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Discourses on the Toxic Effects of Internal Chemical Contamination in Catalonia, Spain

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ABSTRACT

Human exposure to and contamination by environmental toxic compounds generates discourses and practices that merit greater attention. In this article, we assess internal chemical contamination and the risk of toxic effects as an experience related to the production of meaning in everyday life. Drawing on the analysis of semantic networks of narratives from semi-structured interviews conducted with 43 informants in Catalonia, Spain, we consider participants' perceptions of the health risks of toxic compounds, including social discourses on exposure, toxicity, and internal chemical contamination, and on responsibilities, consequences, and proposed strategies for controlling toxic compounds. Informants' narratives on the relationships between nature and nurture suggest that they no longer perceive rigid boundaries separating the human body from the external environment and its chemical pollutants.

KEYWORDS

Body burden; internal chemical contamination; risk of toxic effects; social perception of danger; Spain

An important feature of today's society is the widespread social concern about environmental and human health threats posed by social and environmental processes, to the point of being characterized as a 'risk society' (Beck 1992; Douglas and Wildavsky 1982; Flynn 2006; Jensen and Blok 2008; Lupton 1999; Prüss-Ustün et al. 2016). These environmental risks to health include air pollution, toxic chemicals in animal and human food webs, and nuclear waste. Until now, the social construction of environmental risk has mainly referred to our altered natural environment, climate change, and environmental pollution. Increasingly, however, the human body is taking a more central position in the production of social and scientific discourses on risk and chemical contamination (Iles 2007). The social perception of environmental risk is shifting toward the inside of the body, and new categories are emerging in lay and scientific discourses to express increasing cultural unrest about the problems of bodily risk. This embodied risk (Kavanagh and Broom 1997) is partly a result of the role of synthetic chemistry in the production of food and consumer goods, and partly due to our habits as consumers of items as food, cosmetics, and cleaning products (Bergman et al. 2013; Porta et al. 2003; Porta and Zumeta 2002).

Growing social interest in environmental health and justice has provided the impetus for studies on issues that affect and preoccupy communities, such as health impacts, environmental impacts, and environmental justice (Wing 2009). When scientists show greater political and moral commitment to social issues, the impact of their findings becomes broader and the effects of environmental concerns, far-reaching. In grassroots activism (Bullard 1993; Capek 1993; Morello-Frosch et al. 2002; Taylor 2002), the cause of environmental justice has bolstered community campaigning to defend peoples' rights to environmental health, mitigate the risks workers face from chemical hazards, and uncover cases of socio-environmental injustice (Bullard and Johnson 2000; Taylor 2000).

In the field of environmental justice, various empirical epidemiological and social science studies have gathered evidence on crimes committed by certain chemical companies that exposed workers to heavy metals (Sicotte 2009) and by agricultural industries that exposed farmworkers to pesticides (Arcury et al. 2001; Jensen and Blok 2008). A number of important studies have also examined populations with serious health problems, living in contaminated communities and neighborhoods (Auyero and Swistun 2008, 2009; Quandt et al. 2004).

In this context, human exposure to and contamination by toxic compounds generates discourses and emerging practices that merit greater attention than is usually granted. In this article, we examine how people's transactions of knowledge, values, and experiences are shaped in different symbolic frameworks, both in their narratives and at a practical level. We aim to understand how society perceives, reinterprets, and reformulates discourses on chemical contamination and toxicity of both the external and internal body. By analyzing social discourses on exposure, perceptions of risk, danger, toxicity, and internal contamination, as well as on responsibilities, consequences, and proposed strategies for controlling toxic compounds, we explore understandings of internal chemical contamination, the risk of toxic effects as a human experience, bodily toxicity, and contamination in everyday life.

Chemical compounds commonly used in food production, processing and conservation, and in materials for packaging, cosmetics, and house cleaning can affect human health when they interact with pathophysiological processes (Bergman et al. 2013; Porta 2012; Prüss-Ustün et al. 2016). Human internal contamination by persistent toxic substances (PTS) and other environmental chemical pollutants is the result of systemic processes that involve regular exposure to PTS, and accumulation of many, non-excretable PTS. Such processes begin in the early days of embryonic life, and continue throughout the entire lifespan, "from womb to tomb" (Bergman et al. 2013; Porta 2004).

PTS are chemical agents used in agricultural and industrial production that gradually accumulate in the body at low doses, mostly through the ingestion of food products containing animal fats. They constitute a silent risk because of the invisibility of exposure and its consequences for health (Bergman et al. 2013; Porta et al. 2003, 2012). PTS mixtures commonly found in humans and other living organisms may result in immunosuppressive, proinflammatory, neurotoxic, hormone-disrupting, metabolic, carcinogenic, nongenotoxic, and epigenetic effects. PTS thus contribute to cause certain cancers, infertility, neurodegenerative and immunological disorders, and type 2 diabetes (Barouki et al. 2012; Bergman et al. 2013; Morrens et al. 2012; Porta 2004, 2012).

Although certain PTS—such as polychlorinated biphenyls and pesticides such as DDT—were prohibited several decades ago, most continue to pollute animal and human food webs, albeit at generally low doses. Thus, human exposure to PTS continues and, because of their resistance to degradation and excretion, these compounds remain in the environment and in living organisms for decades and even throughout the life course (Porta 2004, 2012). As in other countries, in Spain numerous studies provide evidence on PTS concentrations in citizens and on their adverse health effects (Bergman et al. 2013; Porta et al. 2009).

