



# Creating conditions for critical trust – How an uncertainty-based risk perspective relates to dimensions and types of trust

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## A B S T R A C T

Although some disagreement about the strength of the relationship, it is generally agreed within risk research, that trust plays a central role in shaping risk perception and risk responses. Over recent decades, risk managing institutions have experienced what by many has been described as a decline in public trust. Strategies like stakeholder involvement and communication of scientific uncertainties are increasingly implemented to rebuild levels of trust but often prove less effective. Also, trust-related research mainly revolves around the relation between regulators and authorities, on one hand, and the public, on the other, with less attention given to the role of the scientific risk assessor. In this paper, we argue that assessors can act to improve conditions of trust by adopting an understanding of risk, stressing uncertainty and knowledge aspects when conceptualizing and characterizing risk. While ‘full’ trust commonly is seen as an ideal situation and distrust as a state of affairs to be prevented, this approach involves recognizing distrust as a resource. Based on an example regarding the authorization and regulation of a feed additive and the Social Amplification of Risk Framework, we show how such a perspective affects trust, both as a filter for processing, interpreting and responding to risk-related information and as an impact following such processes. Drawing on a typology of trust, we also illustrate how this relates to different dimensions and forms of trust.

## 1. Introduction

Trust presupposes a situation of risk (Luhmann, 2000) and involves a choice to make oneself vulnerable to another entity (Earle et al., 2012). In risk research, there is a general understanding that trust affects how one understands and perceives risks and risk events, and how these are responded to. However, there is some disagreement about the strength of this relationship. Where this relationship historically seems to have been approached in deterministic and causal terms, it now appears to be more and more researched based on an associationistic understanding (e.g. Eiser et al., 2002; Poortinga and Pidgeon, 2005), in which trust is seen only as indicative of risk perception. Simultaneously others find a low correlation between the variables of trust and perception (e.g. Sjöberg, 2001). Nonetheless, trust is commonly associated with acceptance of risk-related messages, compliance and effective functioning of democratic processes and societal functions. Distrust, on the other hand, is often related to heightened public concern, risk amplification, questioning of the work of risk regulators, risk reduction or avoidance and selective use of information sources (Walls et al., 2004).

Today, many risks are regulated and managed in what has been characterized as a landscape of social distrust (e.g. Tuler et al., 2017; Leisinger, 2016; Lofstedt, 2004, 2013; Albach et al., 2016; Frewer,

2017). Public distrust has been described as a key issue in research related to European health scares and regulatory food and feed scandals, such as the BSE (Bovine Spongiform encephalopathy) crisis (e.g. Lofstedt, 2004, 2013; Lofstedt and Schlag, 2017) and the use of GMOs (Genetically Modified Organisms) (e.g. Gaskell, et al., 2000; Albach et al., 2016). In response to such risk events, and first and foremost the BSE crisis, institutions like the European Food Safety Authority (EFSA) were established to provide independent scientific advice on food safety. However, the creation of EFSA and the functional separation of risk assessment from risk management did not increase public trust in those responsible for risk analysis (Frewer and Salter, 2010; Jensen and Sandøe, 2002). The public distrust in the motives of regulators, science and industry has been associated with the failure to take into account public concerns when assessing, managing and communicating about risk (e.g. Frewer and Salter, 2010; Jensen and Sandøe, 2002; Wynne, 1989).

Many reasons for public distrust have been proposed; among other the lack of acknowledgement of public reflexivity and capability to evaluate science (Barber, 1983; Nowotny et al., 2001; Wynne, 2001; Lidskog, 2008); ignorance of local knowledge, competence, concerns and values (e.g. Wynne, 1989; Frewer and Salter, 2010; Jensen and Sandøe, 2002); differences between laymen and expert risk perspectives

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(e.g. Wynne, 1989; Kasperson et al., 1988; Slovic, 1993); vested interests and close ties between scientists and industry (O'Brien, 2000; Frewer, 1999; Frewer et al., 1996; Jasanoff, 2009); and failure to recognize the more relational and emotional character of trust (Wynne, 1992; Engdahl and Lidskog, 2014). The reported fall in trust in European food safety regulators has been described as representing a change from an era of trust toward an era of post trust, where main risk communicators are increasingly distrusted by consumers (e.g. Lofstedt, 2004, 2013).

However, the idea of declining public trust has also been drawn into question. Van de Walle et al. (2008) have stated that the claims of public distrust held by policy makers and academic scholars were based on insufficient opinion poll results and data, and Raaphorst and Van de Walle (2018) have claimed that "evidence of declining trust can be complemented by an almost equally substantial body of evidence of stable or increasing levels of trust". Siegrist (2019) recently reported that findings from longitudinal studies showed trust to be a more stable phenomenon across time than previously supposed in much risk literature. Wynne (2006) used the term 'Public Mistrust Myth' and argued that the conventional wisdom stating that until the BSE risk event the European public trusted science and scientists should be rejected.

Despite dissent within the scientific community about the decline or stability of trust and the strength of the relationship between risk perception and trust, the idea of the existence of public distrust in today's society still influences much research and dominates the political discourse and work of many governments, policy makers and risk managing institutions. Strategies like stakeholder involvement, public participation and communication of scientific uncertainties in risk governance processes are increasingly drawn upon in order to rebuild or increase levels of public trust. However, in practice, these strategies have yet to produce the expected effects on trust. Following the above statement of Wynne (2006), such attempts at rebuilding trust, can be seen as attempts at rebuilding something that never may have existed. Or, as we propose in this paper, it may be the case that what we are 'talking about' are not expressions of trust or distrust, but of something more complex and multidimensional, and that trust or distrust is not necessarily descriptive of how the public perceive and relate to risk managing institutions and information coming from these. This is in line with research of Poortinga and Pidgeon (2003) demonstrating the co-existence of trust and distrust in the public perception of government and its policies, and of Walls et al. (2004) holding that "The binary opposition of trusting or not trusting is inadequate to understand the often ambiguous and contradictory ideas people possess..." (Walls et al., 2004, p. 133).

In practical attempts at creating or rebuilding trust the complexity of the trust concept does not seem to be fully understood or appreciated. The dominating understanding of trust and distrust is as two mutually exclusive states and of 'full' trust as a complexity-reducing factor in society and an ideal 'state of affairs', and of distrust as the opposite: a negative and complicating factor and situation that should be prevented or counteracted. We argue that for stakeholder involvement and deliberation initiatives to positively affect what is commonly described as trust, it is of importance that distrust is understood and related to in more positive terms. This corresponds in different ways with the ideas and statements of previous research. Following Barber (1983), distrust can be effective, with a certain amount of distrust being necessary for political accountability in a participatory democracy. Similarly, Tuler et al. (2017) hold that distrust serves important functions, for instance ensuring social and political oversight, generating alternative control mechanisms and holding in check the power of elites and technical experts. A balance between trust and distrust is critical to public acceptance of risk-related decisions and their implementation (Short, 1992).

