mixture of thousands of chemicals emitted from burning tobacco, all with potential health effects, 50 of them considered potentially carcinogenic. Tracing their lingering concentrations in vehicles is difficult, especially under different volume, speed, and ventilation conditions. At Step 2, there is prevalence, the extent of within-vehicle smoking and smokers. This is also difficult to monitor closely in the private space of a moving vehicle and reliance is generally placed on potentially erratic self-report in surveys. Then we move to the rear seat of the car the equally taxing matter of estimating the extent of subjection to SHS of children in these locations. Cars, of course, are but one of the many, many

microenvironments which children encounter and measuring the extent of their exposure and isolating its effects is as fearsome an example of the “attribution problem” as one could ever meet. Step 4 is susceptibility, which governs the reactions to a potential toxin. Children’s metabolic systems are suspected of showing greater sensitivity to most toxins, another factor that needs be inserted into the risk equation. Finally, we come to health impact, once again furiously difficult to chart because of the potential pathways of so many toxins to so many organs and thus to myriad disease pathologies—short-term, long-term, and terminal.

Does Exposure to SHS in Cars Lead to Ill Health?

The research puzzle, in short, is that of attributing causality to one opaque factor in a blur of individual, family, domestic, and everyday environments. Dealing with this mix of knowns, half-knowns, and yet-to-be-knowns is always the lot of environmental health analysis and we turn first to an account of progress made. We discovered five papers that attempted to span the full causal chain, studying how exposure to SHS in cars impacted on subsequent health outcomes. A typical example utilizes the 2005 Canadian community health survey to chart the association between home and vehicle environmental tobacco smoke (ETS) and chronic bronchitis (Evans & Chen, 2009). Respondents are asked to self-report on:

- a) whether there were regular smokers in their household
- b) whether there was regular exposure to smoke in cars
- c) whether they had been diagnosed with chronic bronchitis
- d) a range of potential background intervening variables

Results are reported as follows: “The proportion of respondents who reported ETS exposure in the home and vehicle was 9.0% and 8.4%, respectively. The prevalence of self-reported doctor diagnosed bronchitis was 1.5%. When considered separately, home and vehicle ETS were both statistically associated with chronic bronchitis in children and adolescents aged 12–19 years. Neither home nor vehicle ETS exposure was significantly associated with chronic bronchitis in age groups greater than 19 years. When home and vehicle exposure were considered together, and sex, age, allergies, marital status, and race were controlled for, home ETS exposure was not a significant predictor of chronic bronchitis while vehicle ETS was.”

In short, the study lays claim an interesting, intricate little web of associations. The findings are interpreted as warranting further curbs on smoking and in particular that vehicle ETS might be more of a threat than home ETS. It is our first snapshot of evidence and our first opportunity to consider the status of such findings. The evidence here is, of course, associational and derives from survey data and so comes with the standard caveat that correlation does not imply causation. These data, perforce, do not follow and monitor unfolding disease pathologies. They are a snapshot relying on self-report of different events at different times. Accordingly, there are several reasons why we cannot yet consider these policy inferences to be justified. Some may be considered technical difficulties, potentially capable of resolution. Other impediments apply because the system under study is so complex that the task of establishing the causal pathways lies at the very boundary of research capability.

The findings here are highly susceptible to the vagaries of the respondents’ memories and are subject to bias though arbitrary operationalization and question wording. The best known problem of this ilk is “systematic exposure misclassification bias,” which may well be present here in that participants with active respiratory symptoms and a formal diagnosis have much more cause to recall exposure to ETS. These issues are raised not to dismiss this particular study but to establish

a more generic type of technical uncertainty that besets this form of public health evidence. What such surveys produce are indicative tendencies rather than known knowns.

This aside this study also raises the most profound and limiting methodological issue—complexity itself. The research task here is to assess the contribution of one microenvironment, itself consisting of a spasmodic history of hundreds of car journeys taken over many years and under many conditions, and then comparing them to a lifetime of irregular exposure to many equally complex air quality environments, and then attempting to discover the onward influence of the former but not the latter upon the individual's health profile, a complex dynamic in itself responding to many, many other influences other than air quality. Even the most powerful longitudinal research system could not track all of these pathways and the current one-shot survey provides only rough estimates in respect of a few byways of the process. Such research is indeed tantamount to discerning the influence of the needle in the haystack. Much more will be said about this issue—suffice to log here a core source of uncertainty in evidence-based policy, the complexity of processes and structures into which interventions are embedded.

Any single study is unlikely to find its way across such an imbroglio. A perhaps more feasible method of establishing the impact of in-vehicle cigarette smoke is to amass evidence separately about all the crucial stepping stones in Figure 1. And indeed, there are very many studies measuring toxicity, prevalence, exposure, and susceptibility. We move on to consider a handful of characteristic findings, posing the same question about their conclusiveness.

What Toxicity Levels Are Encountered in a Car When Cigarettes Are Smoked?

Several studies have attempted to gauge toxicity, under different driving conditions, when smoking occurs in the vehicle. In most cases, a volunteer smoker is asked to light up and an air quality monitor, strategically located, is set to record the fluctuations in toxicity levels. As with all “in vivo” experiments, these studies have to contend with significant natural variation in the behavior under study. The investigation requires a smoker and a child (substituted by an air quality monitor) but, thereafter, the encounter will vary according to: traffic conditions, climatic conditions, speed of vehicle, type of vehicle, duration of journey, number of passengers, number of smokers, number and frequency of cigarettes smoked, proximity of smoker and passenger, history of smoking in the car, and the ventilation conditions. The latter, the matter of whether smoking drivers open windows or operate air conditioning is a crucial bone of contention between proponents and opponents of the law and we turn shortly to closer consideration of this matter.

The pioneering inquiry (Edwards, Wilson, & Pierse, 2006) provides us with some typical data. The principal investigator drove the car while another investigator smoked cigarettes under specified conditions. Data were collected using a *TSI SidePak* AM510, a portable real-time air quality monitor measuring average levels of respirable particulates (known as “PM2.5”) over 1-minute periods. The *SidePak* was located on a child's booster seat in the rear of the car at approximately the height of the nose of a small child sitting in the back of the car. Ambient air was monitored before the experiment began and in-car during the journey. Three cigarettes were smoked with window open and cigarette held outside; with window half open and cigarette in car; and with all windows closed.

Mean PM2.5 levels during smoking of the first cigarette were $199 \mu\text{g}/\text{m}^3$ (peak $217 \mu\text{g}/\text{m}^3$), during the second cigarette $162 \mu\text{g}/\text{m}^3$ (peak $181 \mu\text{g}/\text{m}^3$), and during the third $2,926 \mu\text{g}/\text{m}^3$ (peak $3,645 \mu\text{g}/\text{m}^3$). Fifteen minutes after the third cigarette was extinguished, PM2.5 levels were $631 \mu\text{g}/\text{m}^3$, and did not return to the baseline level until almost 40 minutes after the cigarette had been put out. PM2.5 levels observed during smoking were many times higher than in ambient air ($3\text{--}4 \mu\text{g}/\text{m}^3$), which was measured “next to a busy traffic roundabout.” In summary and in terms of orders of magnitude, one can say that this study uncovers considerable variation of toxicity across

Table 1. Particulate Concentrations Under Different Speeds and Ventilation Conditions

Speed (mph)	Windows Position	Air Conditioning (AC)/Ventilation	Max PM2.5	Mean PM2.5
20	closed	AC Max	3184	1113
20	Passenger window fully open	AC off	371	97
60	Passenger window open 3"	AC off	608	119
60	closed	Ventilation off	3212	1150

Note. Exposure levels in $\mu\text{g}/\text{m}^3$.

the smoking conditions but these are marginal compared to the almost thousandfold difference between the mean “windows closed” and “ambient” comparison.

Such data might understandably be termed “hard evidence” and indeed they come closest to the elusive “known knowns” in this review. A more accurate description of their status might read “conditional knowns.” In specific and specified circumstances—low speeds, windows closed, passengers in close proximity, several cigarettes smoked, and so on—vast levels of toxins are observed.

Does Ventilation Make a Difference?

One of these conditions, especially, has aroused much research interest. What happens if the driver opens windows or operates the air conditioning? This “ventilation solution” has for some time been part of the argument of the “informed-choice” lobby and evidence is needed to settle the debate. We thus turn to the most rigorous inquiry on this matter. Ott et al.’s study involved more than a hundred air change measures in a variety of vehicles under many different ventilation and driving conditions (Ott, Klepeis, & Switzer, 2008). Its first aim is to provide some metrics on air change—just how much air is shifted under different driving conditions? The basic measure used in this regard is air changes per hour (ACH) and opening a single window by 3 inches turns out to “increase ACH by 8 to 10 times.” Ventilation, it seems, causes air change rates (hardly surprising for that is what it means). But what of the effect on dangerous toxins? Ott et al. provide the most comprehensive body of data on particulate mass concentrations, summarized brutally here in Table 1.

