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Unrecognized, concealed, or forgotten – the case of absent information in risk communication

Abstract

There are differing and partially incompatible views about what kind of issues should be included into risk discussions and what kinds of risks should be emphasized and dealt with. While the emergence of new risks has been extensively studied, relatively little attention has been paid to the roles that the absence of information can play in risk debates. Potentially relevant information may be downplayed or omitted and less relevant overemphasized when actors with varying interests, knowledge bases, and risk frames interact. Multiple and cumulative environmental and health risks caused by chemicals and other stressors pose particular challenges for risk communication. We identify and discuss different forms of unrecognized, hidden, and forgotten information by using chemical risks as a case. A widely applicable typology of absent information in risk communication is outlined.

Keywords: chemicals; information; risk communication; recognition; risk management; risk assessment; science-policy interface

1. Introduction

Communication about environmental risks is complicated and turbulent due to the complex character of the issues at hand, their public sensitivity, and the various interests that are involved. Building and maintaining undistorted, open-minded, and constructive interaction between stakeholders and other actors is a difficult task. The lack of relevant information is routinely recognized as a key constraint. However, even when relevant information for such interaction and learning exists, it may remain unrecognized, concealed, or forgotten.

Many studies of risk perception and communication in environmental management, health care, and related areas such as food safety have addressed information seeking, knowledge generation, and social learning (Renn 1998; Bickerstaff 2004; Frewer 2004; Huurne and Gutteling 2008). Less attention has been paid to the absence of information due to lack of recognition, forgetting, rejection, or restricted disclosure. Forgetting presents a particular dimension in that information has already been possessed but subsequently abandoned, for various reasons and with various consequences. Lack of recognition and forgetting in our analysis mean mainly involuntary and accidental processes, whereas restricted disclosure and rejection are based on conscious and deliberate decisions. We will show that there are important interactions between these processes. Our analysis focuses on the social and communicative aspects of the absence of information (cf. Douglas and Wildawsky 1985; Severtson and Henriques 2009) and not on individual cognitive aspects.

The common consequence of lack of recognition, forgetting, rejection, or restricted disclosure is that information is absent, although it is in principle available. Communication and decisions are then based on unnecessarily restricted information. Some groups can use this to their advantage if the absence of relevant information strengthens a particular conclusion.

The absence of information means that information remains unnoticed, unused, or underutilized in contexts where it would be relevant. It is important to note that there are different and also incompatible views (i.e., not different in a fruitful way) on what kind of information is relevant and should be used in a particular context (Assmuth et al. 2009; Lyytimäki, Assmuth, and Hildén 2009). Confusions, controversies, and also omissions of relevant information can thus occur when actors with different views and frameworks try to communicate (Assmuth and Hildén 2008; Beninghaus and Renn 2008). Limited disclosure, rejection, and non-recognition of information consequently play important roles not only in debates on risks but also in less charged communication. This has further important implications for risk management. When the absence of information is recognized, the precautionary principle may be invoked, but the absence of information, when unrecognized, may also lead to a flawed sense of certainty or security (Tversky and Kahnemann 1974).

Chemicals provide illustrative and important examples of non-recognition, non-disclosure, rejection, and forgetting of complex and cumulative risks. These risks are caused by different kinds of substances, by sudden transient events and long-term processes, and they include various kinds and durations of effects in humans and other organisms, prompting different forms of recognition and recall (Assmuth et al. 2009; Assmuth, Hildén, and Craye 2010). From the point of risk communication, chemicals pose a challenge partly because they are commonly feared, debated, and prioritized risk agents (Slovic 1987; CEC 2006).

In this paper, we analyze and discuss how the absence of information interacts with risk communication. Our main goal is to increase understanding of the different forms of absence of information, including that due to forgetting, and of their implications for risk communication. In particular, we will analyze how and why the role of absent information changes when one considers multiple risks from cumulative stressors. The specific examples we examine have been derived from an assessment of dioxin-like compounds in the Baltic Sea (Assmuth and Jalonen 2005) and from a survey (Assmuth et al. 2007) of opinions of experts and stakeholders on risk assessment and management of chemicals within a project on Novel Methods for Integrated Risk Assessment of Cumulative Stressors (<http://nomiracle.jrc.it/>).

The paper is organized as follows. In Section 2, we conceptualize general processes of non-recognition and forgetting; in Section 3, we develop a typology for the absence of information. In Section 4, we examine additional contextual factors affecting the absence of information. Section 5 discusses implications for risk assessment, policy, and participation. Section 6 concludes the paper with a discussion on the importance of absence of information in risk communication.

2 The processes of non-recognition and forgetting in risk communication

Generally, risk communication is influenced by three major factors: the risks themselves, those communicating – or refraining from communicating – relevant information, and by the wider context of the communication. The factors are interrelated, so a communicator is shaped by and may shape his or her context, and risks are shaped by, and in turn shape, both other factors. The interaction between these processes and factors affects how risk information is recognized and used. To be used, risk information must be received by the intended audience and gain its attention. The information and its context must be understood and remembered. Finally, it must be responded on. Failing at any of these tasks means that the communication process fails (Therkelsen and Fiebich 2001). In a multi-directional and charged process between the parties engaged in communication, the possibilities for failure grow, and essential information may be lost. Furthermore, with growing amounts of information and complexity in issues such as multiple stressors and cumulative chemical risks, the danger of communication failures also grows (Assmuth et al. 2009). However, a diversity of issues may also create new possibilities for social learning by opening up new points of entry into the debate (Lyytimäki, Assmuth, and Hildén 2009).