Different frameworks for studying trust and distrust exist. The Social Amplification of Risk Framework (Kasperson et al., 1988) provides one such representation. It provides a detailed description of how risks and risk events can have significant and unexpected impacts on trust and may generate effects that also spread to affect perceptions and levels of

trust of other previous unrelated risks. Issues of trust are highly inter-related with mechanisms and components of amplification dynamics, but a host of questions surrounds the interpretation of trust and its effects (Kasperson et al., 2003). According to Kasperson (2012), there is an urgent need to understand how trust is shaped, altered, lost and rebuilt in the processing of risk-related information in social amplification research. Following Tuler et al. (2017), independent scientific expert assessments merit special attention in confronting 'conundrums' relating to trust and are of particular importance in climates of social distrust. The use and communication of risk assessments and related results can impact trust in different ways. Jensen and Sandøe (2002) have for instance connected public distrust to the presentation of food safety issues as purely objective scientific events and to a form of risk communication based on a notion of risk that does not take account of the public's perception of food risks and the complex value questions involved in food production. Yet, the main body of research and work concerning trust focuses on the relation between risk managing authorities and the public, and less attention has been paid to the role of the risk assessor in this context. In this paper, we 'turn the lens' towards the scientific risk assessors and the risk assessment process and show how assessors can act to improve conditions of trust, by adopting what we refer to as an uncertainty-based perspective on risk. This means broadening the understanding of risk compared to more traditional and probabilistic approaches where risk commonly is defined in more narrow terms as the combination of a set of consequences and the associated probabilities. Such an understanding particularly entails emphasizing uncertainties and knowledge aspects when conceptualizing and characterizing risk. Adopting such a perspective enables approaching distrust as a resource, a different angle than in most risk assessment and risk managing contexts.

This way of relating to distrust requires an acknowledgment of the complexity of the trust concept and that distrust and trust are not 'either or' states. Walls et al. (2004) argue that trust and distrust exist along a continuum, ranging from critical emotional acceptance at one end of the extreme to downright rejection at the other. In between these two extremes on the continuum of trust lies what is defined as a healthy type of distrust, reflecting that the public can rely on institutions and at the same time possess a critical attitude towards them. To illustrate the multidimensional and complex character of the trust concept, we draw on the typology of trust put forward by Poortinga and Pidgeon (2003). In a study of public trust in governmental risk regulation, Poortinga and Pidgeon found that different degrees of trust coexisted with different degrees of skepticism. The typology combines varying degrees of the two independent dimensions: general trust and skepticism, into different categories of trust; see Fig. 1. The dimension of general trust covers aspects of competence, care, fairness and openness, while skepticism, the second dimension, concerns a skeptical view of the process by which policies are brought on and put into practice and includes the credibility and reliability of the enactor. Skepticism also includes the 'vested interest' factor, put forward by Frewer et al. (1996) as a measure of integrity, and has an affective character. The typology ranges from full trust (acceptance/trust) to deep distrust (rejection/cynicism). The category of trust called critical trust in the typology is similar to what Walls et al. (2004) describe as a healthy form of distrust. Critical trust is defined in Pidgeon et al. (2010) as a practical form of reliance on a person or institution combined with a degree of skepticism.

Where the typology of trust originally was constructed to describe how the public perceives government and its policies, we use it to analyze the relations of trust between the different actors involved in risk assessment and regulatory processes. In this context, special attention is paid to the skepticism dimension of the trust concept and the role of the risk assessor. Based on an example concerning the authorization and regulation of the feed additive, narasin, and related risk events, and on the Social Amplification of Risk Framework (SARF), we show how the introduction of an uncertainty-based risk perspective in theory relates to and can impact different dimensionalities and types of public trust

<b>Level of general trust (Reliance)</b>	<i>High</i>	<b>Acceptance (trust)</b>	<b>Critical trust</b>
	<i>Low</i>	<b>Distrust</b>	<b>Rejection (cynicism)</b>
		<i>Low</i>	<i>High</i>
<b>Level of scepticism</b>			

Fig. 1. Typology of trust (based on Poortinga and Pidgeon, 2003).

(Fig. 1) both as a filter for processing, interpreting and responding to risk-related information and as an impact following such processes.

The rest of the paper is based on the following structure. In addition to some other examples related to food and feed risk, the narasin case is used throughout the paper to illustrate the discussion. In Section 3, we analyze the case based on the stages and the structure of the SARF. We show how the different actors involved in the authorization process relate to, understand, make use of and respond to risk-related information and data, while relating the findings to different aspects and types of trust. We also discuss the impacts on trust across shorter and longer time horizons. In Section 4, we conduct a thought experiment, showing how an uncertainty-based risk understanding theoretically impacts levels and relations of trust in the example. Here, we perform the same analysis as in Section 3 and pay special attention to how this potentially affects the understanding and interpretation of data, information and knowledge, how risk-related information is used, communicated and responded to. The outcomes are related to the different categories and aspects of trust, as described in the typology of trust. Based on this twofold analysis, we provide some final conclusions and recommendations in Section 5.

## 2. The narasin case

The narasin case covers a set of risk events, spans a period of many years and is separated into two parts or stages. The first part concerns the authorization of and direct regulatory responses to the risks related to narasin, an additive (coccidiostat) used in poultry feed. The second encompasses the communication, interpretation and broader societal responses to messages of risks and risk events in Norway in the period stretching from 2006 to 2016. This part of the case is further divided into two sub-phases, the first of which comprises the years of 2006 and 2012, while the second covers the years from 2014 to 2016.

It must be noted that there have been some recent developments in EFSA practices regarding stakeholder involvement in food and feed risks and the development of guidelines regarding transparency and reporting of uncertainties within risk assessments. The case in the paper does not cover these developments; it concerns only risk events and the situation up to and including 2016.

### 2.1. Part 1 of the case

The first part of the case mainly concerns the authorization process of the European Union, concerning the risks related to the use of narasin. Following Commission Regulation (EC) No 1464/2004 (EFSA, 2004), narasin is authorized as a feed additive for chicken fattening, with a maximum content of the active substance in feed of 70 mg/kg. When a company wants to put a product containing narasin on the market, it

must apply for authorization. As part of this process, following Council Regulation 2003/1831/EC (EC, 2003), the applicant company must provide all data required for toxicity assessment and hazard characterization related to the various target animal species for which the product is to be used. Information is required on the toxicological profile of the additive, control methods, conditions for use and data demonstrating efficacy and safety (Dorne and Fink-Gremmels, 2013). FEEDAP, EFSA's panel on additives and products or substances used in animal feed, reviews the information submitted by the applicant company and conducts assessments in which product efficacy and safety related to the environment and to human- and animal health are examined. When assessing the risks, estimated exposure levels are compared to acceptable daily intake limits (ADIs), to conclude on human health risks (Dorne and Fink-Gremmels, 2013) and propose maximum residue limits (MRLs). These FEEDAP assessments are to a large extent based on the data provided by the company applying for authorization and commonly show estimated exposure below threshold values (ADIs) and conclude that narasin does not have any adverse effects on animal or consumer health or the environment. When EFSA's opinion is favorable, the European Commission prepares a draft regulation to authorize the additive.

