

1 **Comparativist Rationality and**
 2 **Epidemiological Epistemology: Theory**
 3 **Choice in Cases of Nuclear-Weapons Risk** *Kristin Shrader-Frechette*

7 **ABSTRACT:** US testing of nuclear weapons has resulted in
 8 about 800,000 premature fatal cancers throughout the globe,
 9 and the nuclear tests of China, France, India, Russia, and the
 10 UK have added to this total. Surprisingly, however, these
 11 avoidable deaths have not received much attention, as com-
 12 pared, for example, to the smaller number of US fatalities on
 13 9-11-01. This essay (1) surveys the methods and models used to
 14 assess effects of low-dose ionizing radiation from above-
 15 ground nuclear weapons tests and (2) explains some of the
 16 epistemological and logical problems (with these methods and
 17 models) that have caused scientists to decide against health
 18 screening of the most likely test victims. It also (3) argues that,
 19 once the faulty presuppositions and question-begging frames
 20 about testing and screening are recognized, there are compel-
 21 ling arguments in favor of nuclear-test nations' screening
 22 fallout victims, at least among their citizens. Finally, it (4)
 23 suggests that logically and epistemically flawed fallout studies/
 24 recommendations against screening are more like to occur
 25 when scientists adopt a Laudan-style comparativist rationality,
 26 rather than when they adopt a metascience more like that of
 27 Kuhn and others.

28 Nuclear weapons have not been used in war since the
 29 bombing of Nagasaki in 1945. Yet US above-ground testing of
 30 nuclear weapons has put billions of innocent civilians at higher
 31 risk of cancer and caused more than half a million premature
 32 cancer fatalities throughout the globe; the Soviet testing pro-
 33 gram caused a comparable number of avoidable, premature
 34 fatalities (Makhijani and Schwartz, 1998, p. 395; Hu and
 35 Makhijani, 1995, p. 586). Because fallout has circled the globe,
 36 approximately half of these million-plus deaths, of innocent
 37 non-combatants, occurred outside the nations actually
 38 engaging in nuclear-weapons tests. Why are these deaths sig-
 39 nificant, since most nations no longer engage in above-ground
 40 nuclear weapons tests?

41 **1. Introduction**

42 For one thing, because even low-dose radiation causes
 43 germline mutations and cancers, casualties from the
 44 mid-20th-century weapons development will continue

45 for centuries to come. Calling to mind these nuclear 45
 46 risks also is important for at least two additional rea- 46
 47 sons. One is that some nations, like the US, are 47
 48 attempting to resurrect their commercial nuclear-fission 48
 49 programs, even though no new nuclear plants have been 49
 50 ordered in the US, for example, since 1974. Another 50
 51 reason is that nuclear-generated electricity is more 51
 52 expensive than any other, except for solar photovoltaic. 52

53 Considering the hazards of low-dose ionizing 53
 54 radiation is necessary thirdly because, facing high 54
 55 costs from decontamination/closure of existing nu- 55
 56 clear plants, cleanup of weapons-testing facilities, and 56
 57 nuclear waste storage, some scientists and regulators 57
 58 have called for weakening radiation-protection stan- 58
 59 dards, primarily as a cost-cutting measure. The head 59
 60 of the main international body making radiation- 60
 61 protection recommendations (the International 61
 62 Commission on Radiological Protection or ICRP), 62
 63 Dr. Roger Clarke (1999), has called for weakening 63
 64 radiation-protection standards, particularly for low- 64
 65 dose exposures. After all, cleaning up the last one 65
 66 percent of pollution is typically more expensive than 66
 67 cleaning up the first 99%. Clarke's proposals would 67
 68 save government and industry billions of dollars, but 68
 69 they have been challenged on ethical, logical, scientific 69
 70 grounds (Shrader-Frechette and Person, 2002). Thus 70
 71 an important reason for examining the epistemolog- 71
 72 ical and epidemiological reasoning behind health 72
 73 assessments, of above-ground weapons tests, is that 73
 74 the same epistemological flaws – which encouraged 74
 75 scientists to dismiss risks of nuclear testing – are now 75
 76 occurring again, in the analyses of those who are 76
 77 attempting to dismiss risks of low-dose radiation 77
 78 from commercial and cleanup activities. 78

79 Dismissals are occurring even though the database 79
 80 of 70,000 Japanese survivors of Hiroshima and 80
 81 Nagasaki confirms that statistically significant, pre- 81

153-163



Topoi 0: 1-11, 2004.

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	Journal : TOPOI	Dispatch : 4-5-2004	Pages : 11
	PIPS No. : 5275373	<input type="checkbox"/> LE	<input type="checkbox"/> TYPESET
	MS Code : TOPOI AP3	<input checked="" type="checkbox"/> CP	<input checked="" type="checkbox"/> DISK

82 mature, excess cancer deaths have been observed in
 83 the exposed Japanese population among those
 84 receiving fallout doses equivalent only to 2–3 years
 85 of normal background radiation (one cSv or rem),
 86 excess cancers among nuclear workers have been
 87 three times greater, from such low-dose exposures,
 88 than among the Japanese (Nussbaum and Koehnlein,
 89 1996; Nussbaum et al., 1990; Koehnlein and Nuss-
 90 baum, 1990). And ever since at least a classic article in
 91 *Nature* in 1996 (Dubrova et al., 1996; see Wedemeyer,
 92 2001), scientists have known that even low doses of
 93 ionizing radiation cause germline mutations, still-
 94 births, low birth weight, and neonatal mortality. Yet,
 95 ignoring good logical, epistemological, and scientific
 96 methods and models (and facing industry pressure),
 97 the main standard-setting bodies for radiation (the
 98 UN Scientific Committee on Effects of Ionizing
 99 Radiation, UNSCEAR, and the US Committee on
 100 Biological Effects of Ionizing Radiation, BEIR) have
 101 not made radiation standards stricter (Nussbaum and
 102 Koehnlein, 1994). On the contrary, as just mentioned,
 103 ignoring the best empirical data, even prominent
 104 ICRP leaders are arguing for weakening the stan-
 105 dards.