This study thus teaches us that ventilation does affect the presence of toxins—though their removal varies according to molecular structures (heavier and more dangerous particles are harder to remove). We have further evidence here of the virulent levels of contaminants under adverse conditions. We also have significant new evidence in the middle rows of the table of the fall in rates under more benign circumstances. But to return to the question at hand—what does this study signify for potential legislation? Many smokers who drive cars carrying children do so under informal rules about reducing their consumption during journeys and having windows open in order to achieve “safe levels.” Are they correct? The answer is “not yet known.” We now have splendid evidence on how toxicity gradients vary under different in-car conditions but this study cannot decipher the cutting point of acceptable air quality standards. Nor can it tell us, though we might well guess, whether a law could survive the ambiguity of trying to prespecify how ventilation should operate.

Are Toxicity Levels Comparable to Other Risky Environments?

One way of determining pertinent benchmarks is to examine precedents and relativities—comparisons of vehicle toxicity data with measurements of air quality made in other domains already subject to smoking restrictions. The rationale for doing so is obvious—“if intervention was needful *there*, then surely the same applies *here*.” This sentiment is uttered in virtually all lobbying for banning

smoking in cars carrying children. The “smoky bar,” the *bête noir* of public health advocates, is the favored precedent and we turn to an inquiry that throws some light into that smog.

Edwards et al. is one of the most substantial studies of air quality in pubs and bars. It was conducted in the United Kingdom in 2005, before the introduction of smoking bans in these establishments. Sixty four pubs came under scrutiny, chosen to span different communities (Edwards et al., 2006). The mean fine particle level (PM_{2.5}) across all sites was 285.5 $\mu\text{g}/\text{m}^3$, though as with in-car measures, large variations in air quality were uncovered according to pub location, usage, time of week, time of day, and so on. In the worse category (pubs in deprived areas), mean levels were 400 $\mu\text{g}/\text{m}^3$, with a range of 54–1,395 $\mu\text{g}/\text{m}^3$, figures that the authors and indeed policy makers considered strong support for this particular ban.

Drawing parallels on air quality levels across the two situations is not straightforward, however. If we recall the studies examined in 1.2 and 1.3, peak levels in cars under closed conditions are over 3,000 $\mu\text{g}/\text{m}^3$, seemingly even more dangerous. Then again, if a comparison is drawn with mean levels in a well-ventilated car, Ott et al.’s measure at 97 $\mu\text{g}/\text{m}^3$ is lower than the means in any of the establishments above. The upshot, perhaps, labored by these simple comparisons, is that as toxic environments, both cars and pubs vary widely according to context and usage. There is no Archimedean point from which we can declare a given, objective difference between car and bar.

The crucial difficulty is the matter of duration of exposure. Many of the reported measures are of “mean prevalence.” These “means” refer to quite different time intervals and circumstances. In-car, the mean typically refers to air quality during the smoking of a single cigarette and not the entire journey. In-pub, the mean refers to the contributions of many smokers over an extended period of time. Much of the argument for banning smoking in such venues was that high levels of air contaminants persisted over the entire shift of the bar worker. Once again, in terms of policy implications, the evidence is ambiguous. In a world of conditional knowns, there is no such thing as a clear precedent.

How Does the Potential Harm Compare With Formally Approved Air Quality Standards?

Another compelling option for gauging the risk associated with in-vehicle smoking is to compare it with publicly sanctioned benchmarks—formal air quality standards recognized by official agencies such as the U.S. Environment Protection Agency (EPA). These have considerable attraction for evidence-based policy, being what Rumsfeld might term “official knowns.” We begin by extracting the EPA’s figure of the “primary standards” for PM_{2.5} concentrations (U.S. Environmental Protection Agency, 2010). Aptly, primary standards are intended to set limits to protect the health of “sensitive” populations such as asthmatics, children, and the elderly. Two exposure figures are presented limiting the acceptable standards of ambient air to 15 $\mu\text{g}/\text{m}^3$ annually and 35 $\mu\text{g}/\text{m}^3$ in a 24-hour period.

These baseline levels represent very low magnitudes indeed when compared to the car exposure levels reported earlier. If one considers a child making routine car journeys involving an exposure during smoking of the order of 3,000 $\mu\text{g}/\text{m}^3$, then clearly such exposure will contribute significantly to exceeding the recommended limits. But again, there are provisos. The EPA is required to produce standards for the totality of potential toxins in the widest range of environments and, accordingly, guidelines tend to the generic and are not intended to adjudicate upon the momentary details of exposure in microenvironments, such as the rear seat of vehicles. Again, we are drawn into a comparison that conflates long-term harms with short-term exposure.

Consider next the primary standard of the Office of U.S. Surgeon General: “The scientific evidence indicates that there is no risk-free level of exposure to second hand smoke” ... “The US Surgeon General has concluded that breathing even a little second hand smoke is bad for your health.” (U.S. Department of Health and Human Services, 2006). *Ipsa facto*, it follows that any

amount of smoking in cars carrying children should be considered a significant risk. Under these benchmarks, we move from strong to unequivocal support for the in-car ban.

How is this zero magnitude to be explained and should it be regarded as an authoritative standard for the in-car smoking ban? It transpires that they are underpinned by a fundamental change in the interpretation of “risk.” In classic academic toxicology an ancient maxim, the Paracelsus principle, is considered the cornerstone of public health standards: “All substances are poisons; there is none which is not a poison. The right dose differentiates a poison from a remedy” (Pagel, 1982). The rule is that a substance only becomes poisonous when ingested at above some tolerable level. Caffeine is an exemplar—commonplace in range of foodstuffs without leading to illness but capable of causing death at 50-times standard exposure levels.

More recently, an alternative credo has come to the fore known as “the precautionary principle.” It states that, “in cases of serious or irreversible threats to the health of humans or ecosystems, acknowledged scientific uncertainty should not be used as a reason to postpone preventive measures.” The principle originated as a tool to bridge uncertain scientific information and the political responsibility to act to prevent damage to human health (Martuzzi & Tickner, 2004). It transpires then that the Surgeon General’s new standard and, incidentally, the recent benchmarks published by the World Health Organization, are based squarely on risk eradication (World Health Organization, 2005).

As we trust this discussion has made clear, “acknowledged scientific uncertainty” inevitably persists about the risks associated with smoking in cars carrying children. The new principle is thus designed for such a scenario. But what is its status? By definition the zero emission, zero tolerance standards are not empirically derived—they concede that the evidence is not yet in. Their role is thus to acknowledge uncertainty but to remove doubt; they are literally “unknown knowns.” While this neologism provides pleasing symmetry to Rumsfeld’s typology (it completes the missing, fourth permutation of knowns and unknowns), it betokens a move from evidence to advocacy. Invoking the maxim stifles the search for further evidence (Tickner, Kriebel, & Wright, 2003). From the perspective of Paracelsus, precautionary propositions are illogical. They deny the dose–response rule in lumping together the dangers of a lifetime’s exposure of nonsmoking spouse to a smoking partner with the infinitesimally small exposure when the passer-by passes by a marooned smoker expelled to the street corner.

Interim Summary I

The above represents a brief sample of some key studies relating to the toxicology of SHS in cars carrying children. Some powerful evidence comes to light, which can be summarized thus: (a) because of the confined cabin space, and (b) under the worse ventilation conditions, and (c) in terms of peak contamination, the research permits us to say that smoking in cars generates bursts of fine particulate concentrations that are, (d) very rarely experienced in the realm of air-quality studies, and that will constitute a health risk: (e) while exposure to smoking in cars is still commonplace, and (f) because children are more susceptible, and (g) since children are open to further contamination if their parents are smokers.

This summary proposition is numbered in order to reemphasize our main conclusion that what emerges from these studies are contingent truths. To put it bluntly, the evidence above does not uncover an absolute risk threshold. It commences with a point of certitude, namely, that smoking in cars can generate fine particulate levels of over $3,000 \mu\text{g}/\text{m}^3$. This calculation turns crucially on the matter of volume—the capture of high concentrations of respirable particulates in a tightly confined area. So much is warrantable. But the risk calculation does not end there. The threat from SHS, quite literally, becomes diluted as people respond to it. That response is biological and social. We know that risks change with the differential ability to metabolize and expel toxins and there is

further evidence to suggest that the very young are most susceptible (U.S. Department of Health and Human Services, 2007). We also know that people will respond socially by adapting ventilations conditions, adjusting their smoking frequency, tailoring their smoking behavior with different types of passengers, and indeed by passing laws against smoking. Our review pieced together evidence on all of these conditions. Save for the data on ventilation, we have had little space to rehearse it all here.

Our task at this point is thus to evaluate the authority of evidence when the issue under investigation depends on many, many contingent conditions, which change over time and with location. This absence of known knowns has led others to leap into the arms of the precautionary principle. Wisely, this tenet tells us not to wait for certitude. Unwisely, as above, it then slopes back to certitude via the production of arbitrary, absolute standards that sit most uncomfortably with the mass of conditional truths produced by the science. Similarly, there is no short cut via the upholding of precedents. Standards established for the smoky bar or the general environment depend themselves on conjoined sets of conditions, which cannot be read across into the family car.