### 2.2. Part 2 of the case

#### 2.2.1. Phase 1

In the second part of the case, the focus is the communication and consequences of messages of risks related to narasin in a Norwegian setting. For all coccidiostats except one (nicarbazin), Norway complies with EU decisions and regulations. This represented the regulatory background, when the media in 2006 reported that residues of the "forbidden drug" narasin were found in two egg samples in Norway. In responding to these findings, the feed producer stressed that 99 percent of the feed for egg-laying hens was produced under safer conditions (Rasmussen, 2006) and that this probably was a one-time occasion of cross-contamination (Totland, 2006). Shortly after these responses, the issue disappeared from the media.

In 2012, the media again brought reports of the risks related to narasin as antibiotic-resistant bacteria were found in 32% of Norwegian chicken fillets and narasin in 8 egg samples (Norwegian Food Safety Authority, 2012). The authorities responded to the risk messages by referring to existing EU legislation and focused on the fact that concentrations of narasin in most egg samples, except one, were below threshold levels values and therefore safe to human health. The authorities and the industry attributed the bacteria findings to the import of breeding material and pointed to the low level of antibiotic-resistant bacteria in Norwegian chicken, relative to other European countries. Again, the media put the issue to rest briefly after these responses.

### 2.2.2. Phase 2

In 2014, the risks related to narasin and antibiotic-resistant bacteria were again brought to public attention. Antibiotic-resistant bacteria were detected in 70% of chicken fillets in Norwegian grocery stores. This time, the findings received considerable media coverage and were followed by a long-lasting debate, in which different stakeholders communicated conflicting opinions and concerns. Some scientists and medical professionals claimed that the use of narasin should be banned and that chicken should be labeled as a risk product (e.g. Sunde, 2014; Gjessing, 2014; Midtvedt, 2014, 2015), whereas risk managing institutions stressed that the risk of bacteria transference was small, as long as recommended hygiene and cooking advice were followed (NFSA, 2014). The Norwegian Scientific Committee for Food Safety conducted new risk assessments judging the probabilities of consumer exposure to coccidiostats and to resistant bacteria in heat-treated chicken meat to be negligible (Nesse et al., 2015). However, despite authority assurance that chicken consumption was safe, demand for “narasin chicken” dropped significantly and, soon after, industry actors started phasing out the use of narasin in chicken feed. Public response brought about substantial changes in chicken production and also came to affect other sectors (e.g. public health, seafood) and influenced national strategies and goals.

### 3. Traditional, probabilistic approaches correspond with low levels of skepticism and high levels of trust

In traditional approaches to risk, risk is conceptualized and characterized as the combination of the consequences (C) of an activity and the related probabilities (P), often summarized by the expected consequences (loss),  $E[C]$ , i.e. the sum of the product of the various outcomes multiplied with the associated probabilities. A typical perspective adopted is the risk triplet of Kaplan and Garrick (1981), reflecting i) what can happen? (i.e., what can go wrong?) (events/scenarios A), ii) if it does happen, what are the consequences? (C) iii) How likely is it that that will happen? (P). Risk is thus described by (C,P), (A,C,P), or  $E[C]$ .

The probabilities are often estimated based on historical, statistical data and measurements concerning the occurrence of similar or related activities. The probability is often interpreted as an objective property of the activity being studied. In the following, we show how such a traditional probabilistic understanding of risk is related to different dimensionalities and types of trust in attenuation and amplification processes, as described in the SARF. First, we approach trust as a cognitive mechanism or filter affecting the processing, interpretation of and direct responses to risk-related information, whilst relating the discussion to risk assessment, decision-making and risk management processes in the first part of the case. Then, we move on to the second part of the case and explore the impacts on public trust over different periods of time.

#### 3.1. Effects of trust on the processing, interpretation of and responses to risk-related information

##### 3.1.1. Risk assessment

As information about a risk or a risk event is communicated from a source to a receiver, this information may be amplified or attenuated in different ways. This commonly happens by the intensification (amplification) or weakening (attenuation) of signals, symbols or aspects in the information and as the messages pass through selection filters, serving to sieve information and signals in the information (Kasperson et al., 1988). Although trust is not explicitly addressed in the original SARF, processes and mechanisms in the framework are closely linked to issues of trust. In the filtering process, levels of trust and of skepticism work as filters for incoming risk messages and information. Within this process, both signals in the message and the source of the message are perceived. Information produced by or that comes from sources that are trusted and seen as credible tends to be accepted and to pass through selection filters

more easily than information from sources that are not trusted (Kasperson et al., 1988). Similarly, Lewicki and Brinsfield (2011) and Cummings (2014) have argued for understanding trust as a heuristic. Lewicki and Brinsfield (2011) describe trust and distrust as cognitive frames aiding the interpretation and organizing of new experiences. Once a trust/distrust frame is formed it functions as a shortcut for decision making. Other cognitive mechanisms, shortcuts and heuristics also affect this filtering process, for instance the fact that we tend to reject or disregard information that contradicts our prior beliefs and to pay more attention to data that correspond with or reinforce our pre-existing values and ideas (e.g. White et al. 2003) and that disproportionate attention often is given to negative information over positive information (Poortinga and Pidgeon, 2004; Siegrist and Cvetkovich, 2001). In addition to affecting the processing and filtering of risk-related information, dimensions and forms of trust also impact how this information is interpreted and responded to.

In the authorization procedure related to products containing narasin, as sketched out in Section 2.1, risk-related information produced by the Applicant Company (AC) is communicated to the European Food Safety Authority (EFSA). The FEEDAP, EFSA's panel on additives and products or substances used in animal feed, reviews the information from the AC and conducts a risk assessment. The assessments are performed based on the ADI-MRL approach (Mantovani et al., 2006): To conclude on human health risks and propose Maximum Residue Levels (MRLs), estimated exposure to narasin is compared to acceptable daily intake limits (ADIs) (Dorne and Fink-Gremmels 2013). In the assessments, estimates showing exposure below MRLs are interpreted and presented as low probabilities of adverse consequences and as representing no or low risk. The FEEDAP risk assessment is conveyed to the European Commission (EC) in the form of EFSA's scientific opinions on the licensing and regulation of certain products.