106 Still another reason for examining the epidemio-
 107 logical epistemology used to assess risks from low-
 108 dose ionizing radiation is the coverup of consequences
 109 of catastrophic nuclear accidents like Chernobyl. At a
 110 90% confidence level, biological effects of Chernobyl
 111 are known to have caused, world-wide, 430,000 pre-
 112 mature, fatal cancers by the year 2000, only 14 years
 113 after the accident. Yet the Russians claim the accident
 114 caused only 28 casualties, because they counted only
 115 immediate, acute fatalities (Maclachlan, 1994, pp.
 116 11ff.). And the pro-nuclear UN Agency, the Interna-
 117 tional Atomic Energy Agency (IAEA), claimed only
 118 31 fatalities occurred because of the accident; the
 119 IAEA (1991, p. 4) used reasoning like that of the
 120 Russians and examined no heavily contaminated areas
 121 and did no epidemiological or genetic tests. The pro-
 122 nuclear US Department of Energy (DOE) claimed
 123 Chernobyl has caused 32,000 premature fatal cancers,
 124 but DOE assumed excess cancers would occur only in
 125 this generation, rather than be carried on through
 126 germline mutations; yet nuclear workers and Japanese
 127 survivors already proved that, because radiation can
 128 cause cancer through germline mutations, excess
 129 fatalities will occur long beyond the current generation
 130 (Shcherbak, 1996, p. 46). Virtually all non-industry

medical scientists agree that the Chernobyl premature- 131
 fatality figure is close to half a million, once one rec- 132
 ognizes the latency period for low-dose cancers and 133
 counts the “statistical casualties” appearing years 134
 after the accident. Physicians for Social Responsibility 135
 warned that low-dose pollution from ionizing radia- 136
 tion is a “public health and safety emergency,” a 137
 “creeping Chernobyl” (Lown, 1995, p. xiv). 138

2. Fallout victims and their risks 139

If nuclear pollution is indeed an “emergency,” one 140
 would expect the nations (like the US) most respon- 141
 sible for it to be doing something about it, at least to 142
 provide medical care for most civilian victims of its 143
 weapons tests. This has not happened, and the 144
 prognosis for help for non-US fallout victims is even 145
 worse. For the last half century, US atomic veterans 146
 and nuclear-weapons facility workers, experiencing 147
 statistically significant increases in radiation-induced 148
 cancers, have lobbied the US government for medical 149
 compensation. In the year 2000 President Clinton 150
 signed a bill to compensate nuclear workers, and in 151
 1990 the Congress passed the Radiation Exposure 152
 Compensation Act (RECA), a limited monetary 153
 compensation effort that provided 50,000 payments 154
 to people who showed they lived in “designated af- 155
 fected areas” of Nevada, Utah, and Arizona during 156
 high weapons-fallout periods of the 1950s and 1960s. 157
 To obtain the 50,000 compensation, however, citizens 158
 had to have been diagnosed with one of 13 radiation- 159
 related cancers and to have filed claims within 6 years 160
 after enactment of the 1990 RECA legislation. To 161
 date, however, the US government has not agreed to 162
 compensate, to provide medical care for, or even to 163
 screen, the hundreds of thousands of citizens, spread 164
 all across the US and the world, who received dan- 165
 gerous, nuclear-weapons doses of ionizing radiation 166
 far in excess of 100 rads (IOM, 1998, p. 42). As the 167
 National Cancer Institute (NCI, 1997, pp. 8.5–8.31) 168
 dose data reveal, virtually all US citizens, living east 169
 of California, are downwinders, and some people 170
 living in New York or Europe, for example, likely 171
 received higher radiation doses than many citizens 172
 living near the Nevada test site. (One reason for such 173
 distant high exposures is that fallout dose is a func- 174
 tion of factors such as rainfall and atmospheric con- 175
 ditions.) Nothing – not even education or public- 176



177 health followup – has been done to help most
178 downwinders, civilian fallout victims of more than
179 200 above-ground nuclear weapons tests in the US
180 during the 1950s and 1960s. Most live outside Neva-
181 da, Utah, and Arizona.

182 Should the governments responsible screen, pro-
183 vide medical care for, or compensate these down-
184 winders? The National Cancer Institute (NCI) and
185 the Centers for Disease Control and Prevention
186 (CDC) have sponsored at least two meetings, on
187 January 19–21, 2000 and June 8, 2000, at which
188 they considered one part of this question, risk from
189 Iodine-131 exposure from US weapons testing, but so
190 far they have been reluctant to make a recommen-
191 dation. This analysis argues that, to the degree that
192 recommendations against free health screening (for
193 fallout victims) rely on faulty epistemological meth-
194 ods and models, they are questionable. But if so, it
195 may be time to support free screening of those most
196 at risk.

197 Who is most at risk? To begin to determine effects
198 of the fallout, in 1982 (under P.L. 97–144), the US
199 Congress mandated a study (1) to develop assessment
200 methods, (2) to estimate dose, and (3) to determine
201 risk to the public from Iodine-131 (I-131) exposures
202 from US atmospheric weapons testing. Fifteen years
203 later, in 1997 the NCI reported the results of the first
204 two of these three tasks. It estimated that just the I-131
205 exposures, from US testing, most likely would cause
206 11,000–214,000 cases of premature thyroid cancer
207 among Americans, or approximately 75,000 such
208 cancers, not counting cancers abroad. The NCI report
209 also said citizens most at risk for fallout-induced
210 thyroid problems (such as cancer, hypothyroidism,
211 and hyperthyroidism) included those who were chil-
212 dren in the 1950s, particularly females who drank
213 significant quantities of milk (NCI, 1997).