Different discourses and socialities (Long and Moore 2012) emerge as part of society's representation of internal contamination. Scientific discourses on PTS-related environmental and public health risks are usually based on a nondeterministic, probabilistic framework, and as evidenced in our study, both scientific and lay discourses on risk use complex systems of symbols and meanings to describe danger, uncertainty, susceptibility, vulnerability, blame, conspiracy, and models of progress (Douglas and Wildavsky 1982). The study of beliefs about human contamination by toxic compounds may further knowledge about social rules and moral values in the contemporary industrialized world.

Environmental risks to human health are commonly linked to the external physical environment and to individual lifestyle (e.g., smoking, sedentarism) (Barouki et al. 2012; Bergman et al. 2013; Prüss-Ustün et al. 2016). A less frequently explored and substantially different category of

risk is embodied risk—the bodily risk of persons who are socially labelled (or even clinically diagnosed) as being at risk of disease (Kavanagh and Broom 1997). Such persons are more likely to develop an illness in the future, seek regular medical surveillance, look for the tools to understand their situation (through social and scientific discourses), and be required, in practice, to face the problems arising from their embodied risk.

The study we describe in this article is focused on the way individuals experience internal chemical contamination and the risk of toxic effects, and on how they produce meanings and symbols about this. If we assume that all human experience is influenced by how we appropriate socially constructed meanings and symbols, then what we refer to here are embodied risks of environmental and sociopolitical origin. Anthropology has long analyzed the boundaries between the body, the self, and the environment, and emphasized that the body is the main place where experience is embedded (Csordas 1994). Since the body is an important source of social classification of symbols (Douglas 1966), the meanings of toxic bodies are understandable when related to the general scheme of social order. Also, in contemporary society, the body is central in the social representation of individuality. The individual body (Scheper-Hughes and Lock 1987), which responds to the lived experience and the existential discourse of the self, is symbolically permeated by the harmful effects of progress.

Douglas (1992; Douglas and Wildavsky 1982) opened new ground in the study of risk by examining the symbolic construction of risk perception and prediction. She showed that how we differentiate between risks depends on cultural and political interpretation. People define risks in terms of their social values, beliefs, and interactions. Further, the construction of risk is rooted in commonly accepted ideas of justice. Concern about the social distribution of risk is based more on ideas of justice and moral values than on the probabilistic values of costs and benefits. Whether we accept or resist risk largely depends on how risks emerge (Douglas 1992; Douglas and Wildavsky 1982), and in societies that are highly medicalized, biomedical scientific discourse is the main producer of symbols of risk and disease (O'Brien 2012).

The study on which this article is based analyzed lay and scientific social discourses on the dangers of exposure to chemical compounds, internal contamination, and toxicity, as well as on the responsibilities, consequences, and proposed strategies for controlling toxic processes. Through an analysis of the semantic networks of narratives (Good 1977, 1994; Good and Good 1980) that emerged from interviews, we examine social discourses on the perception of risk and toxicity, and on the experiences related to the production of meanings about internal chemical contamination and its toxic effects.

Methods

In this article we report on the most relevant findings from an ongoing interdisciplinary, ethnoepidemiological study on the sociocultural dimensions of internal chemical contamination (Almeida et al. 2012; Larrea and Barreto 2006; Larrea-Killinger et al. 2013). The main objective of this study is to analyze sociocultural discourses and practices about the experience of human internal contamination. Specifically, we address internal PTS contamination in the general population, which is generally unaware of its exposure and the chronic effects of contaminants, and in which there has not been medical diagnosis of people suffering health effects from environmental contaminants (Porta et al. 2003, 2012). The study was carried out in Catalonia, an autonomous community of Spain¹ (population over 7.56 million in 2012), a region characterized by an emerging but still limited environmental conscience, numerous problems of chronic contamination (but with little experience of major or acute environmental accidents), intensive research on environmental health, and regular media coverage of the human and social consequences of environmental pollution (Beguiria et al. 2014; Porta et al. 2003; Tàbara, Saurí, and Lemkow 2005).²

Table 1. Informants' sociodemographic characteristics.

Variables	Subgroups	N (43)	Percentage
Sex	Female	20	46.5
	Male	23	53.5
Educational level	Primary and lower secondary	10	23.3
	Upper secondary (sixth form)	15	34.9
	Higher	18	41.9
Age	< 39	11	25.6
	40 – 49	13	30.2
	50 – 59	12	27.9
	60 <	7	16.3
Home province	Barcelona	16	37.2
	Lleida	15	34.9
	Tarragona	7	16.3
	Girona	2	4.7
	Other neighboring provinces	3	7.0

Table 2. Informants' professional profiles.

Code	Occupations*	Informants' Profile	%
1	Managers	Entrepreneurs in metallurgy, the electrical power industry, and construction	7.0
2	Professionals	Specialists in food, environmental sciences, agricultural production, agronomy, and industry (food business) and veterinarians, nurses (oncology), social workers, and primary and secondary school teachers (chemistry)	23.3
3	Technicians and associate professionals	Quality control technicians (thermoplastics), social workers, and environmental groups	9.3
4	Clerical support workers	Office clerks (petrochemicals)	2.3
5	Service and sales workers	Sellers (food, organic products, flowers), cooks, fire fighters, and police officers	14.0
6	Skilled agricultural, forestry, and fishery workers	Farmers and agricultural producers, ecological food producers, flower growers and gardeners	18.5
7	Craft and related trades workers	Auto electricians, enamelling factory workers, plumbers, and butchers	9.3
8	Plant and machine operators and assemblers	Workers in thermoplastic companies and in maintenance and cleaning of sewerage systems	4.7
9	Elementary occupations	Workers of public sanitation and recycling, janitors in public buildings, and private cleaning services	11.6
Total (N = 43)			100

* ISCO-08. International Standard Classification of Occupations, International Labor Organization (ILO).