The SARF shows that, as information travels from a source/transmitter to a receiver, it sometimes also passes through an intermediate transmitter. In the example related to narasin, the AC (the risk producer) and the EFSA/FEEDAP (the risk assessor) may ‘at first glance’ appear as separate sources or transmitters of risk-related information. But, as the risk assessment to a large extent is based on data generated by the applicant, the AC may be considered the primary source of information and EFSA as an intermediate transmitter that information travels through on the way to the EC (the decision-maker and risk manager). However, independent of who represents the main source of information, the point here is that both transmitters, including the receiver, engage in attenuation of the risks related to narasin, although in different ways, and that these attenuation processes are connected to levels and types of trust between the actors involved in the authorization process. The importance of addressing trust in such contexts is also underscored by Adekola (2019). She points out that the SARF focuses on “who” (sources, transmitters etc.) and the nature of the risk-related information, but that it is crucial to also study underlying social and institutional factors such as trust and power when studying risk amplification and attenuation.

The relations between the actors in the authorization process – the risk producer, risk assessor and risk manager/regulator – are characterized by what seem to be relatively high levels of trust. In this context, trust can be seen as an expression of confidence between parties in an informational exchange transaction. Trust plays a role in how much weight is assigned to information received from a source (Mase et al., 2015). Adopting the more multidimensional understanding of trust to this context, as proposed by Poortinga and Pidgeon (2003), allows further distinctions between different aspects of trust when analyzing the relations between these actors. The way the risk assessor (FEEDAP) more or less automatically seems to accept and heavily rely on the information and data provided by the applicant points in the direction of a low ‘score’ on the dimension concerning skepticism of risk-related information. Risk messages and information pass through the selection filters of the scientific assessor and appear to go through what Cacioppo



and Petty (1984) describe as the peripheral route. This route of decoding and processing information utilizes external cues, like trust, credibility or familiarity of source, in ways that allow recipients to make simple inferences and judgments about the content value, without further elaboration, scrutiny or in-depth processing.

The FEEDAP/EFSA does not appear reflexive of or skeptical of data used in the risk assessment. The fact that a large proportion of the information used in the risk assessment does not come from an objective source and that 'vested interests', agendas and perspectives of the risk producer may color data do not impact risk characterization or final risk judgment. Van Asselt et al. (2009) found similar tendencies concerning authorization of GMOs, processes equal to those related to narasin. In the GMO case, the assessments conducted by applicant companies, in this case Monsanto, were phrased in a language of safety. Here, the risk producer appeared dedicated to proving zero adverse effects, and the assessments were described as "deliberate attempts to transform risk into absolute certainty of safety". Assessments by EFSA's GMO Panel mainly consisted of reviewing data provided by the risk producer and were characterized as "de facto meta-analyses" of the assessment of the risk producer. The inclination to rely on industry data in assessment and regulatory contexts is also stressed by O'Brien (2000) in, for instance, referring to studies reviewing 600 Threshold Level Values (TLVs), where it was found that least 104 relied heavily or only upon unpublished information from corporations. O'Brien emphasizes that "...numbers representing accepted TLVs plugged into risk assessments bear the danger of being biased by political or economic factors" (O'Brien, 2000, p. 29).

Weakening, ignoring, deleting or toning down signals and symbols in information are powerful ways to attenuate risks or risk events. When information in which a language of certainty and safety is strategically used and where uncertainties and gaps of knowledge are framed as a lack of causal evidence, and pass through filters of high trust and low levels of skepticism, risks may be further attenuated. If such information is 'directed' through the peripheral route and accepted and relied upon without questioning its rationale and further investigation of uncertainties, this may contribute to transporting attenuation of risk and uncertainty signals originating from the industry and applicant companies into the 'independent' scientific risk assessments.

It can be argued that the manner of relating to information described above is closely coupled to the risk perspective of the assessor. A technical, probabilistic understanding of the risk concept is generally paired with the belief that risks can be estimated based on statistical data, even when limited. A narrow understanding of what constitutes valid information, data and science can restrict the use of diverse and balanced data and information when assessing risks. In the narasin case, we see that such an understanding of risk dominates. Statistical, heterogeneous data are used to estimate and predict future risks. Low probabilities of adverse effects on animal- and human health and the environment due to exposure to narasin are seen as equivalent to low or no risk. Uncertainty is limited to representing the difference between the risk estimate and what is believed to be the true underlying value of the risk and is accounted for by applying an uncertainty factor. Van Asselt et al. (2009) found that such a perspective of risk also prevailed in the assessments concerning GMOs. Monsanto's risk assessments followed "the famous formula of risk = probability  $\times$  effect, with zero effect meaning zero risk" (Van Asselt et al., 2009, p. 369), i.e. risk was expressed by the expected effect or consequences  $E[C]$  using the terminology introduced in the beginning of this section. A narrow understanding of what is considered scientific issues to be covered by risk assessment allowed the scope of risk assessment to be minimized and the assessor tasks in relation to uncertainties to be eased. In our example, the FEEDAP/EFSA states that data related to the use of narasin and its effects are scarce, limited and for some areas (e.g. certain tissues, aquatic environment and secondary poisoning) even nonexistent. Still, no uncertainty assessment is conducted. Nor did the EFSA's GMO Panel actively try to identify uncertainties overlooked by the risk producer. Reliance on industry data

makes assessors vulnerable to the willingness of the risk producer to disclose all relevant information and data. In only a few instances did narasin- and GMO assessors ask applicant companies for more data, but, again, informed by their own assessments, it was concluded that products were safe. Different types of data and knowledge were not sought or acquired, and uncertainties had no bearing on final risk judgments or conclusions. This approach to uncertainties is referred to by Van Asselt et al. (2009) and Weimer (2015) as the uncertainty paradox: a situation in which uncertainty is merely acknowledged but does not alter the outcome of risk assessments. Wynne (e.g. 1992, 2001, 2006) has linked this tendency to a narrow and simplistic scientific culture and understanding of what constitutes science and has repeatedly voiced a need for scientists and risk assessors to be more reflexive of uncertainties. These statements and assertions correspond with our findings of a low or inactive skepticism dimension of the trust concept.

### 3.1.2. Decision-making and risk management responses

As now seen, acceptance/trust (upper left box in the typology Fig. 1) works as a complexity-reducing filter or factor for the processing of risk-related information. It not only characterizes how the assessor relates to and makes use of information and data, it can also serve to describe the relation between the risk assessor and the risk manager/regulator, and it affects how risk messages are interpreted and responded to. In the example of this paper, we see that the interpretation and responses directly concur with the risk assessment result; authorizations are granted and the suggested MRLs are followed. The manner in which decisions on authorizations and regulations are reached indicates high levels of trust and low levels of skepticism. Again, risk messages automatically pass through the selection filters of decision-makers. This acceptance seems to be based on an understanding that risk assessment results in the form of probabilities and risk estimates represent scientific evidence that can be used as prescriptions for decisions and responses. Such an evidence- or science-based decision-making style is linked to a technical comprehension of risk, involving a belief in the objective character of data and risk assessment results, and assumes high trust in sources of information.