There are many reasons why issues are not recognized in scientific, policy, or public debates. Information may be possessed by individuals and institutions unable or unwilling to disseminate it (King and Lenox 2000). Some risks may be consciously regarded as genuinely unimportant, and omitting them is therefore seen to be justifiable (Mazur 2004). Harmlessness can be assumed and risks may therefore remain hidden simply because no one makes the link between existing pieces of information (Douglas and Wildawsky 1985). Important risk information may be lost because of gaps in the organizational knowledge networks (Garner 2006) or when organizations experience institutional amnesia or ignorance (Zack 1999; Pollitt 2000). Risk information may also be actively discarded or played down. For instance, stakeholders fearing that new environmental regulation will become costly may refuse to accept the information underlying the demand for regulation (Kroll 2001).

Many factors affect the transfer of identified risk information into public debate or policy-making (Harremoës et al. 2001; Figure 1). Lack of scientific evidence, of prominent spokespersons, of funding of institutions capable of dealing with the issue, and of media coverage can forestall public

debate and hinder wider recognition. On the other hand, the social amplification of risk (Kasperson et al. 1988; Siegel 2005) suggests that some risks can be emphasized and remembered far beyond their relevance measured in terms of their probability and the severity of their consequences. The recognition of a risk may be caused by its conceived resemblance and resonance with some other risk that has previously been experienced or discussed (Mazur 2004).

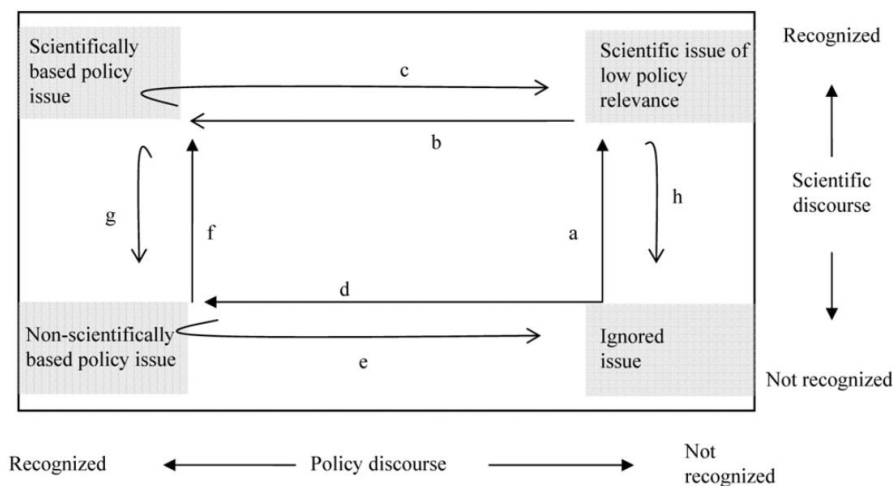


Figure 1 Categories of issues forgotten or recalled in scientific and policy spheres, and possible trajectories.

Questions that are long term, abstract, and obscure are often not recognized by news criteria emphasizing dramatic, fast-emerging, and tangible aspects (Anderson 1997). Dramatized risks can thus be better remembered than other risks that are as such better known (Slovic 1987). Some emerging risks may have long-lasting influence on public perception and behavior, whereas others disappear without leaving enduring traces for future recollection. Actors with different knowledge and interests are also likely to recognize, highlight, or forget different aspects of a risk (Assmuth et al. 2007). Therefore, the re-emergence of issues and risk information is partly unpredictable.

Science plays an important role in making risks recognizable, but science also has an important role in giving advice on issues that should not be highlighted as top priorities (Fischhoff 1995; Sjöberg et al. 2005). Science informs policy, but policy also has a significant effect on science: policy attention steers research interests and resources (Figure 1). Because of such interactions, some level of positive correlation is to be expected between scientific and policy recognition. However, a scientific discourse may recognize or dismiss information partly regardless of policy attention. Correspondingly, issues frequently emerge into public risk discourse based on non-scientific information (Allan, Adam, and Carter 2000). Recognition and forgetting in science and policy discourses are thus partly different but interacting processes. Scientific recognition of information often develops gradually (Figure 1), although there are clear-cut cases. For example, a strong signal in a laboratory tests is, as per definition, scientifically recognized as relevant. In contrast, a completely new finding, e.g., using a novel method, is not immediately accepted or recognized, although it would be the result of rigorous research.

The interaction between the policy and scientific discourses evolves with the identification and recognition of risks, and with the response to them. To understand these processes, it is essential to distinguish between different types of non-recognition and forgetting, and to account for the

access to information. In the next section, we illuminate these processes and their implications for communication dealing with multiple and complex risks.