What actually sits between known knowns and unknown unknowns are partial knowns and partial knowledge remains a useful tool for policy makers. The fact that more research is always needed does not involve an indefinite wait. What the evidence above supplies is a framework for decision making and some incredibly useful nudges on the dynamics of risk. It enables the decision maker to identify key issues and consider how each in turn applies to the policy and the place under consideration. A thorough immersion in the seven contingencies above is the basis for making a balanced judgment.

Our initial reflection also tells that evidence-based policy is a journey rather than a destination. We turn next to examine the voyage through public opinion, seeking further clues on how evidence bundles may be further consolidated.

Is There Likely to be Public Support for Such a Law?

No written law has ever been more binding than unwritten custom supported by popular opinion (Carrie Chapman Catt)

Wise legislators consider not only the grounds for a law but also its acceptability to the recipient community. Adherence to a law (unlike, e.g., responses to medication) is strongly conditioned by levels of public support, which are often variable and fickle. Gathering evidence on public support is a routine task of social science and this section considers the certainties and uncertainties in the evidence provided by the methods of opinion polling. We sample attitudinal evidence on in-vehicle smoking bans, following the subquestions in Box 2, namely, overall support; opposition by smokers; reasons for support; changing dynamics of support.

What is the Overall Magnitude of Support for Such a Law?

There have been many attempts to gauge levels of support for in car smoking bans, much of the evidence has been drawn from items within national public health surveys. As an illustration of some typical data, we sketch some Australasian evidence. In the first major attempt to gauge opinion, Bauman et al. undertook a random household survey in New South Wales using “standard methods for assessing the prevalence of smoking and attitudes” (Bauman, Chen, & Chapman, 1995). Responses to the question, “Do you think it should be illegal to smoke in cars when travelling with children?” are reported as follows: “of the 1461 adult responders, 72% agreed, 27% disagreed and 1% were undecided.” A much later telephone survey assessed attitudes and self-reported behaviors of 1,026 Queenslanders with regard to SHS in cars and homes (Dunn et al., 2008). Overall support

for smoking bans was high (though varying depending on type of passenger)—63.8% (for nonsmoking adults) to 80.5% (for children under 12 and pregnant women).

The highest level of support for legislation discovered in our review emerges from a public health survey of a national sample of 1,376 New Zealand *Adult Smokers* survey (Thomson, Wilson, Weerasekera, & Edwards, 2008). This contained the item “Do you think smoking should be allowed in cars with preschool children in them?” Results showed that, “. . . 95.9% disagreed (95% CI: [4.7%, 97.1%]) and only 3.0% agreed with this question,” leading the authors to conclude that “. . . there appears to be almost universal support for not allowing smoking in cars carrying children, from smokers themselves.”

Many other such studies exist. This area is notable for the weight of evidence. Support appears high, indeed very high and possibly increasing. But what is the quality of the evidence? Should policy makers regard these data as known knowns? There are two familiar problems with such materials—attitudinal responses on health matters can be unreliable and the data, perforce, provide only a snapshot of opinion at particular time and place.

Survey responses can never be taken entirely at face value. Well-known technical problems exist due to the slipperiness of question wording. Quick eyes will spot the above questions carry subtle differences of emphasis that might shape the willingness to support a ban. Public compassion might well differ for “children,” “children under ten” and “preschool’ children, not to mention the “elderly,” “pregnant women,” “nonsmokers,” and so on. Probably, even more of a threat in the present case is the “social desirability effect.” Respondents, naturally enough, prefer to be on the side of the angels and thus often “fake good” when confronted by a stranger asking questions about sensitive topics (Stein et al., 2002). Put in a nutshell, the problem is that smoking addicts, who suffer routine stigma on top of slow poisoning, may well choose to dissemble. Being technical problems there are technical solutions here, albeit limited. Attitudinal information can be hardened, up to a point, by enfolding consistency checks within questionnaires and by mounting secondary investigations that compare what people say and what they do. A more practical fallback is simply to be guarded in making inferences from the data and to regard such evidence as tendencies (indicative knowns) rather than absolutes (known knowns).

General tendencies, however, will not satisfy all policy makers. Trends that might apply in the open swards of New Zealand or in smoke-averse Australia might not apply to their bailiwick. Broadly speaking, it is true to say that the studies reviewed in this section were all made in jurisdictions which were at least in the initial stages of contemplating such a ban. The poll that policy makers require is a sample of “their patch, right now.” In short and in terms of *prima facie* evidence on public support, policy makers will often lack immediate, local evidence and be left confronting a “known unknown.” Is there a way around this predicament? As we have seen, the way forward is to develop conjoined hypotheses rather than await the all-clarifying datum. So is there available information on the closer texture of support that might provide additional lessons?

What Are the Levels of Support Among Smokers?

A great deal of evidence exists charting the contours of endorsement for in-vehicle smoking bans. There are many studies relating support, or lack of it, to gender, education, social class, employment, poverty, region, cultural background, nationality, health status, and so on (Kegler & Malcoe, 2002). Policy makers estimating support for their legislation will need to pay heed to the voices of the relevant constituencies. However, since the crucial task is to gauge headwinds to the passage of the law through this climate of public opinion, the most pertinent data relates to the attitudes of the most palpable foes, namely, smokers.

We reproduce three further nuggets of evidence, which compare the opinions of smokers and nonsmokers. Dunn et al.’s study goes on to report, “Most respondents believed that laws prohibiting

smoking should be implemented as soon as possible in cars (74.2%) and homes (71.9%) (Dunn et al., 2008). Smokers were less likely to support laws prohibiting smoking in cars being introduced now or as soon as possible (61.7%) than were non-smokers (74.2%).” Jalleh et al. provide a further nuance on Australian opinion (Jalleh, Donovan, Stewart, & Sullivan, 2006). Support for a “total ban” on smoking in vehicles was 24% among smokers and 49% among nonsmokers. But, as is the norm, such endorsement is highly conditional and changes markedly to 84% among smokers and 87% among nonsmokers when “a child is in the car.” Moving to a different nation and population segment another survey discovered, “90.2% of Canadian youth reported that . . . smoking should [not] be allowed around children in cars . . . although the prevalence was highest among non-smoking youth (91.8%), most smoking youth (72.9%) also reported that smoking should not be allowed around children in cars” (Leatherdale, Smith, & Ahmed, 2008).

What is the status of this evidence? All of the provisos raised in *What Are the Levels of Support Among Smokers?* section apply again. These are survey data. These are indicative trends and tendencies that are subject to measurement error and reporting bias. Unsurprisingly, the evidence indicates that smokers are more reluctant than nonsmokers in endorsing a potential ban. Even so, the data reveal persistently that this is not diametric opposition. Indeed, the majority of smokers in these studies, and in many others, would appear to support the ban. To repeat, words are not deeds, and the specter of the social desirability effect looms large in these responses. But “faking good” is only one of the possible reasons for the smokers’ expressed disquiet at children’s exposure to SHS. A review needs to consider further explanations in order to harden fragile uniformities into solid explanations.

What is the Motivation Behind Public Support?

Public opinion research, of course, does not only report on opinions, it delves into the reasoning behind them. Firm evidence on this motivational base can help solidify the picture derived in the previous sections about the seeming solidity of support for the proposed ban. Why the general endorsement? Wherefrom the smokers support? We uncovered two bodies of evidence capable of interpreting these outcomes: the first highlights the profound protective instincts that surround children in public health matters; the second concerns the depth of regret that smokers feel about their tobacco use.

Many inquiries, both quantitative and qualitative, indicate that smoking is modified in the presence of children. Here we illustrate two typical nuggets of information from studies attempting to discover how smokers concede the risk. Gillespie and colleagues questioned New Zealand smokers directly about their concerns about SHS: “Of the respondents who reported that they did not smoke at all when they were around children, nearly half (46.5%) said that this was because they did not want to expose children to SHS. Setting a good example for children was also reported as an important reason for not smoking in the presence of children (25.6%)” (Gillespie, Milne, & Wilson, 2005).

The 50 Scottish smokers in a qualitative study by Phillips et al. made their concerns about SHS quite clear; “Many thought that children were particularly at risk because they were still developing,” with this consideration being more important than aesthetic concerns (e.g., the smell of the smoke). Smokers emphasized efforts to not harm children and reported modifications in their behavior in the presence of children: “All respondents with partial or no restrictions described how they would temporarily modify these in particular circumstances. For example, partial restrictions would become stricter in the presence of children and grandchildren, or relaxed if adult visitors were smokers” (Phillips, Amos, Ritchie, Cunningham-Burley, & Martin, 2007).