Van Asselt et al. (2009) also argue that the European Commission's uncritical compliance with EFSA opinions seems to be founded on an established pattern of trust. Analogous to the question concerning who in fact represented the primary source or transmitter of information in the assessments of risk related to narasin, one can ask who in fact is the real decision-maker. Our answer to this question is in accordance with the reasoning of Van Asselt et al. (2009), who state that "Since Commission decisions are based on EFSA advice, the advisory institution is the 'de facto decision-maker' and risk manager (Van Asselt et al., 2009, pp. 377-378). Even when member states reported doubt in EFSA's science and objected that assessments heavily relied upon short-term industry data and did not take into account uncertainties, the Commission turned to the same institutions and the same science for 'certainty' to justify decisions. Lofstedt (2005) also connects this technocratic decision-making style to systematic underrepresentation of uncertainties and to a tendency for risk managers to largely trust risk assessors. Experts and scientists are commonly considered highly trusted sources, and, as described, in situations where there is trust of sources, the peripheral route is likely to be used for the processing of information. Following this route, risk messages are generally accepted as valid and relied upon without going through critical evaluation or further scrutiny. Our example of the authorization procedure and practices concerning narasin illustrates this tendency and shows how high trust, paired with low skepticism of information, can contribute to transporting attenuation from risk assessment, often originating from the risk producer, over into risk management and risk-regulatory responses and processes. When 'objective evidence' represents the main or sole justification and basis for risk management decisions, this transportation of attenuation becomes even more likely.

### 3.2. Impacts on public trust

As we have seen in the above section, trust has a filtering effect on how information, risk messages and risk events are understood and responded to, but these responses and reactions can also have secondary and tertiary impacts on trust itself. What is presumed to be a minor risk or assessed by an expert as a risk or risk event with low probability of adverse consequences can still end up generating considerable amplification and significantly impact public trust. The second part of the narasin example illustrates such ripple effects. The division of this part of the case into sub-phases shows how the manifestation of such effects differs, depending on the variable of time.

#### 3.2.1. Phase 1

In 2006 and 2012, detections of antibiotic-resistant bacteria in Norwegian chicken fillets and of narasin in egg samples were reported in the media. The findings received brief and little media coverage and attention. The authorities responded to the risk messages by referring to EU legislation and regulations and focused on the fact that most concentrations were below TLVs and therefore safe to human health. The discourse was highly influenced by a technical understanding of risk, with references to risk assessment results and low probabilities of effects. Also, the authorities, risk managers and the industry downplayed the bacteria findings, by linking them to imported breeding material and pointing to low levels of antibiotic-resistant bacteria in Norwegian chicken. Reports had little or no impact on consumer trust and behavior, and demand for chicken remained stable.

These ‘non-responses’ of the consumers in this phase of the case indicate what is described by Berg et al. (2005): namely, that consumers depend on large food producing and control systems that are only partly familiar and transparent to them. In such situations, it again becomes evident how trust can function in ways already described by Luhmann in 1979: namely, as a mechanism for reducing societal complexity. Individuals rarely internalize the full array of information to which they are exposed and often choose to rely on sources they mostly trust (Mase et al., 2015). On this account, trust operates as an external cue that allows information to be ‘sent’ through peripheral routes. Trusting in such a sense can also be associated with a form of practical attenuation that allows individuals to more easily deal and cope with risks and risk events on an everyday basis.

Research shows that trust and knowledge affect risk perception together, but, when knowledge is low, limited or absent, trust takes the center stage in forming risk perception (Siegrist and Cvetkovich, 2000; Earle et al., 2012). Also Cummings (2014) state that trust can bridge gaps in one’s knowledge and facilitate making judgments. Similarly, Cacioppo and Petty (1984) find that the possession of little prior knowledge on an issue is a factor reducing recipient motivation or ability to elaborate and effortful thinking, thereby increasing the possibility of information going through peripheral routes. As mentioned, this type of message processing commonly contributes towards uncritical acceptance of information. With such peripheral processing, there is a danger that errors, distortions and knowledge gaps in risk messages are received without scrutiny. This may lead to a ‘false’ perception of risk (Adekola, 2019).

Following the development of the case, it is natural to assume that the public had little or no knowledge of narasin and its related risks prior to 2006 and 2012. The ‘non-responses’ of the public indicate that the public trusted the authorities, risk managers and regulators and saw information coming from these as reliable, and public perception of the risks stayed low. We again see a situation of acceptance/trust in which high general trust and low skepticism exist about institutions and what these communicate and or decide. This situation corresponds with an understanding in which “...‘trust’ means the acceptance of decisions by the constituents without questioning the rationale behind it” (Lofstedt, 2003, p. 419). A setting characterized by such a form of trust can contribute to upholding the status quo and maintaining risk attenuation.

The non-responses of risk managers, regulators and the public may serve to further extend attenuation into a societal drift away from focusing on feed additives and narasin as risk sources or as important issues of attention.

#### 3.2.2. Phase 2

In the case, in 2014, amplification occurred when the risks related to narasin and antibiotic-resistant bacteria were again brought to public attention. This time, the findings received considerable media coverage and were followed by a long-lasting debate in which different stakeholders voiced conflicting concerns and opinions in the media.

When risk messages and advice conflict or diverge, one generally chooses to trust information from sources judged most reliable and trustworthy. According to Luoma and Lofstedt (2007), “Conflicting interpretations about an important consumer issue add to the growing erosion of public trust in advice from experts”. Although authorities continue to place significant trust in scientific risk assessors and lean on these for ‘certainty’ and advice (as in Section 3.1.2), the way members of the public relate to information at this stage of the case can be characterized by relatively low trust and high levels of skepticism. The public now rejects risk assessments showing negligible probabilities and the authorities’ advice claiming that consumption of heat-treated chicken is safe. Instead, consumers now rely on information from those claiming the opposite: that the use of narasin should be banned and that chicken should be labeled as a risk product (e.g. Sunde, 2014; Gjessing, 2014; Midtvedt, 2014, 2015). This distrust and the rejection of risk assessment results and advice are in accordance with the findings of Slovic (1999), which show that when trust does not exist, referring to risk assessments has little effect and may in fact serve only to increase public concern. A common reason for such distrust is the belief that information may be adapted to ‘match’ the vested interest of a source (Frewer et al., 1996).