Our sampling frame (Tables 1 and 2) comprised 43 informants who were connected to these issues either professionally (as veterinary physicians, farmers, fire fighters, butchers, and sanitation personnel) or ideologically (ecologists, vegans, and consumers of ecological and organic products). The sample was nonprobabilistic and purposive, in line with our intention to find wide variation and heterogeneity in the different professional sectors and to obtain a sample with a balanced representation by sex, age, education level, and geographic origin.

In this article, we draw on semi-structured interviews conducted between June and November 2011 with these informants, all moderately familiar with the subject of contaminants and toxic compounds, but who had not been diagnosed with any contaminant-related illness. In the interviews, we used a topic guide to focus on the themes and areas related to major aspects of our research. First, informants were asked about chemical and toxic substances in general. At the end of the interview, if PTS had not been mentioned, the informants were asked if they were familiar with this subject. Those who were not were read a short text defining PTS, on which they were asked to comment. Interviews were conducted in Catalan or Spanish, the two official languages in Catalonia. Most interviews took place in private spaces, mainly at the informants' homes or workplaces, although some were conducted in a café, at the university, or in another location chosen by the informant. The participants were informed of the objectives and methods of the research, and

informed consent for participation was obtained from each informant before the interview. Anonymity was guaranteed at all times.

The interviews were audio-recorded, and then transcribed and analyzed to identify themes, patterns, and topics, and to create codes and categories following the strategies of Grounded Theory (Glaser and Strauss 1967; Strauss and Corbin 1990). This is a particularly useful approach in exploratory studies in social sciences that requires “a continual interplay between data collection and analysis to produce a theory during the research process” (Bowen 2006:2). The data were systematically and exhaustively exploited with ATLAS-TI qualitative analysis software, with which we created codes, categories, families, and semantic networks to analyze the interviews. The information was organized in a hermeneutic unit, and the items and segments of the interviews were coded and then grouped in the thematic aspects that were the focus of the research. The data were also stratified by sex, age, education level, and geographic origin. Our research group reviewed the results and conducted numerous discussion sessions. We then constructed diagrams and conceptual maps to graphically represent the existing relationships between the different codes or categories.

Semantic networks of narratives on the dangers of toxicity

The conceptual maps (Figures 1, 2, 3) illustrate the codes and categories that emerged from the analysis of the interviews in a series of semantic networks of narratives (Good 1977, 1994; Good and Good 1980) on the dangers of internal contamination.

Figure 1 maps informants’ social perceptions of the dangers of toxic compounds. We can differentiate five axes, from left to right.

Axis 1 (*Natural/Transformed*) shows that informants associated between the notions of natural and healthy on the one hand, and transformed and dangerous, on the other. The notions of organic and chemical were also polarized, whereby chemical products marked the first step in the gradient of the perceived danger of a product.

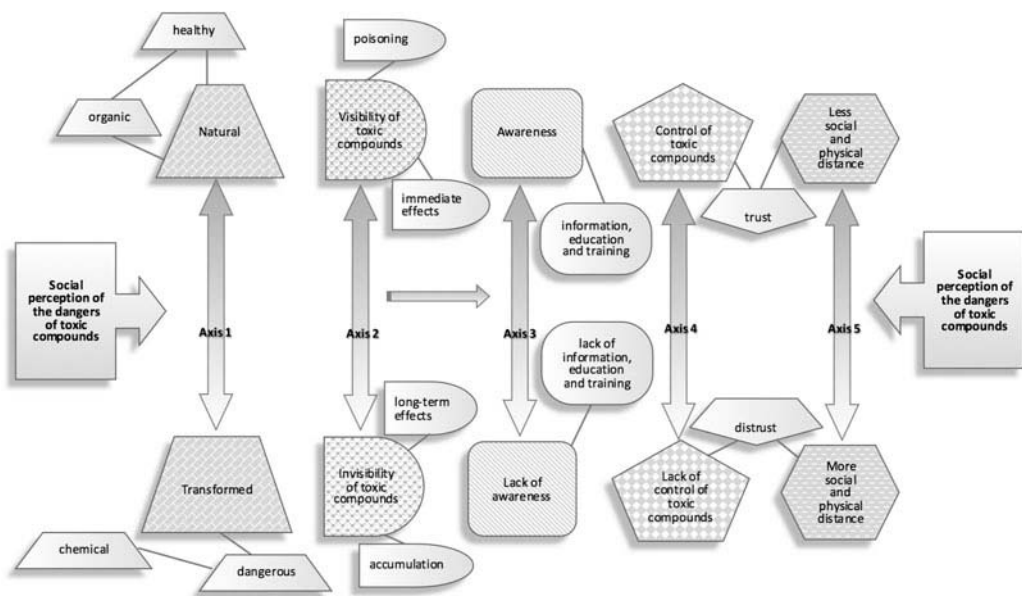


Figure 1. Semantic networks of narratives on the social perception of the dangers of toxic compounds.