This widespread perception of the vulnerability of children is often seized upon in jurisdictions that have implemented the law. Several studies of smoking control policy have noted the attempt to capture this aspect of the moral high ground. For instance, a “save the children” motif was

prominent during the preparation and enactment of the bill banning smoking in cars carrying children in Nova Scotia, Canada. Local officials declaim, “The council . . . has once again reflected the conscience of the community while dealing with an issue on behalf of an element of the population, that is, children, that don’t often have the right to change the environment in which they might find themselves . . . children don’t often have a voice for themselves on health issues . . . cars are an environment where they can’t walk away” (Moulton, 2008).

The same thread emerges from a “qualitative narrative review” summarizing the 12-year Australian history of advocacy for smoking bans in cars (Freeman, Chapman, & Storey, 2008). The authors analyzed data from the print news media seeking out the ascendant themes. A key motif framed the issue as being about the protection of defenseless children with no choice about being exposed to SHS. This theme was explicit in 35% of articles. Highly emotive terms such as “gas chamber” and “child abuse” were used to describe the conditions experienced by a child inside a smoky car, leading the authors to conclude: “Invoking the protection of vulnerable children in the debate about smoking in cars called up an almost invincibly powerful sub-text for advocates.”

A different body of evidence teaches us that smokers, as a collective, are most unusual in the ranks of peer groups and interest groups in as much as they have an ambivalent attitude to membership of their group. Many studies, over the years, have demonstrated that a significant proportion of them want to quit. Several different estimates exist in the literature, with U.S. data suggesting that in any given year, nearly 2 in 5 cigarette smokers try to quit, but fewer than 10% succeed (Lee & Kahende, 2007). Other studies have tried to understand the dissonance that follows as smokers come to terms with cessation failure in the face of addiction. We highlight the largest study attempting to gain a measure of the degree of that contrition.

Fong et al. conducted a random-digit-telephone survey of 8,000 smokers across four countries (United States, United Kingdom, Canada, and Australia). Respondents indicated whether they strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree with the statement, “If you had to do it over again, you would not have started smoking.” The proportion of respondents who agreed or strongly agreed was 90% and was nearly identical in each country, leading the authors to conclude that “regret is a near-universal experience among smokers” (Fong et al., 2004). The study, indecently, profiles the characteristics with the strongest desire (if not ability) to quit. Unsurprisingly, that portrait shows a good fit with the generation of parent-smokers under investigation here. Methodological caution about potentially leading question wording, superficial telephone interviews, and, in this instance, the possibility of “faking sorrow” must always be acknowledged. Nevertheless, these orders of magnitude are rarely seen in opinion polling and, together with the persistent data on the numbers seeking to quit, there is evidence of a powerful tendency here. But with what consequence?

The authors argue that this “near universal regret” is a powerful constraint on a smoker’s future choices and, accordingly, that knowledge of this should feed into tobacco control policy. A straightforward inference is that remorse about their own habit means that even hardened smokers will have little interest in conscripting a new generation of smokers. In short, smokers do not and will not tend to proselytize. “Regret” may be a significant part of the explanation for the muted levels of opposition to the ban on smoking in cars carrying children and thus becomes another serviceable fragment of evidence explaining the lack of opposition to proscription.

Does Endorsement Depend on the Extent and Success of Previous Smoking Bans?

It has already been noted that the vast majority of the available research emanates from counties in which tobacco control has already gained purchase. An obvious corollary is that support for a particular ban is elevated, the more extensive the previous legislation in that policy domain. If smoking bans have been enacted on public transport, followed by office and indoor workplace restrictions,

followed by smoke-free restaurants and finally bars, pubs, and gambling venues, then the hypothesis is that public opinion is softened up for the next location, namely, private cars. Known colloquially as “domino theory” and in tobacco control circles as “denormalization theory,” this thesis comes under considerable research scrutiny.

Hammond et al. analyze further results from the four nation study (reported above) that pertain directly to the smokers’ perceptions of denormalization. About 81% of smokers agreed with the statement that “there are fewer and fewer places I feel comfortable smoking” (Hammond, Fong, Zanna, Thrasher, & Borland, 2006). An identical majority of smokers also agreed that “society disapproves of smoking.” Further research from Ireland probes the smoker’s experience of legislation (Fong et al., 2006). Adult smokers were surveyed by telephone before and after the implementation of the Irish workplace smoke-free law in March 2004. The relevant and paradoxical finding was that even when smokers did not support such a ban at inception, they often did so after it was introduced: “Increase in support was most dramatic in venues where pre-policy support was lowest (for example, bars/pubs and restaurants), suggesting that policy-makers that stay the course in implementing comprehensive smoke-free policies are likely to experience increased support among smokers after implementation.”

These and other studies in our review begin to tackle an issue of great subtlety, trying to chart and interpret smokers’ reactions to the tightening grip of legislation. Persistent evidence exists indicating that smokers are well aware of the progressive weight of legislation and from that finding alone there is useful support for the domino theory.

Interim Summary 2

Our review labors end, once again, with a conditional known. A sizable number of studies have shown significant levels of support for a ban in smoking in cars carrying children. The vast majority of this evidence comes for surveys, polls, and attitudinal inquiries. These methods trade in tendencies and probabilities rather than uniformities and certainties. There is always an imponderable gap between what people say and what they do. Moreover, this evidence is narrow in its population base, emanating from localized studies in specific time periods.

However, these specific indeterminacies do not negate the contribution of the opinion polls. For, as we have seen, evidence is constructed in the intersection of “conjoined hypotheses”—and this section demonstrates a key strategy for weaving together the findings. A more compelling source of certainty lies, we submit, in the process of *explanation building*. The import of public opinion is not just a matter of a percentage of affirmation here or a percentage there. Attitudes are rooted in reasoning and those roots are open to investigation. In this case, the solidity of smokers’ support is attested in further evidence on the grounds for that support, namely, their beliefs about the vulnerability of children, their sentiments of regret about taking up smoking and their acknowledgment that public sympathy for the smoking habit has declined under incremental legislation.

Realist synthesis constructs tests and refines explanations and what this review provides is an account of why and in what circumstance public opinion will harden in favor of a ban. Like all hypotheses, these theories are provisional, falsifiable, and open to further testing. But it is via this process of building conjectures and seeking evidence, for or against, through which science and evidence-based policy approaches (but never reaches) certainty.

Is There Likely to be Effective Pressure Group Opposition to the Ban?

Those who do not know the plans of competitors cannot prepare alliances. (Sun Tzu: The Art of War)

Cigarettes occupy a distinctive but not unique place in modern commerce. In liability law, they face the perpetual challenge of being condemned as a “tangible good that may cause harm.” And yet

their sale, save for restrictions on youth purchasers, is perfectly legal. Legislation restricting smoking behavior has thus tiptoed its way through the judiciary—attempting to restrict a potentially dangerous activity while recognizing the legality of its market. Against this background, it is well documented that the tobacco lobby has mounted a sustained campaign attempting to thwart the steady encroachment of legislation. Truculent opposition has been mounted against smoking bans in public places, against health warnings, against advertising restrictions and, until 1998, against the very idea that smoking was a health risk (Glantz & Balbach, 2000).

Under review here is the narrower question about whether the tobacco industry will mount opposition to the banning of smoking in cars carrying children. It turns out that there is precious little published evidence on the said issue—given that it covers a very recent twist in legislation. Only a few jurisdictions (e.g., Australia, Canada, and the United States) have enacted the ban. What is more, lobbying is a covert business, much of it out of the public eye and absent from research reportage. Put in this way, it makes the reviewer's task sounds most Rumsfeldian—a quest to uncover concealed truths from the lips of unwilling sources—a prime “known unknown.”

Has the Tobacco Lobby Opposed This Particular Ban and Are They Likely to do so in Future?

Our search in this block began by seeking materials on existing tobacco company resistance to legislation on smoking in cars carrying children. Basically, there was only one sighting in an academic journal and a fragmentary one at that in Freeman et al.'s paper showing that the “welfare of children” is the dominant weapon for those supporting proscription (Freeman et al., 2008). We have already quoted the vital passage which continues as follows:

Invoking the protection of vulnerable children in the debate about smoking in cars called up an almost invincible sub-text for advocates. Unlike all other advocacy for smoke-free areas, this debate was not contested by the tobacco industry or other commercial interest groups motivated by the potential to see restrictions reduce sales and further denormalise use. Indeed, one tobacco company was publicly supportive of legislation.

It turns out that British American Tobacco (Australia) was the supportive party in this instance. In a personal communication (Armstrong, personal communication, October 26, 2009), BATA informed us that their submission to the “Preventative Health Task Force” contained the following statement:

Smoking in cars carrying children: BATA Position Summary

BATA supports the sensible regulation of tobacco products, while ensuring that adult smokers can make informed choices about the use of such products. We accept that environmental tobacco smoke is an issue of public importance and believe that smokers should be mindful of others' comfort and should not smoke around young children. We do not support attempts to ban or regulate against smoking in private dwellings or private vehicles that are not containing children. We believe that people should not smoke around young children. However, we think this is more effectively achieved through education and encouraging greater personal responsibility amongst smokers.