At this point of time in the case, people have also gained more knowledge about narasin and its related risks. Demand for narasin-produced chicken dropped and we see changes in consumer behavior that indicate increased perception of risks related to narasin. This amplification is in line with research showing that increases in knowledge about a risk, where initially trust existed, often leads to more concern (Malka et al., 2009; Earle et al., 2012). The typology of trust, see to Fig. 1, distinguishes between two categories in which trust is low. The categories differ, based on the level of skepticism. The first type is labeled “distrust” and refers to a context in which both trust and skepticism are low. The second refers to a deeper sort of distrust, where the public has no trust in an institution and is skeptical of its intentions. Here, the low trust is paired with a higher level of skepticism. Any information coming from or produced by this institution is likely to be discarded or rejected. The responses of the public in phase 2 can be interpreted as reflections of this category of trust. At this point, information and messages of potential risks generate considerable amplification in ways that negatively affect trust. The public appears skeptical of governmental information and discards messages from sources it previously relied upon. In this way, our case also shows that risk messages and information are evaluated differently following an attribution of trust than of distrust, that the dark lens of distrust seems to blacken the associated interpretations (Slovic, 1999) and contributes to heightened resistance in risk arguments (Adekola, 2019). Similarly, loss of trust can increase risk perception and intensify public responses. Although there is an ongoing discussion concerning the strength of the connection between trust and risk perception, much research has demonstrated the asymmetrical relation between the time and effort it takes to gain trust, compared to the time it takes to destroy trust, and that trust in institutions is sensitive to specific risk events (e.g. Slovic, 1999, 1993; Kasperson et al., 2003; Pidgeon et al., 1992; Haynes et al., 2008).

#### 4. An uncertainty-based risk understanding promotes higher levels of skepticism and critical trust

Compared to the traditional, technical approach to risk, as seen in the authorization process concerning narasin, an uncertainty-based risk perspective involves understanding the risk concept in a broader sense (SRA, 2015; Aven et al., 2014; Aven, 2020a, 2020b). Where the main components of risk following a traditional risk perspective are events (A), consequences (C) of these events, and probability (P) - often summarized by the expected consequences  $E[C]$  - here the main components are events (A), consequences (C) of these events, and uncertainty (U). Risk is defined by the combination of

1. these events A and the consequences C of these events, and
2. the associated uncertainties, U, regarding both A (will A occur?) and C (what value will C take given A?)

For short we write risk = (A,C,U). To describe these uncertainties U, probabilities can be and often are used, but it is stressed that probabilities alone are not sufficient to fully describe risk. A clear distinction is made between the measure (e.g. the probability), and the risk concept itself. It is recognized that probabilities are based on some knowledge, K, and that this knowledge can be of varying quality. The value and the usefulness of probabilities are highly dependent on the strength of this knowledge. Therefore, the knowledge base and its strengths and weaknesses, together with the fact that surprises relative to this K can occur, must form a central part of the characterization and final judgment in any risk assessment process.

Broadening the understanding of the risk concept also means extending the understanding of what is considered valid knowledge and input to risk assessments. An uncertainty-based risk perspective entails an extended approach on how to represent epistemic uncertainties and promotes the use of both quantitative and qualitative methods and heterogeneous data when assessing risks. See Aven (2012, 2016, 2020a) for further motivation and details concerning the uncertainty-based approach, including some historical perspectives on the development of the risk concept.

In the following, we demonstrate how the introduction of such a comprehension of risk can affect aspects and levels of trust between actors involved in risk assessment and management processes. We show how this way of understanding risk can have consequences for the processing, interpretation of and responses to risk-related information, whilst using the first part of the case concerning the authorization process to illustrate the points made. Applying the same structure as in Section 3, we then show how this uncertainty-based risk perspective hypothetically affects levels and dimensionalities of public trust and how these effects relate to amplification- and attenuation processes.

##### 4.1. Effects of trust on the processing, interpretation and responses to risk-related information

###### 4.1.1. Risk assessment

Adopting an uncertainty-based approach to the processes concerning communication of risk-related information involves increasing the volume of many of the risk characteristics and signals commonly downplayed following a more traditional probabilistic perspective on risk, as seen in the authorization process related to narasin. In both the construction and communication of a risk message, uncertainty and knowledge aspects would be emphasized. This entails adopting a language and vocabulary different from that used by companies applying for authorization, in which information about safety and certainty is stressed. Relating to uncertainty and knowledge aspects as central components of risk automatically leads assessors to assume a more critical attitude to the information, data and input used in the risk assessment process. It directly involves activating the skepticism component of the trust concept.

Such an approach requires the identification and investigation of uncertainties and knowledge gaps overlooked by the risk producer and

the evaluation of the quality of the knowledge base. The fact that data concerning exposure to narasin are limited, homogenous and provided by an actor holding interest in portraying products as safe and risks as low or nonexistent, points in the direction of a relatively poor knowledge base. Judgments pointing in the direction of weak knowledge could serve as a rationale for seeking more and more diverse and nuanced data. As mentioned, an uncertainty-based risk perspective is coupled with a broader approach on how to represent epistemic uncertainties than conventional risk perspectives. Here, knowledge is understood as justified beliefs, and when judged scientific, these being the most epistemically warranted assertions existing at a certain point of time. The knowledge base is not restricted to representing a set of statistical, historical and what is presumed to be objective true beliefs. This comprehension promotes combining different types of knowledge and 'alternative ways of knowing' when assessing risks. Knowledge of stakeholder values, concerns and experiences are also considered relevant and important input to the knowledge base. Examples of such inputs are: knowledge of consumer behavior, trends, values and attitudes towards the use of chemicals and contaminants in food and feed; input from a broad range of fields (i.e. ecology, medicine, psychology); scientific research indicating consequences and trends deviating from those reported by risk producers; practical experiences of those directly exposed to additives or contaminants; and insights into alternative methods of chicken production.

For risk and risk events holding what is referred to as signal value, using such knowledge in addition to technical, probabilistic data may be especially important. The combination of characteristics like little or no knowledge (e.g. new risk, delayed effect, unobservable) and 'high dread' (e.g. uncontrollable risk, consequences for future generations) is associated with high risk perception and the potential for amplification and subsequent ripple effects (Slovic et al., 1986; Kasperon et al., 2003). The risks associated with the use of narasin bear many of the characteristics associated with signal value. Using alternative sets of knowledge in such contexts when, for instance, specifying potential consequences and the risk events/scenarios themselves, makes risk assessors less vulnerable to risk producers not revealing all relevant information, and can contribute to avoiding attenuation and a narrow framing of risks from the start of the risk assessment process. This can act to prevent what Van Asselt et al. (2009) observed: that risk producers set the agenda, define the problems and frame the issues in their safety assessments in ways that only allow the risk analyst to assess risks within a framework constructed by the industry.