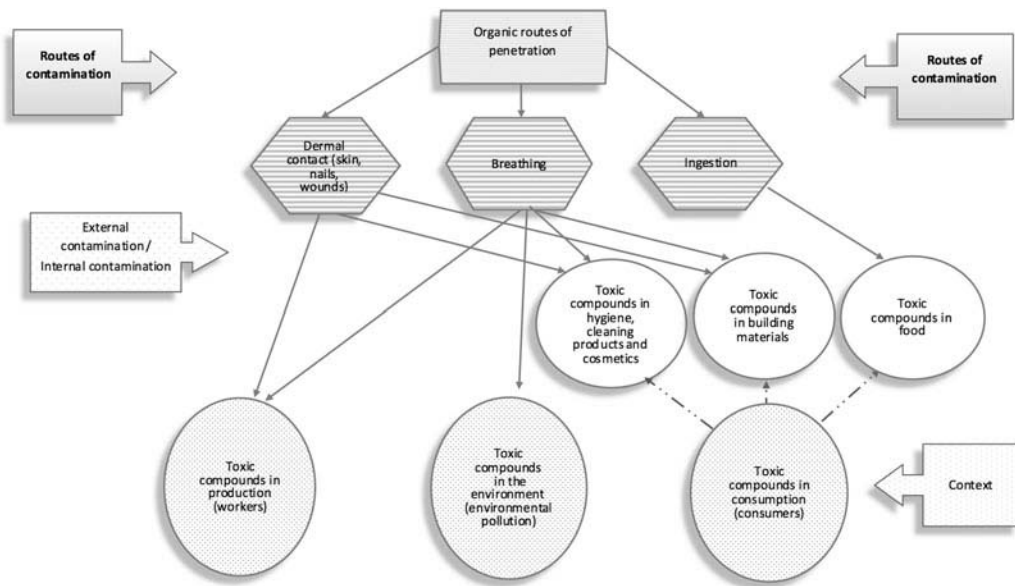


Figure 2. Semantic networks of narratives on routes of contamination.

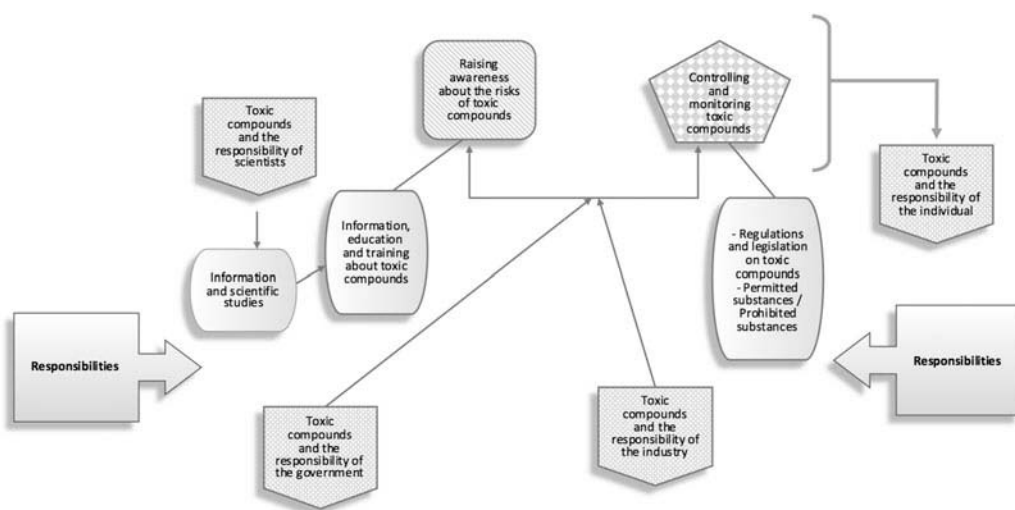


Figure 3. Semantic networks of narratives on responsibilities.

Axis 2 (*Visibility of toxic compounds /Invisibility of toxic compounds*) illustrates two important aspects in the narratives: the time dimension of the effects of toxic compounds, which might be immediate or long-term, and the amount of these substances that enter the body. Here, narratives distinguished between acute or short-term forms of contamination (*poisoning*), and low dose exposures to toxic compounds with cumulative effects (*accumulation*).

Axis 2 is closely related to Axis 3 (*Awareness/Lack of awareness*), where the narratives revealed less awareness of toxic substances when their consequences were less visible. In this axis, the narratives emphasized the importance of how much information, education, and training were available about toxic compounds.

In Axis 4 (*Control of toxic compounds/Lack of control of toxic compounds*), the narratives at one end of the pole placed particular emphasis on controlling toxic chemicals than on getting them to disappear. In this case, there was more confidence in the control activities that the government carries out to ensure that a product is safe to consume (*trust*). At the other end of the pole, certain narratives emphasized that institutions could control the products that the scientific authorities had marked as hazardous but not the products whose effects were not yet known or recognized (*distrust*).

Finally, on the right-hand side of the diagram, Axis 5 (*Less social and physical distance/More social and physical distance*) addresses informants' perceptions of danger. Here, the narratives suggest that the degree of perceived danger increases when the social and physical distance is greater. For example, informants expressed greater fear as consumers of imported agricultural and animal products than of local products. Moreover, as in Axis 4, this distance influences the degree of existing confidence (*trust* and *distrust*).