214 In the case of I-131, the bulk of exposures came
215 from its deposition on pasture grasses and its transfer
216 to cows' and goats' milk. Most of the I-131 arose
217 from '90 (of more than 200 total) nuclear tests con-
218 ducted mainly in 1952, 1953, 1955, and 1957 that
219 released about 150 million curies of I-131. "Some
220 radioiodine was deposited everywhere in the United
221 States... In the Eastern part of the country, most of
222 the deposited Iodine-131 was associated with rain...
223 [Because of the half-life of I-131, most exposure] oc-
224 curred primarily during the first 2 months following a
225 test" (NCI, 1997, p. ES.1).

3. Problems with the NCI methods and models

226

227 Although the NCI tended to minimize health prob- 227
228 lems caused by I-131 exposure, this belated NCI re- 228
229 port employed flawed risk methods and was made 229
230 public only because of citizen pressure. There also are 230
231 grounds far believing that the 75,000 figure grossly 231
232 underestimated I-131 fallout-induced cancers. Instead 232
233 international physicians' groups say the premature I- 233
234 131 cancers are likely about 500,000 (Rush and Gei- 234
235 ger, 1997–1998, pp. 1–5), a number that the NCI 235
236 (1998) considers too high. 236

237 What are some of the flawed epistemological 237
238 assumptions leading to the apparent underestimate 238
239 of the risk? One problem is inappropriate compar- 239
240 isons between indiscriminate (e.g., whole body or 240
241 whole population) versus selective (e.g., single organ 241
242 or population subset) exposures. A second flaw is 242
243 that the NCI reported only county-average doses, 243
244 which means it missed the high-dose tails of the 244
245 exposure distribution. Third, the NCI ignored the 245
246 significance of children's exposures. Because of their 246
247 drinking milk, children's doses were seven times 247
248 higher than average doses and as great as 160 rads 248
249 – enough to kill sensitive members of the popula- 249
250 tion. The NCI also erred in failing to explain how 250
251 it arrived at estimates of excess US cancer cases, in 251
252 not explaining why their thyroid-cancer rates were 252
253 only one-tenth as high as those that already have 253
254 been observed on the basis of Chernobyl data; in 254
255 producing results that no one checked through 255
256 appropriate oversight, and in failing to use open 256
257 scientific competition to select researchers to do the 257
258 NCI work (IOM, 1998; ACERER, 1998). 258

259 The US Department of Health and Human Ser- 259
260 vices' (DHHS) Advisory Committee for Energy- 260
261 Related Epidemiologic Research (ACERER) created 261
262 pressure on NCI to release the final report about 262
263 fallout-related cancers. ACERER conducted a 263
264 number of reviews of the report, disputed the 264
265 screening recommendations of NCI, and suggested 265
266 that screening be conducted for non-cancer thyroid 266
267 and parathyroid diseases for high-risk groups, such 267
268 as US females who were children I the 1950s–1960s 268
269 (ACERER, 1998, p. 6). ACERER also unanimously 269
270 adopted a resolution that US efforts to address 270
271 public-health consequences of weapons fallout are 271
272 inadequate; that difficulties in identifying fallout 272
273 injuries do not absolve the US government from 273