However, the use of comprehensive and nuanced data when assessing risks is an ideal situation and cannot always be achieved in practice. Collecting, filtering and evaluating a wide array of data is time-consuming. The time constraints within which the risk assessments of EFSA are conducted have been pointed to, as well as the fact that insufficient time is allocated for gathering more comprehensive data. But, when EFSA accepts and chooses to primarily rely on limited data from risk producers as the basis for their scientific opinion, this is also a reflection of uncertainty intolerance, as described in Section 3.1.1. Following an uncertainty-based risk perspective, if time constraints were arguments for not seeking or collecting more and nuanced data, an active skepticism dimension and critical way of relating to information and uncertainties would function as a 'safety valve', holding the potential to remove or prevent attenuation. The judgments and evaluations of the strength of the knowledge (SoK), would directly affect the risk characterization and could justify a higher risk judgment and/or recommendations of more cautious regulations or management strategies. Contrary to the narasin- and GMO examples, uncertainties would not be, as Wynne put it, naturally deleted or black-boxed away because uncertainty forms a central part of the risk concept itself.

This manner of understanding risk, relating to and using data, information and knowledge implies lower levels of trust and higher levels of skepticism relative to the one seen in the case. Compared to both the narasin- and GMO examples, it would require a degree of amplification

to be added into the authorization process. As mentioned, this may result in a higher-risk judgment but not necessarily. It may still result in the same or similar conclusions and recommendations as those of EFSA, but the processes and reasoning modes behind the risk assessment results would be of a different character. In the narasin case, high trust and low skepticism worked to allow the transportation and spreading of attenuation. Although EFSA did not deliberately promote the interests of the risk producers, their reasoning modes were mutually supportive (Van Asselt et al., 2009). The way the risk assessor accepted and heavily relied upon data from applicant companies in the analyses to a large extent permitted the risk producer to carry the role of the independent scientific assessor.

The language and the reasoning mode of a risk assessor holding an uncertainty-based understanding of risk do not coincide with those of the risk producer. Here, a higher degree of skepticism paired with generally lower levels of trust and acceptance become filters or mechanisms working in the opposite sense and act to send information via the central route. Following Petty and Cacioppo (1986) and Cacioppo and Petty (1984), this route for processing information is more likely to be used where trust is low or absent. Here, an in-depth analysis of the risk message received is carried out, and information is carefully examined. As Adekola (2019) also has stated, this process can act to amplify uncertainties and gaps in knowledge. Compared to the manner in which risks are communicated and portrayed in assessments in the examples shown, we argue that integrating a degree of amplification into the risk assessment process could prove 'healthy', by making assessors aware of and detect and/or filter out attenuation. On that account, an uncertainty-based risk perspective can introduce similar qualities to what Barber (1983) describes as the functional or effective character of distrust into risk assessment processes, by, for instance, revealing information colored by the vested interests and agendas of powerful stakeholder groups and contributing to keeping power imbalances in check.

Still, the processing of risk-related information through the central route does not necessarily imply that there is no trust between actors, but that trust is not blind, uncritical or naïve, and that risk judgments are reached as part of a more critical and reflexive and uncertainty-accommodating process. More than introducing changes in actual levels of trust, an uncertainty-based perspective involves activating the skepticism dimension of trust.

#### 4.1.2. Decision-making and risk management responses

The way of understanding risk as described above also has consequences for the decision-making process and may affect risk management and regulatory responses. As explained, it may alter the risk assessment result but may also produce an equal conclusion. The main change represented by an uncertainty-based risk understanding is the fact that it alters the way the risks are portrayed and communicated to the decision-maker. Risk characteristics, signals and aspects, hidden, concealed or briefly mentioned, would be openly displayed. Assumptions, uncertainties and limitations of the knowledge base form part of the risk description itself and are explained and made visible to decision-makers. Risk assessment results and probabilities are not presented to decision-makers as objective 'answers' but presented as expressions of the uncertainties and the degree of beliefs the risk assessor has concerning the occurrence of a risk event, based on the knowledge available at a certain point of time.

Such an approach to risk and the communication of risks to a greater extent facilitates critical reflection and evaluation of the risk assessment and its conclusion. Once again, we see how an uncertainty-based risk perspective is tightly connected to an active skepticism dimension. High levels of skepticism may be interpreted to reflect corresponding low levels of general trust, but it is important to note that even though skepticism is high, relations between the risk assessor and risk manager may still be characterized by trust. The point here is the same as in Section 4.1.1: that the trust between actors is not blind and is not

associated with direct acceptance and reliance on information. Trust here implies what Pooritinga and Pidgeon (2003) describe as a practical reliance on an institution. Because of a 'high score' on the skepticism dimension, trust here does not operate as an external clue, sending incoming information through peripheral routes. The risk understanding itself demands that risk messages and information go through processes that foster what Cacioppo and Petty (1984) call high elaboration likelihood. This means that it is likely that recipients will engage in effortful thinking and evaluation of risk-related information and its merits, as happens when information travels through the central route. Actively considering and investigating information makes the recipient more knowledgeable of the risks and limitations of a risk assessment. And, as research has demonstrated, when knowledge is high or increases, the importance of trust as a factor shaping interpretation and responses becomes reduced (e.g. Earle et al., 2012).

Where risk assessment results previously have represented the evidentiary basis for decisions on responses, displaying uncertainties and limitations within risk analyses can challenge decision-making. Risk assessment may not provide clear answers or support for a specific response and may complicate the decision-making process or may lead to 'decision paralysis'. As put by O'Brien (2000), it becomes harder to hide behind the rationality and objectivity of risk assessments. It may change or challenge existing structures and relations of power. At the same time, it could contribute to the opposite: that decision-makers strategically make use of uncertainties and indefinite results in order to pursue their own agendas. It may also produce risk amplification, by leading decision-makers to overemphasize uncertainties, spawning an interpretation of risks as higher than necessary and manifesting in little 'action' and overly cautious responses.

However, in the same way as emphasized in Section 4.1.1 concerning outcomes of risks assessments, an uncertainty-based risk perspective does not automatically imply altered decision outcomes. The important message is that the responses do not directly follow probabilities and risk assessment results as seen in the technocratic science- or evidence-based decision-making style in the case. An uncertainty-based comprehension of risk supports what we describe as a knowledge- and risk-informed approach to decision-making. This involves using the risk analysis as an input to a wider process of weighing and balancing a broad range of values, interests and concerns. Contrary to the 'non-decisions' on the authorization of both GMOs and narasin products, decisions are arrived at as a part of a more critical reflexive process. Also, if risk signals, characteristics or information are downplayed or camouflaged in analyses, such a form of decision-making holds the potential to stop attenuation from spreading into risk management, by providing the rationale for different decisions and/or more cautionary and restrictive responses. Yet again, this illustrates how introducing skepticism into the decision-making and risk management process can prove functional. Much trust-related literature and research does not seem to distinguish between different aspects and components of trust, and this skepticism often appears to be referred to as distrust. As we have seen, this skepticism can exist in parallel with trust, and the category labeled "critical trust" in the typology appears to be a good candidate to describe the relations between actors and their way of relating to information following the application of an uncertainty-based risk perspective.