Figure 2 maps informants' narratives on routes of contamination. Here, the narratives describe the three contexts in which we live with toxic products: as employees in the manufacture of such products, as citizens living in particular environments, and as consumers of products containing toxic compounds (*Toxic compounds in production*, *Toxic compounds in the environment*, and *Toxic compounds in consumption*, respectively). In the last of these three, we can observe three sorts of products (*toxic compounds in hygiene, cleaning products and cosmetics*, *toxic compounds in building materials*, and *toxic compounds in food*, respectively). These narratives also explain how exposure and internal contamination occur in each case, that is, how the contaminants find their way into the body (*External contamination/Internal contamination*) through different organic routes (*Dermal contact*, *Breathing*, or *Ingestion*) through the "holes in our body" (i.e., the mouth, especially in the case of the PTS, and also the nose and the pores in our skin and wounds).

The routes of contamination in Figure 2 are linked to the semantic networks of narratives on the social perceptions about the dangers of toxic compounds in Figure 1 through axes 2, 3, and 4, showing that the existing narratives on *Visibility of toxic compounds/Invisibility of toxic compounds*, *Awareness/Lack of awareness*, and *Control of toxic compounds/Lack of control of toxic compounds* vary according to whether the route of entry is cutaneous, respiratory, or oral, and according to the context in which the informants experience toxic products (*Toxic compounds in production*, *Toxic compounds in the environment*, *Toxic compounds in consumption*).

Finally, Figure 3 maps informants' narratives on responsibilities. Different narratives show that informants' opinions about both *Toxic compounds and the responsibility of the government* and *Toxic compounds and the responsibility of the industry* are oriented to two main considerations: *Raising awareness about the risks of toxic compounds* (a process in which scientists also take part) and *Controlling and monitoring toxic compounds*. Informants felt that when institutions engage in awareness-raising activities at a satisfactory level and monitor and control toxic compounds, then individuals also need to take responsibility (*Toxic compounds and the responsibility of the individual*).

The routes of contamination in Figure 2 and the responsibilities in Figure 3 are also related. The narratives on responsibilities vary according to the different routes of contamination, particularly regarding food and the environment. Thus, toxic compounds acquired through food are perceived as being easier for individuals to control, and narratives on responsibilities impact most on population awareness and behavior. When contamination occurs through the respiratory tract, toxic compounds are perceived as being more difficult for individuals to control, and narratives on responsibilities argue that governments should be responsible for controlling and monitoring these substances and that industry should comply with the standards established by government.

Comments on the main findings

In Spain, in the past decade, awareness of environmental contaminants and new toxicities has increased. Therefore, a set of social actors has become involved in the construction of new social discourses: people affected by contaminants and patients with certain diseases (e.g., multiple chemical sensitivity syndrome, cancer), scientists and other experts (such as physicians, lawyers, architects, and journalists), alternative healers, and other professionals who seek to control toxic substances (such as organic farmers or sellers of organic products). In a dialectic process between lay and scientific discourses on toxicity, these new social narratives are thus (re)elaborated by citizens suffering toxic effects, and by professionals and the general population (Lupton 2005). Such narratives play a key role in structuring symbolic meanings about internal contamination. To understand how society perceives, reinterprets, and reformulates scientific discourses on contamination and toxicity, we now assess the transactions of knowledge, values and experiences, at narrative and practical levels, that take place in different symbolic frameworks.

Discourses on toxicity

Discourses on toxicity are partly based on socially shared beliefs that certain products of synthetic chemistry are dangerous. The separation between 'organic' and 'chemical' is linked to a clear association between 'natural' and 'healthy' on the one hand, and 'processed' and 'dangerous' on the other (Figure 1). As one of our informants observed:

You're buying tomatoes and they all look the same. Or you go to buy apples and all the apples are identical, right? That's not natural. When they put chemicals in these foods, I guess they end up inside you doing harm to your health. ... I don't know. What health effects? Sure, I know they're not good for you. But I don't know exactly why. I know they aren't good because they aren't natural. And if they aren't natural, they can't be very good for you. Like they use pesticides ... and they use chemicals. And the chemicals get into the thing you buy and from there they get into you. That doesn't sound too healthy to me. Yes ... they aren't healthy and since they aren't healthy, they aren't good for you. (36-year-old male street sweeper)

The products considered to be most dangerous by participants were chemical compounds because they could not be removed or excreted, but accumulated in the body and were embedded in the internal organs and in fat. When discussing foods, the informants said that the danger of toxic compounds could come from two sources: first, from the pesticides, herbicides, and other chemicals used in the production of vegetables and from the 'artificial' feed used for animals; and second, from the industrial processing and handling of that food and feed.

However, as the interviews indicated, acceptance of chemical risk is varied. For example, informants who were farmers or breeders of livestock, whose livelihood relied on chemicals, believed that technology and the government could ensure the control of toxic compounds:

The [government's] measures about which products you can or can't use on the land are getting stricter and stricter. So of course, the chemical companies that sell products also need to keep on adapting to the regulations. ... There are laws to be respected, so they have to look for new systems. (49-year-old male farmer and breeder)

This confidence in technical and institutional discourses and in regulations and policies contrasted with the fear that many consumers showed about the health risks of agricultural and animal production, especially when crops and meat are imported, because, as indicated, when the distances are greater, the degree of control being practiced becomes less evident.