3 The loss and re-emergence of risk information

Information on risks can become or remain absent for very different reasons. First, one needs to distinguish between restricted and public information. By restricted information, we mean information to which access is, at least initially, restricted to a limited number of actors, who can determine how it is used. By public information, we mean information that is, at least in principle, freely available from open-access sources such as the media, libraries, or the Internet. Second, one needs to consider risk information which is lost deliberately as opposed to inadvertent loss. This leads to four different categories of absence of information. From a communicative point of view, the interesting questions are how information on risks moves from one category to another.

The extreme cases are easy to recognize, but in many cases, information is partly deliberately withheld and partly accidentally lost. Similarly, it is possible to distinguish between strictly restricted information and information that is distributed, e.g., through the Internet. Between these extremes, one finds cases of partly accessible information. An organization may, for instance, be only vaguely and passively aware of some risk information it possesses and therefore forget it, without consciously concealing it. Information may become absent through gradual cumulative processes in which the knowledge of relevant information is lost as time passes with the change in personnel and shifting priorities (Harvey et al. 2001). New findings and active communication may lead to a rediscovery of such forgotten information and make it visible and public.

3.1 Deliberate non-disclosure

Actors who reason that open dissemination can produce unwanted consequences tend to deliberately restrict access to risk information. The tobacco industry's attempt to influence the information about health effects of smoking is a case in point (Muggli, Hurt, and Becker 2004). Commercial interests frequently require withholding of confidential information. This is justified when it comes to intellectual property rights, but when it is extended to cover risk information on products or processes, scientific and social integrity may become compromised (Krimsky 2003). Competition for research information in a knowledge society involving power and prestige may produce similar effects (Jasanoff 2005).

The access to information on publicly funded applied research and assessment can be deliberately constrained especially with 'hot' risk issues and when non-disclosure is seen to be in the common interest (Mazur 2004). Disclosing information may be considered potentially so harmful that secrecy is required. Such allegedly altruistic withholding of information can violate the principles of right-to-know and transparency, and may also be seen as a form of patronizing. The distinction between deliberate non-disclosure of information that aims to increase social well-being and that aiming at securing selfish interests is not clear cut. Actors can genuinely believe that it is best not to release information in order to avoid undue public concern over small risks. With hindsight, several of these concerns have been flawed (Harremoës et al. 2001). On the other hand, in the contemporary risk society (Beck 1986, 2006), scares are often manufactured also for political and economic reasons, and information leading to questioning and refutation of risk claims may thus be concealed.

Instead of openly declared secrecy, information can be deliberately withheld using more candid and ephemeral means, even under superficial transparency, e.g., by concealing it in technical language. A censoring culture enabling this may develop in an organization or a community also without explicit restrictions. Maintenance of secrecy often requires substantial resources, but is likely to fail eventually, partly because complete monopoly over information exists only rarely. Pieces of information regarding a complex issue are possessed by several actors. Public debate over cumulative risks from multiple stressors may in this respect be important as it raises questions about information that can remain hidden when dealing with single stressors only.

Communication introduces corrective mechanisms, e.g., through the feed-back and criticism from scientific communities and public discussion, but it may also, at least initially, increase disagreements about risks (Sarewitz 2004). Criticism and debate can emerge if secrecy is revealed or even suspected by the media (O'Neill 2002). Thus, attempts to 'bury' an issue may eventually cause it to be remembered particularly well, as shown, e.g., by the bovine spongiform encephalopathy (BSE) and dioxin scandals in the EU (Lanska 1998; Assmuth and Jalonen 2005).

Provisional withholding of risk information may be justified when the information is incomplete, highly uncertain, or difficult to interpret. This presents a dilemma if the perceived urgency of the issue increases its recognition in the political discourse and requires fast judgment. Such processes put conflicting demands on the scientific discourse (see Figure 1). Increasing recognition in the scientific realm is needed to make firm research-based statements, but this usually requires relatively long time periods, whereas policy development can move fast if an issue is perceived to be urgent. The slow processes of science may lead to forgetting about the matter and to inaction in the policy domain if the public interest and political pressure fade away during prolonged research and risk assessment. Thus, information initially subject to deliberate non-disclosure may be forced partly into the open, but may then fall back into oblivion from the public sphere if no new findings emerge that can spur the communication.

3.2 Accidental or unintentional non-disclosure

Originally restricted information can remain inaccessible even when a person or an organization is willing to share this information but lacks resources or skills for active communication. The resources include, e.g., funds, time, and access to communication platforms. The skills may include capacity to formulate and deliver the information in such a way that it is received, believed, and remembered. Information in a specific field of expertise may be too technical to be understood and remembered by those outside the field, even by administrators supposed to deal with the issues. This is particularly true for emerging fields such as nanotechnology (Allan, Anderson, and Petersen 2010). Complex issues such as interactions and cumulative effects of multiple stressors can also demand both broad and specific expertise. Attempts to solve these problems by developing simple indicators, specifically aimed to informing the public, may in practice turn out to be too complicated for communication (Chess, Johnson, and Gibson 2005) and thus are unable to form the link between the realm of detailed but restricted scientific information and the public sphere.

Tailoring the message according to the needs and capabilities of the target group to facilitate remembering requires close interaction between information producers (also archivists) and users (Frewer 2004). However, it is difficult to define what meaningful remembering and efficient information are for each actor and in each case. Lay knowledge that is not included or taken

seriously in risk assessment is one example (Lidskog 2008). Cumulative risks from multiple stressors pose particular challenges in this respect. The research is in many cases complex and difficult to interpret even among researchers. Some of it is so new that it has not yet gained full scientific recognition (Figure 1) and thus its transfer to the public arena may be erratic. The absence of crucial information on a context may lead to flawed conclusions. For example, information on the particular set of stressors and the conditions for cumulative effects to emerge may be required to understand the magnitude of the risks involved.