274	making a public-health response; that research,	background radiation; that NCI "delayed the release"	320
275	alone, is not an adequate public-health response;	of the report, even though it was "substantially done"	321
276	and that delays in sharing public-health information	10 years earlier; and that because of this delay, mil-	322
277	about fallout have reinforced public cynicism about	lions of radiation victims received no timely notifi-	323
278	the government (ACERER, 1998, pp. 1-3).	cation of their exposures. As a result of this delay,	324
279	ACERER recommended that DHHS complete a	citizens in Utah, Arizona, and Nevada (the only states	325
280	comprehensive fallout-dose reconstruction project;	covered by the 1990 RECA 50,000 compensation)	326
281	notify Americans of their possible fallout risks;	had no data enabling them to sue for compensation	327
282	create a public and health-care-provider information	within the 6 years allowed. The Congressional hear-	328
283	service; and support archival projects to document	ings also revealed that the same NCI problems of	329
284	experiences of exposed peoples (ACERER, 1998,	poor methods, poor management, and lack of open-	330
285	pp. 2-4). To date, none of these recommendations	ness are compromising the success of the current	331
286	has been implemented.	Chernobyl studies. They said that NCI, as a result, is	332
		losing the ability both to locate and screen the mil-	333
		lions of Chernobyl victims. Indeed, there is no public	334
287	4. Problems with the US National Academy of	oversight of the HHS/ACERER investigations (US	335
288	Sciences methods and models	Congress, 1998).	336
		In advising against government screening for thy-	337
289	The controversy over risks of weapons testing accel-	roid problems induced by weapons testing, the IOM	338
290	erated when the Institute of Medicine (IOM) of the	(1998) arguably made at least two major errors. First,	339
291	US National Academy of Sciences (NAS) released its	it reduced the ethical question, of whether the gov-	340
292	1998 evaluation of the 1997 NCI report. The academy	ernment ought to bear responsibility for the risk it	341
293	committee said its estimates of the collective radiation	imposed, to the scientific question, of the radiation-	342
294	dose to the American people were "consistent" with	exposure level and its medical consequences. Second,	343
295	those of the NCI committee, but it highlighted	in alleging only minor medical consequences of the	344
296	numerous flaws in the NCI methodology and con-	fallout the IOM thereby sanctioned a number of	345
297	clusions (IOM, 1998). Indeed, even the IOM (1998, p.	flawed epistemological presuppositions. These are	346
298	42) noted that many US children, on a diet of goats'	apparent if one considers some pro-screening argu-	347
299	milk, received thyroid doses from I-131 higher than	ments that IOM ignored.	348
300	160 rads - a lethal doser for some of them. Despite		
301	such flaws, the academy committee nevertheless rec-		
302	ommended that, instead of a government-financed	5. Three arguments for government screening: getting	349
303	thyroid screening program, the Department of Health	the epistemology right	350
304	and Human Services should provide a program of		
305	public information and education about the conse-	At least three compelling arguments, suggest that,	351
306	quences of the US weapons tests (IOM, 1998).	given flawed NCI and IOM methods and models, the	352
307	Frustrated by the NCI and IOM studies, Ohio	US ought to screen its highest-risk fallout victims,	353
308	Senator John Glenn initiated hearings before a US	given that it imposed this radiological risk on its cit-	354
309	Senate subcommittee. The hearings emphasized, as	izens without their consent. These six arguments fo-	355
310	the NCI had noted, that many citizens in the Midwest	cus, respectively, on ignoring stakeholder assessment,	356
311	and Northeast, such as in Albany, New York - in-	suppressing evidence of harm, and relying on average	357
312	deed throughout the country - received radiation	exposures.	358
313	doses from weapons that far exceeded exposures to	The first argument for screening is that if stake-	359
314	citizens living near the test site.	holders were properly recognized and participating in	360
315	Highlighted in testimony by Dr. F.O. Hoffman	the assessment of radiation risks, as the National	361
316	(US Congress, 1998, pp. 421-439), the hearings also	Academy of Sciences says is necessary for sound risk	362
317	revealed that 3.5 million US children - in addition to	assessment (NRC, 1996), then screening would likely	363
318	those abroad - received average cumulative doses of	be required. Important practical information about	364
319	I-131 that were 50 times greater than normal annual	the relevant risks cannot be secured by assessors that	365

366 include only scientists. One reason is that scientists
 367 are likely to make unrealistic assumptions about the
 368 circumstances of exposure or to be pressured by those
 369 who fear liability for harm. Thus, a recent National
 370 Academy risk study emphasized that stakeholder
 371 deliberation is just as important as expert analysis
 372 (NRC, 1996). Because the NCI and IOM studies
 373 failed to incorporate any significant stakeholder rep-
 374 resentation and deliberation, its recommendations
 375 about risk methods and screening are based on
 376 incomplete information and are at odds with earlier
 377 National Academy recommendations (NRC, 1996).

378 A second argument for screening is that, because
 379 government officials "actually suppressed" all evi-
 380 dence of this harm (ACERER, 1998, p. 10; see Ball,
 381 1986), it is impossible to know the real risk without
 382 screening potential victims most at risk. To allege the
 383 risk is minimal, given evidence of coverup, is to beg the
 384 question of the level of fallout-induced harm. In the
 385 face of government coverup of harm, sound episte-
 386 mology requires information, in part from victims.

387 The third argument, in favor of government
 388 screening (at least) of fallout victims most at risk for
 389 thyroid disease such as hypothyroidism, is that failure
 390 to do so would amount to sanctioning the erroneous
 391 belief that averages represent information about
 392 accurate levels of harm. Yet average harm, as re-
 393 ported in NCI and IOM studies, underestimates risks
 394 to at least four groups: the 25% of the population
 395 that is more medically sensitive to radiation; those
 396 who are more sensitive because they were children in
 397 the 1950s or 1960s; those who are too poor to pay for
 398 the screening themselves, such as the 46 million
 399 Americans without health insurance; and the Native
 400 Americans and Latinos who comprise a dispropor-
 401 tionate segment of the downwinders. If the govern-
 402 ment does not provide free screening (at least for
 403 hypothyroidism, and at least for the four groups most
 404 at risk), it will have no reliable information about
 405 high-consequence effects of testing. But if there are
 406 epistemic grounds for arguing that screening is nec-
 407 essary, to determine the real effects of low-dose
 408 exposures, on what faulty epistemic presuppositions
 409 do opponents of screening rely?

410 6. Five arguments against government screening

411 In response to the preceding arguments in favor of
 412 screening, what are opponents likely to say? At least

413 five arguments against screening arose in the NCI-
 414 CDC debate. They focus, respectively, on cost-effec-
 415 tiveness, average harm, risk magnitude, greater good,
 416 and epidemiology. Because of faulty presuppositions,
 417 none appear to succeed.

418 The cost-effectiveness argument, as endorsed by
 419 the IOM (1998), is that it would be prohibitively
 420 expensive to screen all downwinders in order to detect
 421 a relatively small number of thyroid cancers. Yet al-
 422 though screening for thyroid cancer may not be cost-
 423 effective, as the IOM (1998) claims, nevertheless
 424 screening for I-131-induced hypothyroidism is far
 425 more cost-effective, as ACERER (1998, p. 5) recog-
 426 nizes, because it involves only a simple blood test,
 427 because undiagnosed hypothyroidism can be a seri-
 428 ously debilitating or lethal condition, and "because
 429 the number of diagnoses and referrals for treatment
 430 could be substantial," given I-131, weapons-related
 431 exposure. Thus this first anti-screening argument errs
 432 in attacking a straw man: complicated and more
 433 costly cancer screening. It also begs the question of
 434 whether the fallout risk is minimal or whether it may
 435 have caused many problems, including half a million
 436 premature cancers, as PSR claims (Rush and Geiger,
 437 1997-1998). The argument likewise errs because it
 438 ignores the fact that rights violations typically make
 439 cost-effectiveness claims irrelevant, as in the case of
 440 prosecuting a murderer. To the degree that most
 441 murderers are one-time offenders who commit crimes
 442 of passion, it is not cost effective to try them, in part
 443 because it is unlikely that they pose threats to other
 444 citizens. Yet justice requires that these murderers be
 445 brought to trial, that they be held accountable,
 446 regardless of whether it is cost effective to do so. The
 447 same is arguably true in this anti-screening argument.
 448 It errs in presupposing cost-effectiveness always
 449 trumps justice.