In social discourses about hazards in food, we observed that the presence of synthetic chemicals was the first level of the gradient of perceived risk of a product. Informants tended to believe that the risk might be acceptable as long as there were no scientific studies to indicate that these products could be harmful. The second level was attained when scientists identify the dangers of such chemicals. At a third level, the final demonstration of the danger of food contaminants was attained when governments ban them. In the words of one informant:

I believe, *a priori*, that if you go to the market or the supermarket in theory any product that's there, anything you can take off the shelf, can't be bad; because otherwise it wouldn't be there. So if I think that whatever I can pick up and put into my trolley isn't harmful, then I feel fine about everything. ... But then it's also true that any tin of food you pick up has preservatives, food dyes, and all those things, so that's important too. ... What's important is when studies are done and the specialists tell you that certain preservatives may be harmful. ... In other words, everything has to come out, sooner or later. (41-year-old male firefighter)

Thus, the informants offered two opposing narratives. The first placed greater emphasis on regulating and handling dangerous products, so that these might coexist with us, rather than on banning or eradicating them. In this narrative, people relied on the technical control practiced by governments to ensure that all products were fit for consumption. The second narrative expressed the perception of citizens who were more aware of the effects of contaminants on health. This narrative insisted that governments could only control products that had been established by scientists as hazardous, but not those products whose adverse effects were still unknown or unproven. This perception was more evident when informants discussed PTS because of the long-term harmful effects of these substances.

The different narratives showed how toxic compounds are perceived to coexist with us not only at work or in certain highly exposed environments, but also in everyday life. Toxicity surrounds us every day through the air we breathe, the food we eat, and the soaps, creams, and home cleaning products we use. Thus, life-sustaining activities such as eating and breathing become health risk activities. In the narratives, people talked about how contaminants get into the body through the nose, mouth, and other orifices like skin pores or wounds. Toxic compounds were perceived by some informants as substances that permeate our inner body, accumulating and becoming embedded there so that they cannot be removed or dissolved. Thus, people's perception of environmental risk became a perception of internal contamination.

Informants' accounts reflected a preoccupation with two important aspects of internal chemical contamination: the amount of toxic substances that enters the body and the imminence of the effects of toxic substances. The discourses distinguished between acute poisoning (food or environmental), where the toxic substance penetrates the body in high concentrations with immediate effects, and chronic exposure to toxic compounds in small doses but with cumulative effects over time (a feature of PTS). In this latter case, although internal contamination was perceived as slower than more common recognized forms of contamination, informants also considered that it has adverse health effects. And even though it is often difficult to establish causal relationships because the toxicity is difficult to discern (when compared, for example, with classical, acute microbiological food intoxication), some narratives did suggest that the presence of PTS in our body will, over time, cause disease (either known or new types of diseases). As one informant observed:

What really happens is that these are not short term things. And the long term is difficult for us to get to grips with. So there are the products that you eat or use and the bad things in them cause you harm immediately, not in the long term. ... And then there are so many things you eat or use and when you get ill because of one of them in the long run you don't know if it was only because of that or from something else that had the same substance. ... I guess it's this: the problem is that all these things affect us in the long term. I think that's the real problem. (36-year-old male street sweeper)

The informants' narratives about types of toxic substance also varied according to the route of contamination under discussion. For example, few informants mentioned specific substances by name when talking about environmental toxic substances; they usually referred to these with the blanket terms 'contamination' or 'pollution.' The exception was in discussing river and sea pollution, when they named heavy metals like lead or mercury as toxic substances in fish.

On the other hand, informants tended to be more varied and specific when speaking about food. On the use of toxic compounds in the manipulation and conservation of foods, for example, they talked about 'food colorants,' 'food preservatives,' and 'sugar substitutes,' but without referring to specific substances. On the other hand, informants were generally more specific when they described

the production of substances (e.g., pesticides, herbicides), with farmers and farmworkers making the most frequent use of specific names of categories or products.

Responsibilities, consequences, and proposed strategies for controlling toxicity

Most informants insisted on the responsibility of governments, first to control and monitor toxic compounds and, second, to increase social awareness about risks. Controlling and monitoring should be done by legislation and enforced regulations. Increasing awareness should focus on telling the public which substances were allowed or forbidden and ensuring, at the same time, a high level of quality in education and information. If these two conditions were met, informants believed, the responsibility would largely pass from governments to individuals. One informant expressed this as follows:

Basically, I think the solution to this problem depends on each of us individually; in the final event, you're the one who has to make sure that what you eat is healthy and makes your lifestyle healthy and normal; it's my responsibility. The problem is that I believe I'm being sold what they tell me they're selling. Since I'm no expert in nutrition or in anything like that, of course there has to be someone who can protect me: the government has to make sure that I get proper information and it has to give me advice ... and it has to give it to me not just once but repeatedly, two or three times, 'till I'm fully convinced. And when I'm convinced I can tell my family and friends about it and tell the other people around me. (41-year-old male firefighter)

At the same time, there were clear differences depending on the routes of contamination when it came to the ingestion of food: where food was concerned, informants placed more emphasis on the importance of public awareness about the risks of chemicals and on individual responsibility, and they considered that toxic compounds acquired through food were more easy to control. They were also ready to accept institutional discourses about individual responsibility for those going on certain diets and eating responsibly, even when the experts knew that an individual had limited capacity to control her exposure to food contaminants (Porta 2004, 2012).