Information can remain absent because of a lack of courage and motivation to bring up possibly important but contradictory or inconvenient results. Civil servants may fear being stigmatized as trouble-makers, and scientists may fear losing trustworthiness or objectivity. On the other hand, both are frequently eager to selectively and disproportionately 'flag' risks to legitimize and support their positions. The more alert role of media and the polarized debates about environmental risks may even repel regulators and scientists and decrease their willingness to participate in and to bring restricted information to the public debate. Those possessing the information may also be disturbed by time-consuming requests for it.

3.3 Conscious rejection

A person or an organization can choose not to obtain known and available information. Such deliberate rejection may occur when the information is considered useless or even harmful in the situation at hand, or when gathering the information is considered too troublesome or costly in relation to the potential benefits. Others is considered responsible for acquiring and using the information, and hence the actor can feel free to put the matter aside (Gunther and Storey 2003). In strictly sector-based administrations, this is a common problem. For instance, authorities responsible for consumer safety may not recognize information on ecological effects as relevant, and those responsible for environmental effects can omit human impacts.

Most of the information available in the public domain must be left aside, simply because there is not enough time to go deeply into all potentially interesting issues and details. This rejection of information may be seen as a psychological, biological, and physical necessity to cope with super-abundant information. It can also be an economic necessity because of the lack of resources to search and synthesize all potentially relevant information in a society characterized by abundant information. As Bowker and Star (1999) maintain, the question is not any more about finding the information but about sorting out irrelevant information. This particular problem is particularly strong in communication about cumulative risks from multiple stressors. Nearly any information can be seen to be important somehow, but at the same time, most information has to be rejected, because different pieces of information are not compatible and cannot be systematically treated.

Another form of unwanted absence of information due to rejection arises because actors resist information that suggests flaws in their knowledge and current views. The theory of cognitive dissonance in social psychology suggests that people generally try to avoid having conflicting sets of attitudes which would imply contradictory behaviors (e.g., Harmon-Jones and Mills 1999). There is empirical support for the associated overconfidence in the veracity of one's beliefs (Tversky and Kahneman 1974). At a deeper level, such overconfidence and rejection of contrary views is a reaction to perceived challenges and an inevitable part of human behavior. Importantly in our connection, it is likely to be enhanced among many when confronting risks, along with hesitant

reactions by others. A common way to also deal with risk information that is inconsistent with one's personal positions is to deny its truthfulness or relevance and thereby forget it.

Organizations, with a particular task and mandate, such as authorities responsible for approval of chemicals, have an even stronger tendency than individuals to avoid contradictory behavior and decisions. This kind of rejection based on conflicts between different premises can result both from inadequate communication between adversaries and from strong motivation to win the argument. If the experts disagree on assumptions and interpretations, it is unrealistic to expect that all disagreement could be resolved merely by increasing the access to information (Assmuth and Hildén 2008). The conflict resolution process is usually more complex. In both expert and lay debates, some participants inflate risks and others downplay them, often in reaction to exaggeration. If those downplaying risks gain support, and the risk governance system is able to respond in a way that satisfies most participants and stakeholders, an issue can be dropped from active debate.

Communication related to cumulative risks from multiple stressors has to face the problem of rejection at many levels. Rejection is often caused by conceptual and organizational barriers. Current regulatory systems for chemicals, e.g., are not geared to dealing with information on other chemicals (such as pharmaceuticals) or on specific contexts, especially outside those normally considered. The possible number of combinations of multiple stressors is too large to be addressed in a comprehensive way, and there can be resistance against the very thought of synergistic or antagonistic effects.

3.4 Innocent omission

Innocent omission of risk information arises when lack of information is combined with lack of directions to search for the information. Innocent omission of public information is – in principle – a relatively easy problem to solve, because the actor acknowledges and identifies the incompleteness of knowledge and is willing to acquire and remember additional information. However, different actors regard different information as worthy of acquiring or remembering. It may also not be known where this information could be obtained, and the information may not be easily accessible or applicable. A common problem when dealing with complex risks is the unavailability or omission of some necessary intermediate or synthesizing information by other actors. For example, lack of metadata and contextualizing devices can render large information repositories virtually useless (Daughton 2001). Measures reducing unwanted absence of information include systematic and structured sources of information, explicit ontologies, and search functions.

Risks are always selected in a culturally conditioned process where a community censors its beliefs, blaming some risks and absolving others far beyond what would follow from physical facts (Douglas and Wildavsky 1985). De-selection of information based on its perceived value and on other types of cultural dominance also occurs in science. Especially within interdisciplinary research, the problem is that too little resources are used to mine and combine previous knowledge (Daughton 2001), as valuable knowledge on risks can be found in repositories of many disciplines.