450 A second argument often given against screening is
 451 that, on average, weapons fallout has done little
 452 harm. While possibly correct, this argument misses
 453 the point that although the average harm from
 454 weapons-induced thyroid cancer may be small, nev-
 455 ertheless the average harm from weapons-induced
 456 hypothyroidism likely is not small, as ACERER notes
 457 (previous paragraphs). Moreover, even if the average
 458 harm were small, the individual harm may be great,
 459 especially for those in the four high risk groups
 460 mentioned earlier. That is, there would be what John
 461 Stuart Mill (1910) called "the tyranny of the major-



ity," the tyranny of protecting only those who are easiest to protect, such as adult males. If someone releases x level of radiation and induces cancer in a child, that risk imposition ought not be ignored because x level of exposure is harmless for the average adult. The average-harm argument thus also errs because it ignores the 25% of the population with sensitivities far above average, such as children, for whom the same radiation exposure is seven times deadlier than for adults. The average-harm argument likewise errs because it focuses merely on average harm from only about 90 weapons tests, less than half of those done in the US. And once one considers the cumulative fallout from US tests in the Marshall Islands, from tests of other nations, from 2500 US nuclear facilities such as Oak Ridge Laboratories and Hanford Laboratories, as well as fallout not merely from I-131, but also from radionuclides such as Strontium 90 and Cesium-137, even the average radiation risk from all these exposures could be quite high.

A third argument often given against screening, the magnitude argument, is that the weapons fallout (at least from I-131) has caused minimal harm because thyroid problems rarely cause death, and people have thyroid check-ups (IOM, 1998). This argument errs for at least four reasons. For one thing, just because a harm (hypothyroidism, thyroid cancer) may not cause death does not mean it is minimal, as the argument presupposes. Someone who induces hypothyroidism and therefore seriously debilitating conditions, like depression, arguably causes a serious harm. Also there is uncertainty as to whether the harm is indeed minimal, not only because the PSR (1997–1998) and other groups say fallout-induced cancers are 6–7 times higher than the NCI and IOM claim, but also because there is controversy over the slope of the radiation dose-response curve (Jones and Southwood, 1987), because Chernobyl has caused many more thyroid cancers than expected (Abbott and Barker, 1996; Campbell, 1996), and because quantitative risk assessments sometimes err by 4–6 orders of magnitude (Shrader-Frechette, 1991). Moreover, the IOM (1998, ES-2) admitted that its dose estimates were "too uncertain to be used in estimating individual exposure," in part because direct fallout measures were made for only about 100 places nationwide, and exposure depends on a variety of critical factors, such as food consumption patterns, that are unknown.

Given all these uncertainties, it begs the question to avoid screening and to claim the magnitude of the fallout risk is small. After all, virtually all counties of the US, except for a few in California, West of the testing, received doses in excess of 20 rads, an amount sufficient to induce hypothyroidism (NCI, 1997, pp. B-8 through B-29). An alternative to accepting this argument against screening would be to use screening to empirically determine the real risk of fallout-induced diseases. Moreover, for people on welfare, or with no regular medical insurance, or with highly restrictive health-maintenance organization (HMO) insurance coverage, the probability of blood tests or thyroid examinations may be low. For them the fallout-induced harm may not be small in magnitude.

A fourth objection to screening (at least of the thyroid) is the greater-good argument. This stance is that, if the government did thyroid-cancer screening for high-risk fallout victims, the patients would worry about false positive or benign thyroid nodules, would have unnecessary thyroid surgeries, and would be needlessly fearful, in part because there is controversy over whether thyroid-cancer screening reduces thyroid-cancer mortality (IOM, 1998). In other words, the argument is that great harm might be induced by thyroid-cancer screening because 20–30% of indeterminate thyroid samples could lead to unnecessary thyroid surgeries (IOM, 1998, pp. E5-6, 127). Like the average-harm argument, the greater-good argument misses the point and attacks a straw man, cancer screening. Although screening might bring about public anxiety and unnecessary surgeries, the argument ignores the fact that a simple blood test for hypothyroidism likely would not induce much anxiety. It also ignores the fact that not screening has induced anxiety, a distrust of government, and a dangerous tendency to underestimate fallout-related disease. It also ignores the ethical principle that those who cause harm ought to make amends for it and ought not use paternalistic arguments (against public ignorance and anxiety), so as to avoid bearing responsibility for that harm. Victims have the right to help decide about screening.

Still another reason offered for opposing screening is the epidemiology argument. It is premised on the claim that it would be difficult to identify the group of people most likely to have fallout-induced thyroid problems. As the earlier discussion made clear, however, scientists already know that females, born in the

560 1950s, who were significant fresh-milk consumers,
 561 especially of goats' milk, are most at risk, mainly
 562 because the milk was more likely to have been drunk
 563 right after collection, a factor that allowed less time
 564 for I-131 to disintegrate and become less harmful.
 565 Knowing these facts, the screening simply could be
 566 offered to those in this highest risk group, and then
 567 offered later, to other groups, if the risks for them
 568 seemed likely to be statistically significant, given re-
 569 sults from the first group. The identification of those
 570 at risk could proceed, step by step. There is no need,
 571 as the epidemiology argument presupposes, to have
 572 completed the full identification (of all victims) before
 573 any screening is offered.