Here then is a clear statement of principle—“we believe that people should not smoke around young children.” Is this an isolated statement or a common cry? Our more detailed analysis of the websites of tobacco companies worldwide reveals what can only be described as an echoing chorus of support for a range of smoking restrictions on children. Further examples are provided in due course.

Much of the impetus for tobacco companies to concede the risks associated with smoking and thus to inform adults of and shield children from those dangers stemmed from the U.S. Master Settlement Agreement (MSA; National Association of Attorneys General, 1998). This is an accord stuck between U.S. tobacco companies and state Attorneys General, which released the companies

from several lawsuits and future tobacco-related health care costs—in exchange for compensation payments and the curtailment of certain cigarette marketing practices. This linkage between the MSA and company policy on children and young people is acknowledged directly on the R J Reynolds website:

After many years of intense national debate, the major issues regarding cigarette marketing and underage smoking have been comprehensively addressed through a Master Settlement Agreement signed Nov. 23, 1998, by the major U.S. tobacco companies and 46 states and a number of U.S. territories . . . The MSA prohibits taking “ . . . any action, directly or indirectly, to target Youth . . . in the advertising, promotion or marketing of Tobacco Products, or . . . any action the primary purpose of which is to initiate, maintain or increase the incidence of Youth smoking” (<http://www.rjrt.com.msa.aspx>)

Evidence gathers suggesting that the tobacco lobby is unlikely to mount a sustained campaign of opposition to any proposed legislation on banning smoking in cars carrying children. Such public testimony places a direct onus on the tobacco companies to “practice yourself what you preach.” Whether this maxim is actually followed is, of course still open to question. Rumsfeldians know that, when it comes to weapons of mass destruction, public relations pronouncements are not entirely trustworthy.

What is the Broader Strategy Behind Tobacco Company Opposition to Smoking Control?

The methodological argument gathering through the paper is that evidence-based policy is built more adequately on explanatory wholes rather than empirical fragments. One way of hardening our inference about how the tobacco industry will act in this particular instance is to examine broader corporate strategy against the steady encroachment of smoke-free legislation. Does this history of lobbying suggest the law will prevail unopposed? The phrase “tobacco wars” is often used to describe the 50-year battle of lawsuits between the “free-choice” and “smoke-free” lobbies. It is useful to conduct a brief overview of how the battleground has shifted, to better understand (a) where companies devote their current legal and marketing energies and (b) if and to what extent the soft focus on children constitutes an exception to the longstanding hostilities.

Among the strategies deployed over the years include “aggressive and uncompromising litigation” driving legal costs beyond the resources of most plaintiffs (Gostin, 2008); funding research attacking the “junk science” behind claims that smoking causes disease (Stolley, 1991); repeating the attack in relation to the dangers of SHS (Tong & Glantz, 2007); seeking delay in smoke-free bar legislation by calling for further evidence on the utility of a “ventilation solution” and raising economic arguments about loss of business (Magzamen & Glantz, 2001); creating front organizations such as the Associates for Research in the Science of Enjoyment (ARISE) to demonstrate that smoking cessation was itself stressful (Smith, 2007); litigation strategies to oppose tobacco control media campaigns (Ibrahim & Glantz, 2006); buying influence by funding agencies such as the Centre for Corporate Social Responsibility, University of Nottingham (Cohen, 2001).

Given the MSA, many of these forms of procrastination have now been exhausted, bringing us to the current position, the era of so-called corporate social responsibility (CSR). Several papers have explored the tobacco company’s adaptation of CSR strategies (Hirschhorn, 2004). The first change is the public acknowledgment of the grave dangers of smoking, as in the following from R. J. Reynolds:

Cigarette smoking is a leading cause of preventable deaths in the United States. Cigarette smoking significantly increases the risk of developing lung cancer, heart disease, chronic bronchitis, emphysema and other serious diseases . . . No tobacco product has been shown to be safe and without risks, and quitting tobacco use significantly reduces the risk for serious diseases. (<http://www.rjrt.com/prinbeliefs.aspx>)

Hirschhorn's research goes on to identify a corresponding shift in tobacco industry strategies (in terms of lobbying, public relations, and litigation) under this new CSR regime. These are centered on:

1. the defense of a legal commodity and the right to remain in control of the legitimate marketing opportunities to further commerce.
2. the defense of smoking as an adult activity in which individual choice should pertain and the corresponding duty to assist in preventative activities for youth.

As an example of the first impulse, compare the conciliatory statements above on the protection of children with the muscularity of the tobacco lobby's response to a contemporaneous threat to a key marketing tool:

Philip Morris Limited ... will file a joint lawsuit seeking to overturn the ban on display of tobacco products at retail stores in Ireland ... before the High Court in Dublin on October 6, 2009. Plaintiffs will be challenging the tobacco display ban on the grounds that it severely restricts their ability to provide trade and services thus violating Irish constitutional law and EU law. The tobacco display ban came into effect in Ireland on July 1, 2009 ... We know from our experience that a total ban on tobacco display does not work, is costly to implement and ineffective at reducing smoking levels ... this legislation just serves to hand the tobacco business over to smugglers and counterfeiters. Ireland already has one of the worst illegal cigarette problems in the EU, and this ban is making it worse ... We ask the Irish government, 'what type of industry do you want?' One that is legitimate, and supports effective regulation, or one that is run by criminal gangs selling cheap, illegal cigarettes on street corners? (<http://www.product-displayban.com/Footer/PressRelease.htm>)

As an entirely typical example of the second strategy, we reproduce BAT's overview of their activities in youth prevention:

We do not want children to smoke. Our ... sales and marketing activities are directed only to adult tobacco consumers. We fully support laws and regulations which prohibit the sale of tobacco products to a person under the legal minimum age in their country. We agree that there must be enforcement and penalties for breaking such laws which are tough enough to discourage anybody from selling to the under age ... We also fund and support a large number of youth smoking prevention programmes around the world, mostly to help retailers in preventing sales to the under age. (http://www.britishamericantobacco.com/group/sites/uk__3mnfen.nsf/vwPagesWebLive/DO53EC64?opendocument&SKN=1)

This miniature review of company documentation suggests that "Tobacco War" hostilities continue apace even though the industry claims a sustained retreat from the youth market. It provides a further, clear indication that the tobacco industry will not directly oppose and perhaps even support a ban on smoking in cars carrying children. Before, however, we hail the discovery of a "known known" a troubling question needs settling—is this all spin or substance?

How Does the "Smoke-Free" Lobby Interpret and Respond to the Tobacco Industry Tactics?

The decision to contest legislation and the success, or otherwise, of such a strategy does not, of course, rest entirely in the hands of tobacco lobby. Ranged against it are the powerful ranks of the "smoke-free" lobby. This movement includes many foundations and charities as well as a phalanx of venerable professional bodies and medical associations. The decision on whether to press ahead with legislation is conditioned in this partisan clash. Under investigation in this section of the review is a process referred to by the inelegant term "pork barrel politics." This suggests that lobbying

parties usually work with considerable knowledge of the plans of the opposing factions. Vested interests are locked against each other and rather than anticipating outright victory the factions concentrate their efforts at known points of vulnerability in order to obtain their respective “share of the pork.”

The antismoking lobby employs a vast repertoire of measures aiming to empower smokers to quit successfully and to motivate young people to stay tobacco-free. An indication of the breadth of these activities can be obtained by examining the “master index” of antitobacco links of the website at www.TobaccoFree.org. Young children constitute a focal point of interest, with campaigns designed to undermine tobacco company attempts to recruit “new smokers.” It is beyond the scope of this review to cover all of this material. Instead, the aim is to follow the punch and counterpunch of lobbying as it bears upon limiting youth exposure.

A number of studies challenge the idea that industry “youth smoking prevention programs” have any impact, suggesting that they are deliberately ineffectual. For example, research has noted how easily tobacco industry advertising on “adult-choice” could be interpreted as a lure to “forbidden fruit” (Landman, Ling, & Glantz, 2002). Many interventions, such as Lorillard’s ‘Tobacco is Whacko’ campaign, encourage teens to visit company websites where they have access to further advertising, which would otherwise be illegal. The paper also indicates that formal impact evaluations of tobacco industry youth prevention schemes are nonexistent—companies relying on superficial measures of “media hits” as a sign that they are “working.” By contrast, a formal multivariate survey tracking the impact of “tobacco-company, youth-targeted smoking prevention programs” claim that they had “no beneficial outcomes for youth” (Wakefield et al., 2006). On another tack, there is evidence that the “smoke control lobby” has turned its back on youth access programs (Ling, Landman, & Glantz, 2002), responding to evidence on unproductive programs requiring that retail outlets seek proof of age at purchase (Jones, Sharp, Husten, & Crossett, 2002). Teens simply use other means and older friends to obtain cigarettes. In short, there is mounting evidence suggesting that the tobacco lobby has chosen deliberately to support the very schemes that the smoke control lobby consider ineffective.