4 Contextual factors – risk type and time in communication related to chemical risks

4.1 The influence of risk type

Chemical risk assessment and management deal with largely abstract information. Generally, risks of chemicals in the form of adverse effects can be experienced firsthand only in immediate poisoning cases and in toxicity tests and other experimental studies. These observable and causally attributable risks of chemicals are special cases of and proxies for the risks that the regulatory systems address. Therefore, recognition and forgetting are essential as they affect the framing and the generalizing of conclusions of risk assessment, and the focus and issues of risk management.

Examples of different categories of absence of information in the communication on chemical risks are presented in Figure 2. Different chemicals and areas of chemicals control raise their own contextually dependent risk issues. The reasons for and the roles and consequences of absent information vary accordingly. They can be transformed from one category to another depending on the communicative context. Thus, different pieces of information may be deliberately withheld, forgotten, or rejected depending on what is being communicated to whom. In formalized frameworks for risk management that are based on a specific legal procedure, any information that does not fit into the framework specified by the law is rejected and rapidly forgotten, whereas the picture is more varied in, e.g., general planning situations, which can deal with a broader range of information (Asssmuth and Hildén 2008).

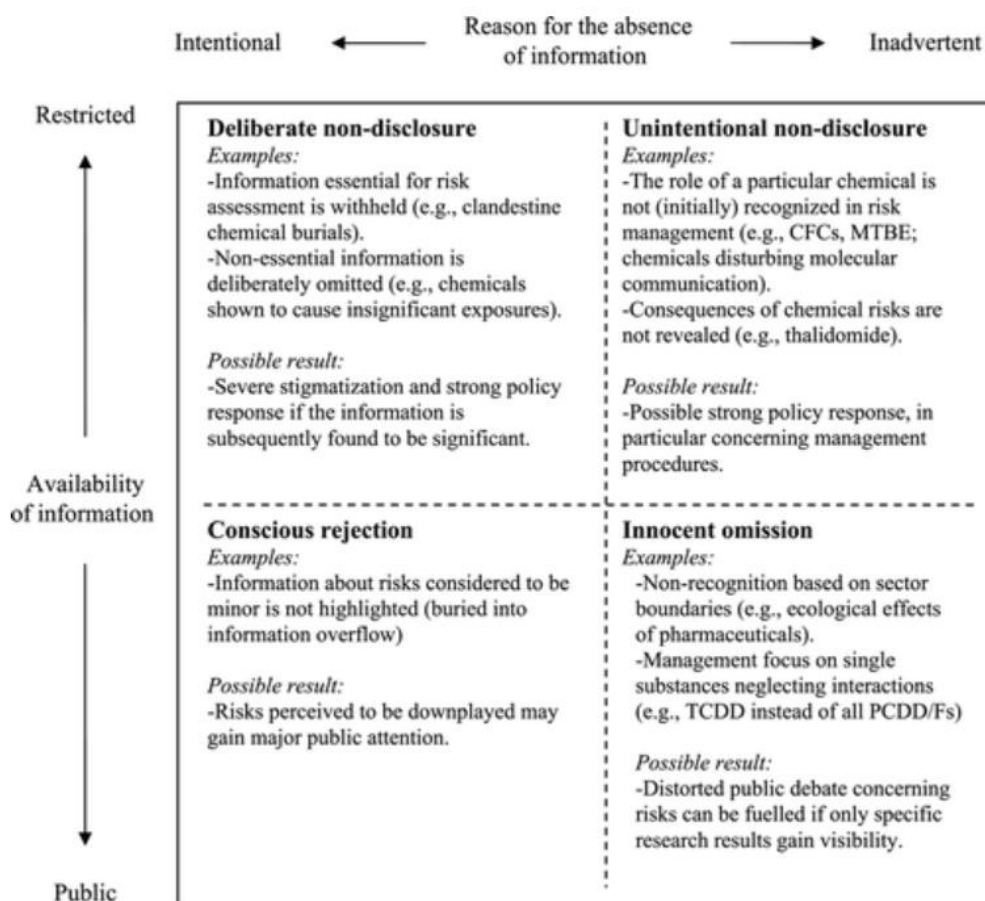


Figure 2 The typology and examples of forgetting and non-recognition related to assessment and management of chemical risks, and likely policy responses.

Some chemical risk issues can be forgotten and remain hidden because of structural biases that are difficult to recognize. Structural bias is, for instance, often induced by an expert's position in

the professional community (Assmuth et al. 2007). Different chemical risk assessment conventions have evolved between fields and even sub-fields (such as toxicology and epidemiology), reflecting the sensitivity of modes of recognition and judgments to socio-cultural influences. In the field of practice, a parallel structural and contextual biasing factor is the division between sectors of governance that may leave some chemicals and risks unattended.

Cumulative chemical risks are particularly challenging since they may remain unintentionally omitted even when public information is available, simply because there is a lack of processes and frameworks that would bring together pieces of disparate information. On the other hand, the aggregation of deliberate acts of forgetting that may all be rational in their own limited context causes such unwanted unawareness. Overcoming this type of unintentional forgetting requires a revision of the framing of the problems by many different experts. Broader framing may cause chemical risks to either stand out or to be diminished in comparison with other risks. In the latter case, conscious forgetting can be justified if the chemical risks do not have particular qualities or strong synergies with other risks.