574 7. Comparativist rationality and theory manipulation 575 or bias

576 If preceding paragraphs are correct, political and
 577 economic factors (such as the desire to minimize
 578 harms from weapons development, to reduce gov-
 579 ernment liability for fallout damage, and to avoid
 580 public outcry against radiological pollution) appear
 581 to explain some problematic fallout science and
 582 question-begging arguments against government
 583 screening. What epistemic and metascientific factors
 584 might have encouraged faulty scientific and screening
 585 decisions?

586 One answer might lie with comparativist meta-
 587 science. To understand it, recall that members of the
 588 logical school of epistemology/philosophy of science
 589 (LS), like Carnap, Hempel, and Braithwaite, had one
 590 approach to metascience, while members of the his-
 591 torical school (HS), like Kuhn, Laudan, and Fey-
 592 erabend, had another. On one hand, LS emphasized
 593 the theory neutrality of experiments and the presence
 594 of a common observation language; because they
 595 appealed to some apriori criteria to evaluate individ-
 596 ual scientific theories, these LS proponents might be
 597 called non-comparativists. On the other hand, HS
 598 spoke of conflicting paradigms as "competitors"
 599 (Kuhn, 1962, pp. 147–150, 154–155) that were
 600 scored in terms of progressiveness (Laudan, 1977,
 601 1997). HS tended to deny the theory neutrality of
 602 experiments and the presence of a common observa-
 603 tion language; because they believed most or all cri-
 604 teria for theory evaluation were comparative, HS

605 proponents might be called "comparativists." Al-
 606 though comparativists differ, especially in the degree
 607 to which they say there are epistemic criteria for
 608 theory choice, independent of theory comparison,
 609 Larry Laudan is perhaps the most extreme compar-
 610 ativist. Laudan (1977, 1997) says the rationality of
 611 theory choice is explicable only in terms of problem
 612 solving ability, relative to another theory, and not
 613 vice versa: Comparative problem solving defines
 614 rationality, and not vice versa. While Feyerabend
 615 claimed one could approach closer to truth, and
 616 Kuhn admitted there were rational values, like pre-
 617 dictability and heuristic power, independent of theory
 618 comparison, Laudan (1997, p. 306; 1977) says "what
 619 does (and what should) principally matter to scientists
 620 is not so much whether those hypotheses are true or
 621 probable. What matters, rather, is the ability of the-
 622 ories to solve empirical problems."

623 In addition to the comparativist problems noted by
 624 Gunderson (1994) and Mayo (1997), the remainder of
 625 this paper argues for two theses: (1) LC errs in
 626 overestimating the potential of procedures, indepen-
 627 dent of truth and probability, to warrant relative
 628 choice among theories. (2) Comparativists' preferring
 629 "problem solving ability" to truth allows for more
 630 scientific manipulation/misinterpretation, as occurred
 631 in the fallout case.

632 LC appear to fall into problems (1) and (2) because
 633 of three main claims, (A), (B), and (C). (A) They ig-
 634 nore truth, probability, and evidence, and instead
 635 focus only on relative problem-solving ability (Lau-
 636 dan, 1997, p. 306; 1977); I call this "the truth claim."
 637 (B) LC say a severe test of a theory means simply
 638 "that is has survived tests its known rivals have failed
 639 to pass," not vice versa, and hence that a theory
 640 ought not be rejected until a better one is available
 641 (Laudan, 1997, p. 314; 1977); I call this "the test
 642 claim." (C) LC claim that theory competition should
 643 be restricted only to those that are "extant rivals."
 644 Laudan (1997, p. 314) explicitly says that choosing
 645 one theory over another "requires no herculean enu-
 646 meration of all the possible hypotheses for explaining
 647 the events in a domain. The fact that there are in
 648 principle ... theories which could pass all the same
 649 tests ... is, from a comparativist perspective, neither
 650 here nor there – until such time as these in – prin-
 651 ciple theories are given flesh-and-blood in the form of
 652 a clearly articulated formulation." I call this last tenet
 653 "the availability claim."



654 If LC accept the truth, test, and availability claims,
 655 why are they more likely to err in believing (1) that
 656 comparative theory-evaluation procedures are suffi-
 657 cient to warrant theory choice? One reason is that
 658 comparative theory assessment provides justified
 659 grounds for theory choice only if the choice is as
 660 objective/rigorous as possible, and only if it is able to
 661 distinguish between legitimate and illegitimate influ-
 662 ences on theory choice. One attempt to distinguish
 663 legitimate and illegitimate influences has been to sep-
 664 arate cognitive from social values, as Larry Laudan
 665 proposed in *Progress and Its Problems* (1977). But if
 666 one subscribes to the truth claim and ignores truth/
 667 probability, then it is unclear how they can, in prac-
 668 tice, separate cognitive and social values and there-
 669 fore, on their own terms, be as objective/rigorous as
 670 possible. Suppose a scientist working for the US DOE,
 671 an avid proponent of nuclear power and weapons, was
 672 motivated to discourage inquiry into effects of US
 673 nuclear-weapons tests. Suppose further that he denied
 674 (and gave no behavioral evidence whatsoever) of
 675 being motivated in these "social" ways. Suppose, even
 676 further, that he instead gave purely cognitive reasons
 677 for negligible fallout effects and for rejecting screen-
 678 ing. Practically speaking, the only way to show his
 679 bias would be either to judge his intentions (and
 680 thereby fall into non-empirical accusations) or to
 681 show that independent scientific criteria, such as se-
 682 vere statistical testing (see Mayo, 1997), did not sup-
 683 port his conclusions. But the first option would be
 684 question-begging and unscientific, whereas LC would
 685 not allow the second, given the truth claim. Moreover,
 686 comparative problem solving, in which one compared
 687 (i) the theory that fallout caused few casualties, versus
 688 (ii) the theory that it caused at least hundreds of
 689 thousands of casualties, would not be possible because
 690 of the availability and test claims. It would not be
 691 possible because the availability claim requires scien-
 692 tists to compare only fully formulated theories, and
 693 the test claim requires a theory not to be rejected until
 694 a better one is available. Although Feyerabend and
 695 Kuhn urge pluralistic theory development, LC do not.
 696 As a result, LC are not required to compare (i) and (ii)
 697 because (ii) is not fully formulated. And it is not fully
 698 formulated, in part, because the US has tested only for
 699 some (not most) effects of I-131 exposure; only for
 700 some I-131 (not other, longer-lived radionuclides')
 701 effects; and has done no epidemiological fallout-ef-
 702 fects tests whatsoever.