Finally, we note an additional strand of research contending that the tobacco industry finds more surreptitious routes into the youth market. Heaton et al. map the high residual presence of youth smoking (80% of adult smokers report take up before age 18) and estimate the annual revenue from youth consumption at \$1.2 billion (Heaton, Farrelly, Weitzenkamp, Lindsey, & Haviland, 2006). Other researchers have conducted inquiries on how this market is being sustained *indirectly*. Sports sponsorship (now banned in some countries) is claimed to work by “intertextuality”—that is, by linking brands to other desirable youth-oriented activities (Dewhirst & Sparks, 2003). A recent U.S. innovation is the production of Camel “Orbs,” “Sticks,” and “Strips” (flavored “candy-like” products that release nicotine and tobacco upon chewing). The first report has recently appeared on poisoning in children following consumption in this “unsolicited” market (Connolly et al., 2010).

Interim Summary 3

This section asks whether the tobacco lobby is likely to oppose a law banning smoking in cars carrying children and begins with direct testimony from the tobacco companies claiming that they will not do so. We sought to deepen this anecdotal evidence by examining the broader dynamics of the “tobacco wars” and the tobacco industry attempts to stifle smoking control. Following the constraints of the Master Settlement Agreement, the evidence suggests that companies have made a strategic compromise—seeking to protect and expand legal markets while funding youth prevention programs. There is little or no evidence to show that these latter schemes serve significantly as deterrents and some evidence indicating that the industry uses indirect and subliminal strategies to maintain the youth market. In terms of overt actions, such as counterlitigation opposing a ban on

smoking in cars carrying children, the tobacco companies thus have scant room to maneuver—being trapped in a pincer movement of their own conciliatory, legally underwritten pronouncements and the invincibly powerful subtext on the “protection of children” that is applied by the smoke-free lobby. We end, as ever, with a conditional known. *Given the history of these political maneuvers*, legal counteraction to the proposed ban is likely to be precluded.

The “evidence” called upon in this section is highly politicized. All the empirical materials dealt with above consist of or reflect strongly the perspectives of advocates. The reviewer’s task is thus to synthesize pre-chosen, pre-interpreted evidence *from both sides of a debate*. Tobacco company pronouncements, perforce, reflect tobacco company interests. Just as incontrovertibly, it should be acknowledged that much of the empirical research in journals such as *Tobacco Control* is written with the objective of enhancing tobacco control. This raises the old conundrum of whether it is possible for anyone, especially the reviewer, to avoid taking sides. It is a “known known” in military conflict or tobacco wars that opponents see the world differently. Does this mean that in attempting to explain their actions, the reviewer has to pronounce on the “good guys” and the “bad guys”—and then accept the “truths” of the former?

While this may have been Rumsfeld’s *modus operandi*, it is not the method adopted here. We have extended the strategy utilized in the previous section of consolidating the evidence into explanations. The inference drawn here that tobacco companies have limited room for legal maneuver on the particular issue of smoking in cars carrying children reflects analysis of the *wider system* of pork-barrel politics. Our analysis does not claim, God-like, to pronounce upon the respective truth of each piece of testimony. Rather, the evidence is used to construct an *explanation* of how the warring parties seek advantage. An analysis of these *rules of engagement* shows, in the specific instance of the legislation about children, how the machinations fall conclusively against the tobacco industry.

Is the Law Enforceable?

Better no law than laws not enforced. (Italian Proverb)

This section of the review takes us much further down the implementation chain. We assume at this point that all the grizzly obstacles in the form of risk measurement, regulation drafting, public support, lobby group opposition, and so forth, have been settled. Appropriate legislation is on the statute books. It is illegal to smoke in cars carrying children. If you continue to do so—you will be fined. But will you? We are reminded that public health laws sit on the margins of criminal justice, often lacking clarity in this vital final stage:

When deciding what their legislative goals should include public health advocates need to incorporate into their strategy the locus of enforcement and implementation responsibility and the sanctions available to the enforcement agency. Failure to specify enforcement mechanisms in the legislation will lead to delays in implementing and enforcing the laws as well as compliance problems. (Jacobson & Wasserman, 1999)

In terms of a law banning smoking in cars carrying children, the potential impediments are clear. It is quite possible that the legislation will be stymied at street level in a pincer movement between smokers’ skepticism about whether a fleeting infraction will be detected and police ambivalence about the lack of a mandate and the absence of resources to act in this arena. Our review thus has two tasks: (a) to discover the key ambitions for enforcing such a law and to chart their potential barriers and facilitators and (b) to assemble the evidence on how and with what success enforcement strategies have worked in this area of public health law.

Both of these tasks face severe methodological problems. Because these laws have only recently arrived on the statute books in very limited jurisdictions, little is published on either the planning or

the actuality of enforcement. Such a scenario threatens the very idea of evidence-based policy—novel interventions do not and, seemingly, cannot have an empirical base on which to foot policy recommendations. In the section on Is there likely to be effective pressure group opposition to the ban?, we struggled in drawing inferences from an information base that was hidden; here, it is almost nonexistent. Is retreat inevitable? Do we now seek sanctuary in the common cry about known unknowns, namely—“more research is needed?” Or can the strategy of theory testing and explanation building assist once again?

What Are the Main Barriers and Facilitators in Discharging the Law?

At each step in the implementation chain, realist synthesis commences by eliciting the key theories that underpin emerging interventions. As Jacobson and Wasserman suggest, at inception there is often no clear plan of *how* bans will be policed and *how* sanctions will be applied. Our review examined many potential sources in search of such tactics in documents such as *A Smokefree Future: A Comprehensive Tobacco Control Strategy for England* (Department of Health, 2010). Modern policy documents of this ilk operate glossily at high levels of abstraction, covering “visions,” “rationales,” “targets and target groups,” “strategies for preventing uptake,” “strategies for aiding quitting,” and then “delivery.” As foretold, this latter section goes no further than identifying the “responsible bodies.”

Detailed ideas on enforcement tend to be voiced by the practitioners who will ultimately bear responsibility and these enter the review radar in a bricolage of news reports and web commentary, from which we extract four hypotheses:

Enforcing smoking ban not a police core function—Police Commissioner, Karl O’Callaghan, today addressed a parliamentary inquiry into proposed legislation, which aims to outlaw smoking in cars with children. He told the inquiry that the Health Department should pay for monitoring and prosecutions. “It’s not a police core function,” he said. “Police have responsibility for public order, keeping the peace, road safety . . . We have never been asked to police health laws.” (<http://www.abc.net.au/news/stories/2009/02/10/2487789.htm>)

A different theory (policing works) is forwarded in another news item from the same state. “MORE than 400 people have been cautioned or fined for smoking in cars with children in South Australia since the controversial law was introduced. The state led the nation by introducing a law prohibiting smoking in vehicles in the presence of people under 16 in May 2007, in a bid to protect children from passive smoking. Since then, police have fined 317 people and cautioned 85 (<http://www.news.com.au/adelaidenow/story/0,,26318329-5006301,00.html>).

Yet another theory (no fines!) is embedded in this version of the law. “Finnish daily Etela-Suomen Sanomat reported . . . the government would propose banning smoking in cars carrying children within a fortnight . . . part of a range of proposed amendments to the *Act on Measures to Restrict Tobacco Smoking* . . . the ban would not be enforced by fines as these would clash with privacy legislation” (<http://www.helsinkitimes.fi/htimes/domestic-news/general/7947-finland-to-ban-smoking-in-cars-carrying-children-but-no-fines-.html>).

Still another view (self-enforcement) is embedded in the following press release from ASH Australia: “*A practical and popular measure*—Concerns over enforcement should not be a barrier to further safety measures. Enforcement by police is similarly opportunistic in monitoring seat belt use, mobile phones and drink-driving . . . Smoke-free cars carrying children are likely to be largely self-enforcing—since community support is strong. (www.ashaust.org.au/lv4/ACTcarsASHsubm09.doc).

These speculations, which typify much of the public debate, are in some agreement that the putative offence being difficult to discern would, therefore, be difficult to police. Consensus then disappears

on who takes responsibility for enforcement and how they would do so: the police by opportunistic monitoring; the police by secondary enforcement; other public health authorities; self-regulation; symbolic authority; and community surveillance. To complete this brief overview of perspectives, we examine the theories of the putative offenders, many of whom question the practicalities of enforcement. Dozens of claims can be found declaring the in-car smoking ban to be unenforceable, none put more engagingly than this one:

The Curmudgeon Sounds Off: So let's add another unenforceable law to the books. While we're at it, let's ban the following activities while driving—applying make-up; shaving; eating of any kind; drinking, not only alcoholic beverages but also coffee, tea, milk, soda, and water; disciplining the kids; conducting heated arguments; diddling with the radio or CD player; swaying to and fro in time with the music on the stereo; fixing one's hair; reading maps or other printed materials; reaching over to the passenger's seat or the back seat for something; blowing one's nose . . . The possibilities for prohibited activities are enormous (<http://www.grammarmudge.cityslide.com/articles/article/733270/30449.htm>).