Different assumptions, conceptions, and values underlie much of the different views about risks also among chemical risk experts (Sjöberg et al. 2005; Fromm 2006; Assmuth et al. 2007). This is reflected in the different risk management or governance cultures and policies (Jasanoff 2005). For example, although a majority of the experts of chemical risks believe that extrapolation from test animals to humans can provide useful estimates of chemical risks (Assmuth et al. 2007), there is always the residual question of the relevance and applicability of such information, which cannot be resolved by clear-cut scientific grounds.

4.2 Time factor: persistent, transient, and recurring chemical risks

Chemicals that cause persistent risks make a particularly important group for risk communication and policy. Especially the lessons from decades-long problems with DDT, polychlorinated biphenyls (PCBs), dioxins and furans, and heavy metals (notably methyl mercury and lead) have served as a standard argument for precaution in the sense of avoiding lagged cumulating risks (Harremoës et al. 2001; Assmuth and Jalonen 2005). Thus, they have also served as a 'memory aid' of chemical risks more generally. This memory is institutionalized through international actions and organizational structures such as the 2001 Stockholm Convention on Persistent Organic Pollutants.

Strong memories of the persistent and bioaccumulating chemicals may, on the other hand, detract attention from other types of chemicals that have different characteristics, but under some conditions, they represent a greater risk. The observation of adverse changes in the environment can trigger searches for persistent organic pollutants (POPs) even when rapidly metabolized substances such as pharmaceuticals are the culprit. For example, endocrine disruption in wildlife can be due to hormone therapy products, instead of persistent organochlorides with weak hormonal activity (Assmuth and Louekari 2001). Among POPs themselves, a sustained preoccupation with substances already included in the lists of the Stockholm Convention and other regulatory mechanisms, while serving the continuity of action, can hinder focusing more proactively on POPs carrying increasing risks, such as brominated compounds (de Wit 2002). Such 'new' compounds (sometimes old but recently noted) are in any case dealt with in a setting framed by the already heightened risk awareness, communication, and management that have resulted from earlier pollutants.

Chemical risks that have been previously prominent but subsequently forgotten in the public sphere may re-emerge into headlines. For instance, amid the media coverage heightened by EU restrictions on marketing fish with high dioxin contents, the fact that the average exposures to and risks from dioxins are now but a fraction of the peak levels around 1970 has received relatively little attention (Assmuth and Jalonen 2005; Figure 3). When the peak in the perceived risk follows decades after the actual peak in risks, a deliberate rejection of information would be a justifiable management goal, but it is difficult to implement in practice. It is often claimed or implied that sustained attention is in place either due to new aspects of the risks in question (such as new evidence of effects, also lagged ones) or as a warning for more or less related other risks (such as rising 'new' dioxin-like compounds). The latter argument is problematic, as it may lead to indiscriminately extended warnings. The complexity of dioxins and dioxin-like compounds also in terms of structures contributes to lingering concerns and to a long process of forgetting.

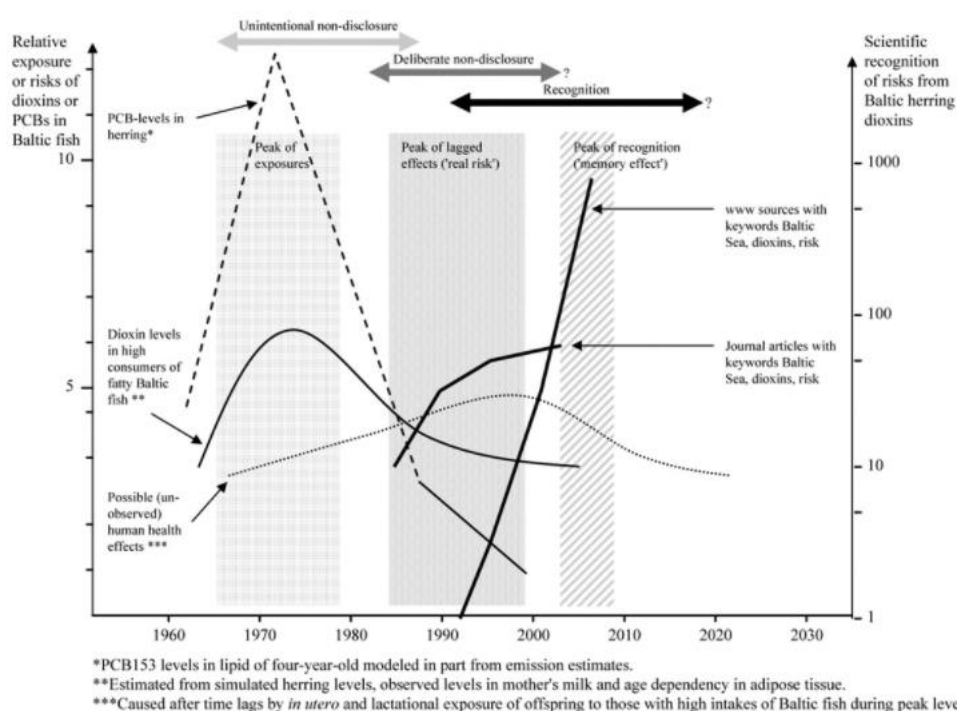


Figure 3 Proxies of time trends in risks from chlorodioxins and PCBs in Baltic Sea fish (modified from Assmuth and Jalonen (2005) based on various sources) and of their scientific recognition.