703 By avoiding funding research on theory (ii) the US
 704 government has thus caused (ii) not to be developed.
 705 Instead it has accepted the most developed/best
 706 comparative theory, (i), on grounds that it "explains"
 707 the apparent absence of a fallout-induced cancer
 708 epidemic. In other words, the US has accepted (ii)'s
 709 problem-solving ability because (ii), not (i), better
 710 explains the absence of evidence (for hundreds of
 711 thousands of fallout casualties). Because the US has
 712 not funded epidemiological testing/screening, it has
 713 kept (ii) from being fully developed, and it has al-
 714 lowed (I) to remain the dominant theory. Thus it has
 715 confused the absence of (epidemiological) evidence
 716 (for (ii)) with evidence of absence (of support for (ii)).
 717 Thus LC use of the truth and availability claims seem
 718 unlikely to support procedurally sound theory com-
 719 parison. It more likely supports biased comparison
 720 precisely because LC believe there are no norms of
 721 truth/probability/evidence that a flawed theory must
 722 meet (the truth claim); that a flawed theory can be
 723 rejected only on grounds of comparative problem-
 724 solving ability (the test claim); and that it need be
 725 compared only to fully formulated theories (the
 726 availability claim). Whenever vested interests keep
 727 research from being done, as in the case of weapons
 728 testing, and as allowed by LC, who do not promote
 729 alternative-theory development, then (2) compara-
 730 tivists' preferring "problem solving ability" to truth
 731 allows for more scientific manipulation and misin-
 732 terpretation of the data because LC have no powerful
 733 tools (such as severe testing through probabilistic-
 734 statistical studies), enabling them to "call to account"
 735 probabilistic biases, begging the question, or making
 736 some of the flawed presuppositions mentioned in
 737 earlier sections of the paper. LC have no resources,
 738 within their account, to criticize one of the most basic
 739 forms of manipulation and misinterpretation: failing
 740 to fund studies that could prove a dominant (but
 741 perhaps politically motivated) theory wrong. And
 742 once they accept the test, availability, and truth
 743 claims, then given a dearth of research, the default
 744 position will be either the null hypothesis (e.g., no
 745 serious effects of weapons testing) or the most-
 746 developed hypothesis, like (i), having the most (rela-
 747 tive) problem-solving ability. To see why (2) appears
 748 likely, consider that, in above-ground US weapons
 749 testing, people have been able to accept the default
 750 hypothesis (that testing had harmless/negligible ef-
 751 fects) because vested interests prevented epidemio-

752 logical analyses. Even when, 40 years later in the
 753 1980s, the US Congress called for analyzing effects of
 754 weapons testing, once the studies were done, they
 755 were covered up for 15 years, again apparently for
 756 political reasons. They were made public, and thus
 757 potentially available for comparativist theory choice
 758 about testing effects, only after the National Acad-
 759 emy (IOM, 1998; see NCI, 1997) and the Congress
 760 (1998) held hearings and tried to undo the cover-up.
 761 Thus, even if one could fully separate cognitive and
 762 social values, real-world operation of social values
 763 (delaying weapons studies) skews the ability of LC to
 764 choose rationally and suggests (2) is correct. LC ac-
 765 counts may work theoretically, but practically
 766 speaking, it requires a perfect world in which no such
 767 values and vested interests can dominate research.
 768 The weapons case reveals that, by avoiding research
 769 necessary to formulate a theory and discover anom-
 770 alies in it, the extant theory can retain its hold. But if
 771 so, then despite their theoretical appeal, LC accounts
 772 appear to have inadequate cognitive resources to
 773 handle problems outlined in (1) and (2).