On the subject of toxic exposure through airways, informants thought that the government should control and monitor the use of these substances more than it did at present, and that industry needed to comply more consistently with regulations. In this case, toxic compounds were perceived as being more difficult for individuals to control. As one informant explained:

In everyday life, I think we can do something about the whole issue of persistent substances in foods. [PTS] in the atmosphere are more complicated and at least with the ones in food you can do something; not much but something. As I've said, you can, whether we're talking about getting food from organic vegetable gardens or simply washing food really well, making sure you know where the meat and fish you eat comes from. I think that's the only thing we can do, that's all we have in our hands to do: controlling our food. (48-year-old female secondary school chemistry teacher)

Those informants who were environmentalists and those who had been personally affected by toxic substances provided an example of social discourses on the responsibility of PTS. Both types of informant requested stricter measures to control chemical contamination, along with a wider recognition of the scientific evidence of PTS risks to health.

On the subject of the workplace, informants thought that it was the responsibility of industry to comply with government standards and regulations on handling toxic compounds, and to ensure that workers observed appropriate safety measures and received the specialized training they needed. If this was properly done, they thought, then the workers could more effectively take their own responsibility for toxic compounds and be able to decide how to use the information and the safety equipment.

Many informants who had been exposed to contaminants observed that knowing about the risks did not always ensure that people took protective action. Often, they ignore danger in their daily routines, especially if it has no immediate effects on health. When the threat is visible, major and

short term, people are more willing to use protection measures. When risk is unpredictable, invisible, and long term, security measures are less likely to be taken.

Most informants were pessimistic about chemical contamination, reflecting that risks are perceived as fairly inevitable in contemporary, industrialized society, and that this was simply the result of progress, industrial capitalism, and consumerism. For these informants, progress and industrialization were unstoppable. This, they believed, was compounded by the fact that chemicals could not be removed. As one informant pointed out:

Progress always has a downside, doesn't it? ... If we have all the comforts of the modern world then we have to have other things as well, like chemistry, or nuclear power plants or oil. This affects other things but it is worse. Because maybe the people who live in the mountains or in more rural areas don't have all these advances that we have ... but they live longer and better. That's possible, isn't it? I mean, it may be that they have a better quality of life than us. (61-year-old female office clerk, petrochemical firm)

Most informants complained that more chemicals are used today than in the past, and that food products are constantly becoming more processed and less natural. But some also took a more moderate and optimistic stance, arguing that there is greater control and awareness about toxic compounds than some years ago, that we now have more information, and that production systems and food quality have improved.

* * *

These narratives highlight two pathways for strategies aiming to control human contamination: individual and collective pathways. The former are perceived as more feasible and simple, and the latter as more complex (due, for instance, to the difficulty of achieving social consensus) (Porta 2004). Whether individual or collective, any proposed strategy for controlling toxic compounds must always be conditioned by economic interests and social barriers. Yet some informants thought that public policies should break such barriers, for example, by subsidizing renewable sources of energy and ecological products.

Most narratives on food contamination proposed strategies for avoiding the adverse effects of PTS. These included the consumption of organic food, the acquisition of good eating habits, and practices of responsible consumption. These narratives understood responsible or sustainable consumption to mean that people refrained from eating all types of foods at all times of the year. Also, the consumption of organic food was seen to involve paying more for access to better food, and so involved a trade-off between price and quality. These were the narratives that proposed adopting individual strategies. By contrast, the narratives that proposed collective solutions considered that there should be stricter regulation of the toxic compounds in food production, and that the government should increase its efforts to stimulate biointensive agriculture and livestock farming.

Most discourses on environmental pollution stressed the limits of individual solutions, and considered that the environmental control of toxic compounds was essentially the responsibility of governments and the industry. However, some participants argued that assuming responsibility at an individual level could be effective (e.g., using more public transport or recycling waste).

Our analysis of the narratives on PTS and other chemical substances revealed that informants perceived risk and attributed responsibility for risk differently, according to whether they were workers or consumers. The experience of the workplace, which involves greater contact (handling and/or exposure) and/or knowledge of toxic substances, produced a scientific discourse that was more homogenous, based on technical and administrative training about the risks of these products and, therefore, greater individual responsabilization for controlling such products. We observed no differences between the discourses of workers in contact with chemical substances and the discourses of technicians, entrepreneurs, and administrative staff, for whom danger was associated with the inappropriate manipulation of a product rather than with the type of substance. The consumer's role allowed consumers' narratives to be more heterogeneous about

responsibilities, because the consumer is immersed in a world where scientific information converges with mainstream and/or alternative mass media, discourses about progress, and ideological choices in food consumption.

Discussion

The adverse effects of certain industrial organizations, scientific approaches, and economic policies, when manipulating nature and people in the name of progress or economic efficiency, become more evident when we consider social discourses on the contamination of the body by toxic compounds. The discourses on internal chemical contamination and the risk of toxic effects acquire new cultural, political, and moral dimensions when centered on the harmful effects of environmental hazards on personal and public health.

When analyzing the social construction of risk in contemporary Western societies, Lupton (1993) distinguished between two dimensions in discourses on public health: one in which environmental hazards are seen to originate from external causes the individual cannot control; and one in which hazards are seen as the result of personal habits and a lifestyle, with much emphasis placed on self-control and individual responsibility. PTS exposure, internal contamination, and clinical effects are important factors in both dimensions (Porta 2004, 2012).