Many industrial and consumer chemicals, biocides, and pharmaceuticals are reactive and not persistent, and have gone through a rapid onset and offset of usage that is followed by rapid decline of exposures and risks. However, such chemicals may also re-enter collective recognition and memory. For instance, many chemicals that were noted for their acute toxic endpoints have resurfaced due to new studies, i.e., increasing recognition in the scientific realm. Indications of new effects (Assmuth and Louekari 2001), types of exposure, or reaction products may trigger media coverage or other attention and thus bring chemicals back from oblivion into the public sphere. Also, the old risks of the same chemicals are then likely to be remembered.

Risks associated with dramatic chemical accidents, such as those in Seveso and Bhopal, easily cause more alarm and memories than their magnitude alone may warrant, and may become symbolic representations of chemical risks in general. There are institutional ways to maintain the

memory of these events, e.g., naming the EU Directive 82/501/EEC on industrial accidents, the Seveso Directive serves this purpose. It can be expected that in a long, variable, and partly random process of social learning, lessons of old chemical risks and even of fears that did not materialize serve as signposts, although at the same time becoming non-specific and attached to chemicals and risks more generally. This means that although lingering and inaccurate 'phantom' risk perceptions may be seen as a problem for informed risk communication, e.g., by shifting attention away from some other risks, they cannot be dismissed completely as irrational and outdated.

The lingering and sporadically elevated awareness, the accrued information, and the persisting communication about chemical risks allow only partial forgetting. When, e.g., chemical risks related to food are reassessed and introduced frequently into news, the public may be confused (Caswell 2006). Against this background, it is no wonder that most experts of chemical risks feel that the media exaggerates risks and should give more detailed information to the public (Assmuth et al. 2007). However, as suggested by the 'quantity of coverage theory,' a great amount of publicity is likely to increase uncertainty regardless of the level of detail in the environmental news stories (Mazur 2006). Thus, the increase in detailed media coverage on risks is likely to lead to a public apprehension of inadvertent rather than intentional absence of risk information.

5 Implications for assessment, policy, and participation

The need to assess risks appropriately, and to carefully plan risk communication and abatement, can be used as an argument for deliberate restriction of information. For example, health authorities and other experts often reason that communicating minor health risks might cause unnecessary worries or panic among the public (Caswell 2006). Along this line of reasoning, supported by many experts of chemical risks (Assmuth et al. 2007), resources are better used on other risks that are considered more important. In the case discussed in Section 4.2, benefits of chemical-contaminated foods such as oily fish or mother's milk are emphasized to enable a balanced diet (Assmuth and Jalonen 2005). Such controlled deliberate and intentional non-disclosure requires, however, that the actors trying to exert the control have meaningful ways to compare risks with other risks and with benefits, a requirement that is not easily fulfilled due to the multi-dimensionality of such comparisons, especially with risks and benefits that are complex, uncertain, and ambiguous (Finkel 1996).

Risks may have particular qualities such as irreversibility that preclude dropping them from social memory. This is a key basis for precautionary regulation of POPs and endocrine disrupters, along with the basis that some 'stealth' risks are not easily recognized and never even enter social memory. However, precaution also has other effects than reducing an identified or presumed risk, and may need to be extended to cover adverse effects of risk reduction (Starr 2003). Sandin et al. (2002) argued that although counterveiling risks may increase most easily if assessment is too narrow, this does not constitute a fundamental challenge to the precautionary principle. Nevertheless, at some point, even prolonged risks may need to be forgotten to tackle other risks, such as emerging POPs. The difficulties in these choices contribute to erratic public perceptions and long-lived concerns even when deliberate forgetting and absence of the issue would be justified.

Risk-averse parties such as environmental and consumer organizations and activists often suspect deliberate non-disclosure of risks, such as those from toxic effects of chemicals (Mazur 2004; Muggli, Hurt, and Becker 2004). Transparency is a natural response to this. For instance, the EU's

REACH Regulation (EC 1907/2006) attempts to respond to this concern, e.g., by procedures aiming at disclosing information even if perceived unfavorable by its detector (Fisher 2008; Assmuth, Hildén, and Craye 2010). However, as the responsibility for both data generation and assessment is shifted to industry and as they are constrained by confidentiality, there are potential problems for recording, processing (e.g., evaluating transparently), and recalling risk information.

One corrective mechanism is that registration of chemicals may induce others to explore the existence of adverse effects, especially if purposeful negligence is suspected. This can lead to the other extreme, trying to prove only the adverse effects. There is an inherent reason for this: toxicological studies usually set out to find adverse effects more strongly than their absence, and the latter is not considered as publishable. This publication bias has been acknowledged among experts and stakeholders (Assmuth et al. 2007). However, the processes differ widely, depending, e.g., on the access to information and freedom of expression. Developing rapid assessment methods that provide sufficient results for defined management needs would offer a partial solution to dealing with prolonged or recurring and uncertain and complex risks (Assmuth and Hildén 2008), but experts on chemical risks seem to have divided opinions about whether it is possible to develop such methods (Assmuth et al. 2007).