Our review thus moves forward with a core theory about offender skepticism and what are best described as rival theories about enforcement and sanctions. The purpose of realist synthesis is to refine program theories and the suggestion here is that one can add to this remit the idea of “adjudicating” between different theories—attempting to discover the optimal enforcement strategy.

What is the Optimal Enforcement Strategy—Police Action, Community Surveillance, Self-Regulation, or Public Information?

Having established the pertinent question, we turn to the stumbling block—the sheer lack of evidence with which to answer it. While it is true that there is no formal evidence on the enforcement of bans on smoking in cars carrying children, dozens of other laws, bans, and edicts operate in similar scenarios. In this instance, we are interested in the hypothesis on whether enforcement works in a configuration defined by three primary elements: “cars,” “smoking” and “children.” Prohibitions already operate on other smoking activities, on other in-car activities, and on other behaviors infringing on the welfare of children. Many of these share the same core difficulties—the offence is hard to spot and difficult to intercept, offenders are skeptical about being caught, police have other priorities and limited resources, a “private space” is under surveillance, and so on. Often such legislation has many more years under its belt and, more to the point, has amassed a body of evaluation tracking the efficacy of enforcement. Accordingly, in this section, we examine briefly research on the extent and success of the enforcement of (a) bans on using mobile phone in cars and (b) obligatory use of safety restraints when carrying children in cars. After understanding how enforcement works in these two domains, we consider their contextual similarities and differences with the law under study in an attempt to seek transferable lessons.

Banning hand held phones in cars. Johal et al.'s U.K. study is one of many showing a significant immediate reduction in usage following the law (Johal, Napier, Britt-Compton, & Marshall, 2005). Roadside observations saw a reduction in prevalence from 1.85–0.97% over a period of 10 weeks before and 10 weeks after the introduction of legislation. However, longer term follow-up studies (e.g., McCartt & Geary, 2004) show a clear “U” shaped effect of the legislation, that is, that usage rates fall after the law comes into effect, but that with time, rates climb again. The only exception to this rule was seen in Washington, DC (McCartt & Hellinga, 2007), where immediate post-legislation reductions were maintained.

Other studies shed light on the “rebound” in usage thus offering potential advice on how it may be avoided. The underlying reason for lack of compliance is simple enough. Foss et al. carried out a pre- and post-law survey of drivers in North Carolina, discovering that their pre-law “hunch” that there would be relatively little enforcement was heavily reinforced by their post-law experience of

compulsion, or lack thereof (Foss, Goodwin, McCartt, & Hellinga, 2009). Other studies also indicate that cell phone using drivers feel that it is unlikely that they would be caught in their local area (McEvoy, Stevenson, & Woodward, 2006). Drivers were aware of the law, its consequences (criminalization), and safety risks (liability for crashes)—but, in the absence of expectations about regular enforcement, significant levels of recalcitrance remain.

So how can risk perceptions be raised? Unsurprisingly, research reveals that substantial and sustained enforcement is the basic requirement. In Washington, DC (the case without the substantial “rebound”), in the 12 months following the enactment of the law, 9,718 citations were issued for drivers talking on handheld phones (8% of total vehicle citations) as well as a further 4,500 warnings (McCartt & Hellinga, 2007). A Melbourne study reported similar levels of activity and, significantly, also noted the use of further tactics to maintain the law in the mind’s eye. These include the targeting of drivers at particular risk (for young drivers, the ban included hands-free phones), the use of plain-clothed “spotters” passing on “sightings” to arresting officers, and the instigation of periodic, high-visibility “days of action” to refresh the initiative (Taylor, MacBean, Das, & Rosli, 2007). Risk perception may also be sustained unwittingly if routine roadside surveillance is present. Hussain et al.’s U.K. study compared observance rates at three urban sites (Hussain, Al Shakarchi, Mahmoudi, Al Mawlawi, & Marshall, 2006). Compliance was higher in the location covered by cameras—even though these were checking speed rather than in-car activity.

In short, this particular ban is not discharged by legislation alone. Sustained enforcement activities, high visibility, prescribed penalties, further targeting and periodic blitzes seem the order of the day.

Compulsory child safety restraints. Evaluations of laws mandating child safety restraints in cars have been underway since the eighties and tend to show highly significant positive results. A study of the impact of such a law in Michigan provides us with some typical early results. The study involved time-series data for a 5-year period. Data on the usage of seat restraints were based on accident records and thus on direct observation rather than on malleable self-report. Use of restraints increased from 12% to 51% after the introduction of the law (a 25% decrease in injury also followed). The authors apply appropriate caution on the matter of attribution, noting that the new law was accompanied by a high-profile information campaign (Wagenaar & Webster, 1986). Significantly, as with many other such studies, no specific data were collected on the extent of police efforts to enforce the legislation.

A later Japanese study by Despriya et al. used official traffic accident data on child casualties to measure the effectiveness, benefits, and usage of safety seats for child passengers aged 1–5 years (Desapriya, Iwase, Pike, Brussoni, & Papsdorf, 2004). Their data covered the period before and after the introduction of legislation in 2,000 requiring all 0- to 5-year-old children to be restrained in appropriate seats when traveling in private vehicles. Restraints usage increased from 8% in 1998 to 60% by 2000 but dropped back to 51.7% by 2003. Interestingly, certain forms of injury increased following the legislation (attributed to improper use of restraints). The researchers provide a number of explanations for the increase and partial drop in compliance. The Japanese legal system at the time was overburdened and prosecution was seen as more time-consuming than warranted by the offence. Most significantly, penalties were low (demerit point on license rather than monetary). Furthermore, the authors report that there was an absence of media and educational campaigns on the safety benefits of child restraints. This is a significant result—the law impacted (if with some fade) in inauspicious circumstances in which enforcement effort is minimal.

A recent Italian study begins to explain why. A mail survey with 514 respondents was conducted before and after the introduction of a law mandating the use of child safety restraints (Collarile, Valent, Di Bartolomeo, & Barbone, 2008). The reported change of usage, based on potentially questionable self-report, was of a rise from 74.7% to 92.5%. The study, however, uncovers telling information on the motivations behind the change. Nearly all (95.5%) parents were aware of the

consequences of disobeying the law on child restraints while driving. However, it was not the fear of the penalty but the protection of children that appeared to drive compliance: “The most frequent reasons for using child restraint systems were ensuring child safety (reported by 99.2% of responders), avoiding monetary fines (16.7%) and avoiding losing license points (13.6%).”

The above examples give a first indication of some of the evidence on the enforcement of two “neighboring” public health laws. Can we extrapolate these findings across to the law under review here? Extrapolation is the attempt to extend knowledge about known knowns into knowledge about known unknowns. As such it is a perilous venture in both science and policy making. We have a clear indication that enforcement regimes and compliance levels differ in these two mini case studies. The safety seat legislation seems to have more self-momentum. The majority of child restraint legislation is followed by sustained increase in compliance and even in those cases in which police action is negligible, compliance rates do not return to pre-legislation levels. Cell phone compliance, by contrast, dissipates more rapidly and more markedly without a systematic program of crackdowns.

This brings us to the tricky business of making inference across to the ban on smoking in cars carrying children. Put simply—is it closer to the laws on cell phones or safety seats? All three misdemeanors are similar in that they occur in the private spaces of family cars. All three are hard to detect in busy traffic without the intensive use of police time, a resource for which there is much competition. All three involve pulling over and arresting drivers involves on the grounds of “reasonable suspicion” and thus have to overcome a range of legal technicalities. There are, nevertheless, crucial differences between the laws, which provide grounds for hypothesizing that enforcement regimes should differ:

1. A classic premise in evaluating the effectiveness of criminal law is to investigate the possibility of “displacement.” In this instance, a stubborn cell phone addict may (at some expense) continue to parlay by going hands-free. However, complying with the safety restraint legislation requires safety seat installation and the cigarette addict’s only recourse from the law is a smoke-free car.
2. The respective misdemeanors also suggest a potential difference in police responsibility. Driver inattention (a traffic offence) is *raison d’être* behind the mobile phone ban, while improvements in public health lie squarely at the root of the safety seat and smoking legislation.
3. A third significant difference turns on broader cultural values in regard to the potential victim. In the cell phone example, the law is there to protect other drivers, pedestrians, and indeed cell phone users from accident and injury. In the cases of the seat belt and smoking-free laws, the welfare of children is paramount.

On all three dimensions, the smoking and child seat legislation share more in common with each other than they do with the cell phone ban and on these grounds, an inference might be drawn that enforcement patterns might also be more similar. The third comparison is especially compelling. The evidence in this section indicates that the steady increase in usage of child restraints in cars is rooted in motivations about safeguarding children rather than a strategy of avoiding fines. While we have no evidence to report on how families have responded to the prosecution of a ban on smoking in cars carrying children, the evidence discussed earlier (the section on *Is There Likely to be Public Support for Such a Law?*) suggest that there is considerable *pre-intervention* public support for the smoking ban on the same grounds. Post-intervention compliance, we conclude, may thus be significantly, if not entirely, sustained by self-enforcement.