In contemporary industrialized society, powerful economic and cultural forces favor shifting social perceptions of environmental risk to the (individual) body (MacKendrick 2010). By contrast, while acknowledging that individual dimensions of the problem do exist, other narratives on internal PTS contamination emphasize the social origins of chemical exposures and toxic body burdens, and the need for regulatory measures. Often, these narratives integrate the physicochemical, epidemiological, economic, cultural, and political dimensions of a truly systemic problem (Bergman et al. 2013; Edge and Eyles 2013; Jensen and Block 2008; Porta 2004, 2012).

The new social perceptions of internal chemical contamination look 'inside' and 'outside' the body, aware that chemical body burden originates in the food, air, and water that we need, and that such a burden is largely the result of how our societies are organized and 'how we live.' Such perceptions of the causes of internal contamination produce a new set of cultural and social meanings. Eating, breathing, and drinking become health risk behaviors. Although related, such perceptions are distinct from the more common and traditional discourses on the risks of certain eating habits in contemporary societies (Lupton 2005).

Two dimensions of experience can be distinguished: one is linked to the development of discourses on the social perception of risks from chronic, life-course, low-dose internal contamination, largely attributed to the consumers' society and lifestyle (Lupton 1999; Kavanagh and Broom 1997); the other is related to acute chemical intoxication. Both dimensions question the separation of the self and its environment, as well as the idea of skin-border separation (between inner self and outer self), where the self becomes the center of narrative gravity (Dennett 1991).

As a cultural construction, therefore, the body requires analyses that integrate the fact that environmental risks 'surface' in it, polluting it for years and generations. As mentioned, PTS are resistant to degradation and excretion, and thus remain for long periods in the environment and in living organisms; further, they are often transmitted from mothers to children during pregnancy and breastfeeding. These features, which are obviously highly sensitive in cultural terms, can radically change perceptions about environmental pollutants, the body, and well-being; about the skin as an outside/inside frontier between the self and the environment; about the vulnerability of the body through its entrances or orifices; and, fundamentally, about our susceptibility to the way we live, inextricably, as individuals and societies.

Environmental and human contamination (external and internal) is the result of highly complex, systemic processes involving intensive industrial practices, mass production and consumption of foods, huge volumes of waste, and inefficient transportation and energy consumption patterns. It is not nature that penetrates and impregnates the body, through microorganisms or

natural chemicals, but culture: toxic compounds produced by man transform the body into a potentially toxic object, a silent chemical reservoir. Hence, our informants' narratives on the relationships between nature and nurture—that is, our physical and cultural environments—suggest that we are thinking about this subject in new ways and that we no longer consider there to be a rigid boundary separating the body from the external, environmental pollution that surrounds and affects it. What stands between the two are porous membranes that are both physical and cultural in nature; and internal contamination can kill human beings or convert bodies into vulnerable living elements, capable of transmitting their toxic load and vulnerability to future generations. In short, the toxic body becomes a legacy passed on through processes that are indissolubly political, economic, cultural, and biological.

Assaulted by industrialization and global dysregulation, nature threatens our bodies, our existence, and our reproduction (Haraway 1995). Footing the bill for 'social progress' has become a dramatic affair in which the body pays in terms of disease, disability, and suffering. Scientific discourses stress the multifactorial and probabilistic causality behind modern diseases and disorders, highlighting environmental and social interactions. Old and new technologies have furthered knowledge on PTS, showing that these pollutants can have substantial clinical and social effects even at low concentrations (Bergman et al. 2013; Porta 2004, 2012). Epistemic communities attempt to dialogue on their findings so that citizens, social organizations, and authorities take action.

Human contamination by PTS encourages us to think anthropologically about (a) corporal representations of toxicity ('toxic corporality') and (b) internal body images (e.g., the body as a reservoir of toxic chemicals). These two categories reflect the importance of the body in the development of social discourses. The symbolic meanings of chemical body burden belong to the dark side of our human experience and constitute the 'bill' that we pay for contemporary 'progress.' Today, a human body without toxic compounds is almost impossible to imagine: all humans are, to different degrees, contaminated. The social discourses are quite convincing when they argue that PTS accumulation will increase unless stricter policies are implemented.

Social discourses based on notions of body risk incorporate scientific findings on PTS, demanding that public responsibilities be assumed and that solutions be found. As Lupton (1993) pointed out, risk is a discourse about normalizing strategies from public health that requires the advice of experts, institutional surveillance, and the self-regulation of individuals. While the advance of synthetic chemistry and modern 'civilization' leaves its imprint on our bodies for generations to come, for better or worse the largely invisible—but very real—threat of internal contamination remains a powerful cause of society's widespread distrust of technological 'progress.'

Notes

1. Spain was one of the signatories of the Stockholm Convention, which came into force in 2004. The original 12 pesticides classified as POPs under the Convention were DDT, aldrin, dieldrin, endrin, chlordane, heptachlor, hexachlorobenzene, mirex, toxaphene, polychlorinated biphenyls, dioxins, and furans. In 2009 the Convention drew up a second list that included chlordecone, alpha hexachlorocyclohexane, beta hexachlorocyclohexane, lindane, and pentachlorobenzene. European laws governing the sale of phytosanitary products were strengthened by Regulation (EC) 1107/2009.
2. In another study our research group performed a comparative analysis of the social perception of pollution in Spain using the examples of mercury-contaminated fish and atmospheric pollution in the city of Barcelona. Considering the role of media in the construction of social discourses about risk, this study analyzed the online contributions made by readers of the major Spanish newspapers (Begueria et al. 2014).

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