The attempts by the chemical industry to undermine Rachel Carson's claims in *Silent Spring* (Kroll 2001) are a classical example of purposeful rejection of information on chemical risks. There are many other examples of initial denial of adverse effects and withholding of information, such as the case of methyl mercury poisoning epidemic of Minamata (Japan) (Yoshida 2007). The effects of this purposeful lack of recognition have turned out to be significant, also impairing the credibility of the chemical industry (and in some cases regulators). The industry has since become more concerned for the stigmatization of its products and keen on avoiding the onset of fears, e.g., by developing practices such as 'responsible care' (King and Lenox 2000). Such practices aim to demonstrate not only that intentional forgetting against public interest is ruled out, but also that unintentional and accidental lack of recognition or forgetting of relevant information is minimized.

Policy interventions that aim at avoiding forgetting can be efficient. Pollutant emission registers such as US Toxics Release Inventory (<http://www.epa.gov/tri/>) and the European Pollutant Emission Register (<http://eper.ec.europa.eu/eper/default.asp>) exemplify this. Registers of toxic effects of chemicals also promote recognition of their risks, although most of this information is not localized. Fung and O'Rourke (2000) argue that a key factor explaining the success of the mandatory disclosure of pollutant releases is that it makes available information that previously was not accessible. Such publicly available and regularly updated registers make it more difficult to intentionally omit risk information and keep the issue from falling into oblivion. Registries are designed to avoid forgetting but have limited coverage and duration. There is constant debate within and between sectors, actors, and levels of governance on the emphasis and obligations of information gathering, processing and sharing to reduce forgetting. Sooner or later, such registers become downsized or merged, and finally discontinued or obsolete, and new ones emerge. The question becomes not only which ones should be continued, but also how to utilize a series of isolated memory systems, e.g., by ensuring their compatibility and extracting their essential contents.

6. Summary and conclusions

The absence of information has both positive and negative aspects. Risks need to be forgotten, as there are a myriad of risks and as excessive worry about them is counterproductive (Douglas and Wildawsky 1985). The 'finite pool of worry' hypothesis suggests that increase in worry about one risk may result in decrease in worry about other risks (Linville and Fischer 1991), and this is supported by the cases discussed previously. On the other hand, forgetting minor risks can be dangerous if it leads to the decrease in preparedness for other risks. As detailed in our analyses, the implications of absent information will depend largely on the perceived significance of risks and thus on the context and on those involved. Also, the process of dealing with the risk information plays a role; if it is conscious, transparent, and deliberate, the persisting and legitimate lessons from the risk communication are more likely to be achieved.

Inevitably, more is forgotten than remembered about risks. By paying more attention to what kind of information is absent or forgotten, we may find ways to improve risk communication, which is needed especially in dealing with uncertain and ambiguous cumulative risks caused by multiple stressors. The analysis of categories of absent information in the field of chemical risks shows that simply producing more information is unlikely to alone lead to better communication on risks. The dynamic processes of disclosure, rejection, forgetting, and recognition operate continuously and on many levels in individuals, groups, organizations, and institutions, depending also on the type of risk and risk information in question. Both increasing and decreasing risk factors can become forgotten or accustomed to, as social amplification of risk and associated risk aversion interact with and are constrained by social attenuation of risks (Douglas and Wildawsky 1985; Kasperson et al. 1988). Risk qualities and communication contexts thus influence recognition.

In a risk society as postulated by Beck (1986, 2006) and critically elaborated by others (Mythen 2007), new risks appear in public discussion faster than it is possible to evaluate them thoroughly. Partly due to heightened risk awareness, alarming and dramatic interpretations of new information on chemicals have been prominent (Bickerstaff 2004; compare also Slovic 1987; Sjöberg et al. 2004; Mazur 2006). Often, repeated public warnings may also cause indifference or even denial toward potential hazards. In other words, too much information may paradoxically increase rejection or forgetting of public information. On the other hand, denial can take dramatized forms in media and other debates when skeptical views of risk claims are presented.

In some cases, there may be a negative correlation between scientific evidence and policy attention, e.g., when risk communication and policy-making address poorly known new risks which on subsequent evidence are evaluated to be minor, or in contrast, when new scientific findings dispel the ignorance and doubt. The former case may become more frequent in the wake of more common adoption of the precautionary principle, whereby attention is put precisely on conceived risks for which there is scarce evidence (Starr 2003; Wiedemann and Schütz 2005). This has structural effects on the processes of generating, using, and retaining information, but these effects are poorly known (Sandin et al. 2002; Grandjean 2004). The precautionary approach focuses on the earlier warnings that turned out to be true, but it tends to ignore false alarms (cf. Mazur 2004). Reliance on precaution, while needed especially with severe, irreversible, long-term risks, may provide less incentive for providing detail and proof and for arranging deliberation, and can thus weaken social memory in the long term.

Consideration of different forms of absent information helps us to understand why risk communication easily ends up with frustrated experts and concerned but confused public and policy-makers. As our discussion has shown, there are various forms of and reasons for the

absence of risk information. These include unawareness of missing knowledge, attempts to avoid overloads of information and unnecessary panic and attempts to safeguard self-interests. We also have shown the importance of the risk and the context for the processes and implications of forgetting. These results and detailed challenges point out to broader and more nuanced assessments of multiple risks and consequences that would pay more attention to the dynamic processes of recognition and lack of recognition of information.

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