774 Another example of LC's problems doing rigorous,
 775 non-manipulated theory choice is evident in the work
 776 of the best known comparativist, Larry Laudan. He
 777 accepts the theory that there are only minimal levels
 778 of technological risks. In his volume, *The Book of*
 779 *Risks*, Laudan (1994, pp. 9, 23, 24, 14) repeatedly
 780 discounts the "scare stories," "exaggerated reports,"
 781 and "media obfuscation" of "most of us ... most of
 782 the time" regarding societal risks like nuclear power
 783 and toxic chemicals. Laudan's (1994, pp. 3-4) chosen
 784 theory is that, once one considers "the straight facts"
 785 and keeps "editorializing to a minimum," industrially
 786 and environmentally induced risks, are seen in reality
 787 to be very small, yet they are misperceived and
 788 exaggerated by most people. He appears to confirm
 789 his hypothesis, consistent with LC beliefs, by using
 790 (what I call) the test and availability claims. That is,
 791 he assumes his negligible-risk theory is correct be-
 792 cause there is no better-developed alternative and
 793 because, in the absence of a fully developed alterna-
 794 tive, his theory "wins" by default. For example, he
 795 says the Chernobyl nuclear accident caused 31 fatal-
 796 ities and that mining causes about four deaths per
 797 10,000 miners (Laudan, 1994, pp. 6-7). In both
 798 claims he considers only acute fatalities, immediate
 799 deaths, not statistical casualties (which are approxi-
 800 mately 10 times greater than acute) resulting from

risks such as radiogenic cancers and mining-induced 801
 black lung/lung cancer. Yet annually in the US, 802
 approximately 7000-11,000 people die from acute 803
 workplace fatalities, and 62000-86000 die from 804
 occupationally induced diseases like cancer (Leigh, 805
 1995, pp. 3-7, 215). The latter, higher numbers of 806
 deaths are arrived at by using an alternative theory 807
 based on a dose-response curve derived from effects 808
 of epidemiological tests in other cases; because vested 809
 interests prevent epidemiological studies in the cur- 810
 rent cases, like Chernobyl or coal mining, the alter- 811
 native theory (that casualties from both are actually 812
 about 10 times higher than Laudan claims) "loses" 813
 out, in the comparative competition, because it is not 814
 developed and because, given the availability claim, 815
 comparativists need not consider it. 816

817 Consider a second example of how LC handle
 818 comparative theory choice. When someone has a
 819 worry about a possible industrial-environmental
 820 risk, using the availability claim, Laudan does not
 821 allow it to challenge his chosen theory, under com-
 822 parativism, unless the challenger is a "clearly articu-
 823 lated formulation" (Laudan, 1997, p. 314). To
 824 support his theory that industrial risks are low,
 825 Laudan (1994, pp. 9-10) says "unless someone can
 826 tell you what level of risk is associated with a given
 827 activity, then they have no business telling you that it
 828 is risky to begin with." Using the test and availability
 829 claims thus forces Laudan to count unknown/un-
 830 quantified risks as 0 risks, and unknown/unquantified
 831 information as 0 information. He says nothing about
 832 getting more information, attempting quantification,
 833 or assessing when catastrophic consequences trump
 834 considerations of probability. Again, the LC stance
 835 appears to result in an appeal to ignorance, in con-
 836 fusing absence of evidence with evidence of absence.
 837 Laudan's use of the truth, test, and availability claims
 838 thus appears to cause cognitive bias in theory choice
 839 and to support claims (1) and (2).

840 Biased theory choice also seems more likely on a LC
 841 account because, as Gunderson (1994, pp. 307-308)
 842 notes, comparativists presuppose unambiguous the-
 843 ory choice, yet ambiguity is almost always built into
 844 alternatives, especially in the real world where social
 845 and political values often infect theorizing. Given this
 846 "infection," the comparativists' look-and-see attitude
 847 hardly suffices for theory choice. As ethicists have
 848 been quick to recognize, procedures are rarely suffi-
 849 cient fully to justify choice/action, in part because few

850 procedures are ever followed perfectly in the real
 851 world. If not, what compromises procedures can
 852 compromise objectivity. Care (1978), for example,
 853 discussed the way participatory democracy, like trial
 854 by jury, warrants its resulting outcomes. He noted that
 855 necessary conditions for this warrant include more
 856 than 20 items such as all participants' being non-
 857 coerced, rational, accepting of the terms of the pro-
 858 cedure by which they seek agreement and evaluation,
 859 disinterested, committed to community self-interest-
 860 edness and to joint agreement, willing to accept only
 861 universal solutions, and possessed of equal and full
 862 information, and so on. Care argues that, because
 863 circumstances never permit full satisfaction of these
 864 procedural conditions, following procedures alone
 865 will not obviously produce a rational choice. If not,
 866 one might make an analogous argument: Because
 867 circumstances never or rarely permit full satisfaction
 868 of necessary conditions for warranting a comparative
 869 outcome, following LC competition, alone, will not
 870 obviously produce a rational/objective choice. Relying
 871 on comparison, in the absence of perfectly followed
 872 procedural rules, is like relying on the invisible hand,
 873 in the absence of full market information and free
 874 market choice.

875 8. Conclusions

876 If the arguments of the previous sections are correct,
 877 and if LC have problems because of their accepting
 878 the truth, test, and availability claims, what might be
 879 done to improve the comparativist account? With the
 880 truth claim, instead of explanatory power's trumping
 881 truth/probability, as Laudan (1997, p. 306) requires,
 882 one might accept the more modest claim that
 883 explanatory power is "at least as important as
 884 questions of truth, probability, or falsity" (Laudan,
 885 1997, p. 308). This claim would give the compara-
 886 tivist resources to use, beyond mere comparison, in
 887 theory evaluation. Second, instead of the test claim
 888 and "relativizing severity to the class of extant the-
 889 ories" and requiring "clearly articulated formula-
 890 tion" of competing theories (Laudan, 1997, p. 314),
 891 comparativists might require as full theory-formula-
 892 tion as possible, before engaging in comparison.
 893 Third, with respect to the availability claim, com-
 894 parativists might admit there are grounds for reject-

ing a theory (such as bias in its formulation), even in 895
 the absence of a compelling or better alternative. If 896
 LC metascience and epistemology were amended in 897
 these ways, scientists might avoid some cognitive 898
 biases, and citizens might have more trust in their 899
 governments to protect them from science-related 900
 harms. 901

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