Interim Summary 4

Drawing parallels with the enforcement regimes in these two kindred “in-car” laws, suggests that a smoking ban bears close similarities with the legislation on child safety restraints and thus may be

expected to be self-enforcing to a considerable extent. While the urge to safeguard children may be expected to drive compliance, there is no evidence to suggest that it is the entire solution. A supporting program combining safety promotion and education, alongside periodic but well-publicized sanctions may also provide a useful role. It is less likely that tough enforcement would be forthcoming or particularly effective.

Let us reprise more closely the empirical warrant for the above proposition. Evidence-based policy normally requires that interventions have a history and undergo many replications. The laws banning smoking in cars carrying children have not rolled out sufficiently to gather a significant evidence base on their enforceability. Instead, we have proposed that a theory-driven approach may be drafted in to do the job. As before, this works by explanation building—the explanations in this instance having a further layer of complexity. The logic is as follows. Different laws require different enforcement regimes—ranging from those based on self-compliance to those requiring rigorous surveillance and punishment. The evidence on safety restraint compliance and handheld phone abstinence allows us to build an explanation showing that the former has been enforced more successfully thanks to a tide of public support. The theory also specifies the range of secondary conditions about police priorities, victim identities, and displacement opportunities, which have fostered public support. This theory about the optimal contexts for compliance is then fed back to the law under consideration and conclusions are drawn about its likely efficacy. To be sure, this is a long inference chain. Inevitably, some of the links must be considered provisional and will benefit from further refinement. Our purpose is to show that one can conduct a review of the evidence when, formally speaking, there is no evidence.

Conclusion

The empirical basis of objective science has thus nothing ‘absolute’ about it. Science does not rest upon rock-bottom. The bold structure of its theories rises, as it were, above a swamp. It is like a building erected on piles. The piles are driven down from above into the swamp, but not down to any natural or ‘given’ base; and when we cease our attempts to drive our piles into a deeper layer, it is not because we have reached firm ground. We simply stop when we are satisfied that they are firm enough to carry the structure, at least for the time being. (Popper, 1935)

There is no such thing as a typical policy intervention or a quintessential program. Legislative instruments aimed at entire populations, of the type considered here, are worlds away from interventions targeted at communities and individuals. And with this observation, it is necessary to confront the predicament of all case study research, namely, the generalizability of the inferences made. How far can the single instance speak to the universe of possible cases? In this respect, it is necessary to concede that there are programs that are more straightforward (technically, administratively, and politically) than the one interrogated here. Accordingly, in instances with less implementation heterogeneity and reduced partisan noise, there will be bodies of evidence, which will be more secure methodologically and more decisive politically.

In other respects, our case study confronts a surprisingly common riddle, namely, that is far more complex than at face value. Many public health practitioners yearn for the simplicity and muscularity of legislation, for in their eyes the “law is the law” and thus far more incisive than programs depending on exhortation and education. Yet, as we have seen, once inspected, there is layer upon layer of complexity. And so what our case study has in common with very many other interventions is a nest of ambitions, a plethora of stakeholders, a sprawl of localities and a checkering of histories. In these circumstances, evidence-based policy has to deal with a standard predicament. Research synthesis can only provide partial information on the medley of issues that face the decision maker. That data, as here, are likely to draw upon inquiry conducted in diverse research

traditions—toxicology, social psychology, political science, socio-legal studies, and so on. Accordingly, the information infrastructure is also likely to be partial in research quality and in political leanings. So what does this tell us about the warrant of evidence?

Our conclusions are positive—in the particular and the general. In terms of the immediate issue of children's involuntary exposure to SHS in vehicles, we have attempted to reflect the balance of known knowns, known unknowns, and even unknown unknowns (a final word on unknown unknowns follows). We have uncovered evidence on four issues—"toxicity," "public opinion," "lobbying," and "compliance"—topics on which the policy maker should ponder before enacting such a law. Each domain reveals its truths but in ways that are highly conditional and multiply contingent. Thus, smoke pollution in cars is dangerously virulent—if exposure is frequent and ventilation absent. Public opinion is likely to be supportive—especially if other smoke-free laws have been passed. Lobby group opposition may well be muted—in the word if not the deed. Compliance tends to wax and then wane—unless public support can be nurtured. In short, the evidence does not deliver the legislative decision. It does, however, provide the grounds on which the policy maker can make a more informed decision. Armed with the evidence and thus knowing the contextual requirements and the implementation niceties, policy makers can (a) decide whether there is a readiness for such a law in their particular jurisdiction and (b) make delivery plans that will play to local strengths and skirt the weaknesses.

Finally, a brief reflection on the overall predicament of evidence-based policy. What is the consequence of our general portrayal of "the evidence" as a never-ending network of conditionalities and contingencies? Our answer, taking inspiration from the Popper quotation above, is that the evaluation community needs to learn to live with this "plight" and then learn to love it as a "virtue." The never-ending, ever-widening structure of intervention planning has been apparent throughout the paper. We began with a quartet of puzzles. Each one of those rapidly subdivides into four or five different questions and the process continues. One question receives an answer . . . but it is usually a partial answer that will beget further questions . . . and the process carries on *ad infinitum*. Recall, for example, how the quest to uncover pollutant levels in cars led us via the measurement of small particulates and interior volume, to questions about frequency of exposure and ventilation, to comparisons on smoking prevalence in other environments, and onto philosophical questions about the precautionary principle. The whole exercise has this structure.

But why is it virtuous? For the answer, take note of the intrepid Popper rather than the wavering Rumsfeld. Popper rejects the notion that science, and here he refers to physics, rests on a bedrock of solid, unimpeachable observations. Measurements never stand alone; they always need interpreting. There are always rival explanations for any experimental result and findings only become hardened through the collective process of testing, weeding out, and refining the strongest theories. In short, the legitimization of any hypothesis rests on the testing of a web of main and subsidiary propositions. He attempted to capture this process with his famous "bridge rising over the swamp" metaphor. Science always proceeds by erecting an elaborate raft of evidence upon which a theory stands. This process, what is more, is perpetual. Theories always seek to cover more ground by adding supplementary hypotheses. As with all hypotheses, any supplementary conjecture is provisional, falsifiable and thus open to further revision. Theories only hold "for the time being."

The inspiring thought for evidence-based policy is that this process can be imitated. Program theories, too, only hold in certain circumstances. In testing these theories, we have uncovered both promising evidence and questionable data. But throughout, we have shown that it is possible to enwrap and harden the available intelligence into explanations. One fragment of evidence makes sense of another and these together help to account for a third, and so on. It is these explanatory configurations, these well-placed pontoons, which are the medium of evidence-based policy. Recall, for example, how survey evidence on support for this smoking ban hardens thanks to attitudinal data on the near-inviolable beliefs on child welfare, which solidifies with further testimony on

near-universal regret for starting smoking, which becomes more durable with the research on the ratchet effect of denormalization. The whole exercise has this structure and through it decision making becomes more rational. To paraphrase—we simply stop when we are satisfied that explanations are firm enough to carry the policy decision, at least for the time being.

Evidence does not come in finite chunks offering certainty and security to policy decisions. Programs and interventions spring into life as ideas about how to change the world for the better. Evaluation research allows us to refine those explanations and systematic review allows a refinement of those refinements. The review process should be understood as a means of building, adjudicating and extrapolating program theories. Evidence-based policy will only mature when it is understood that it is a continuous, accumulative process in which the data pursue but never quite draw level with unfolding policy problems. The whole point is the steady conversion of “unknowns” to “knowns.”

It may well be that policy makers are too busy, too stubborn, or too complacent to digest the significance of the qualifications and contingencies that govern whether a policy will work (this subject is much studied but not pursued in this paper). Nevertheless, we arrive at the inescapable, long and short of it—evidence-based policy deals in conditional truths and provisional explanations.

Postscript

Our Cook's tour of the uncertainties awaiting a smoking ban has unearthed an exotic selection of knowns and unknowns. But what of Rumsfeld's most chilling challenge—the unknown unknowns? These, recall, are things that we do not even know that we do not know. Their presence has been acknowledged for some time in policy circles. More than half a century ago, in answer to a press question about the supreme challenge of government, the patricianly U.K. prime-minister, Harold MacMillan replied, “events dear boy, events.” And it is “events,” of course, that may blow any evidence-based advice off course. A nuclear accident would reduce air quality by more than the odd $\mu\text{g}/\text{m}^3$ and render pointless smoking bans and much else besides. The death of a celebrity associated with heavy parental smoking might darken profoundly the public mood. A “tobacco-friendly” government may be elected and the tightening grip of legislation may loosen. In the very act of naming such events we have, of course, transformed them to the status of known unknowns. And this latter twist falls perfectly within overall thesis here. Once contemplated, unforeseen eventualities become recognized outliers and thus begins the slow process of hauling in the data to interrogate them. The whole point is the steady conversion of “unknowns” to “knowns.” At any particular juncture, of course, some eventualities remain unforeseen, unknown, and unknowable. Perhaps, Rumsfeld, in his own time, was such an event.

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