## 4.2. Impacts on public trust

Compared to traditional, technical approaches to risk, an uncertainty-based risk perspective represents some fundamental changes that potentially can affect public trust and the development of attenuation and amplification processes. The two sub-phases of this part of the case illustrate that these effects are time-dependent.

### 4.2.1. Phase 1

Assuming the adoption of an uncertainty-based approach to risk, one could hypothesize that the reports of detections narasin in eggs in 2006



and of antibiotic-resistant bacteria in chicken and eggs 2012 were interpreted and responded to differently by various actors. First, this way of dealing with risk requires uncertainty aspects to be emphasized, and, by relating to these as central aspects of what risk is all about, the detections could have been interpreted as warning signals, indicating that narasin could have other and larger consequences than those predicted. They could also have been seen as indicators that the knowledge base behind the risk assessment was even weaker and less informative than previously assumed. These judgments justify revising the scientific risk assessments and reconsidering the responses. As described, this approach to risk also corresponds with the use of more diverse and heterogeneous data. This encourages relating to different signals and types of information in a more proactive sense, for instance making use of knowledge about stakeholder values, concerns and preferences to identify risks holding the potential for high risk perception and large amplification. Subsequently, the detections could have been interpreted as holding signal value: as early messages and signs pointing at risks that potentially are in need of stricter regulation and increased societal attention. Accordingly, an active approach to uncertainties and knowledge can act to avoid 'continued' attenuation associated with not responding to or not absorbing new information and knowledge into risk assessment and risk management processes.

An uncertainty-based risk perspective alters the way risks are portrayed and communicated to the public. In the example, the 2006- and 2012 findings were communicated as non-risks and presented to the public in ways that involved significant attenuation. Authorities and risk managers stressed 'safety' aspects, by emphasizing concentrations below EU regulation levels, low probabilities of adverse effects, and by stressing low levels of antibiotic-resistant bacteria relative to other countries. An uncertainty-based risk understanding corresponds with a more transparent and open style of risk communication, and the risk conceptualization itself requires that uncertainties and knowledge limitations are explicitly addressed. This manner of communicating risks could potentially have given a more balanced picture of the risks related to narasin and inspired reflexivity and critical thinking among the public. It stimulates using more elaborate strategies of thinking and of processing information in ways that could serve to increase levels of public awareness and knowledge, and lead to more informed and independent consumer choices.

As we now know, increased knowledge of an issue makes trust less influential in affecting risk perception and subsequent responses. When one is well informed and knowledgeable about a topic, one can use this available knowledge when making decisions, and trust becomes superfluous (Earle et al., 2012). Hence, by facilitating consumers and the general public to actively and skeptically relate to information and by increasing their knowledge and awareness of risks, an uncertainty-based risk perspective can act to diminish the role of trust when it comes to how these groups interpret and respond to risk-related information.

At the same time, exposing and emphasizing uncertainties and knowledge gaps when communicating risk-related information can generate risk amplification in different ways. Risk assessors and risk managers may appear less competent and less in control and may lead the public to interpret risk as higher than following a more traditional, technical approach to risk and risk communication. Studies have, for example, shown that when there initially is trust, reception of knowledge is associated with more concern and higher risk perception (Malka et al., 2009; Earle et al., 2012). Also, stimulating careful evaluation of the information about risks can serve to amplify signals or aspects previously ignored or overlooked and affect how this information is perceived and reacted to. It may, for example, lead to cynicism or rejection of information, decrease the perception of safety of food products (Frewer et al., 2003; Jansen et al., 2019) and negatively affect levels of trust. This may spur responses resembling those seen in 2014–2016.

It has been hypothesized by many (e.g. Frewer et al., 2003; Van Asselt et al., 2009) that the fear of increasing public distrust lies behind

much of the unwillingness to disclose uncertainties. However, studies have also demonstrated that the general public is familiar with and capable of handling uncertainties (e.g. Wynne, 1992, 2006; Frewer et al., 2003), and that uncertainty constitutes a central element in how the public understands and relates to risks (Fjaeran and Aven, 2019a). Generating some distrust and amplification in the early life of risks may prove an important investment in the long run. Honestly and openly displaying uncertainties, stimulating skepticism of information and enabling public awareness at an early stage, can act to avoid or reduce later amplification. And, as indicated by research (e.g. Earle et al., 2012; Malka et al., 2009), when the background is characterized by skepticism, low trust or distrust, the reception of more or new knowledge does not necessarily entail increased risk perception and concern. It is when there is initial high trust that the impact on risk perception is greatest.

#### 4.2.2. Phase 2

The course of the events and reactions seen in phase 2 of the second part of the narasin case illustrate the last statement in the section above. The media reports of high levels of antibiotic-resistant bacteria and concerns of certain scientists and medical professionals in 2014 initiated considerable amplification that was to bring ripples of effects. In this part of the case, conflicting messages and advice were communicated to consumers and the general public, and consumption of narasin-produced chicken quickly fell. Authorities responded to the amplification by ordering new risk assessments from the Norwegian Scientific Committee for Food Safety. These echoed the same technical understanding of risk as the FEEDAP/EFSA assessments and, although these admitted a possible connection between the use of antibiotic-resistant bacteria and the use of narasin, probabilities of consumer exposure to coccidiostats and to resistant bacteria in heat-treated chicken meat were judged negligible (Nesse et al., 2015). As we know, risk assessment results and authority assurance were again rejected, dismissed and/or ignored. Consumers now chose to rely on information from sources stressing uncertainties, knowledge gaps and the potential for long-term and serious effects. Uncertainties were interpreted by the public as indicative of high risk and as a reason for precaution, and demand for 'narasin chicken' continued to drop.

Throughout the entire case, the authorities appeared to place a high level of trust in experts and their advice. In both parts and phases of the case, risk communication was directly rooted in risk assessments, their conclusions and statements related to or derived from the assessments. Presenting the public with an 'objective', technical and narrow picture of risks and stressing safety aspects where uncertainties, concern and low trust exist can, as seen in the case, have the opposite effects of those expected. Referring to risk assessments and estimates in such settings may increase concern, lead to amplification and, according to Frewer and Salter (2012), result in distrust in the motives of regulators, science and industry. Such distrust is connected to the belief that information has been distorted and that the source of the information is protecting its own interests rather than providing good information out of concern for the public welfare (Frewer et al., 1996, 2003). In general, the public places substantial trust in independent scientists but gives little weight to statements it believes to be made by scientific 'guns for hire' (Jenkins-Smith and Silva, 1998; Tuler et al., 2017). This can result in distrust of sources traditionally providing risk-related information. A consequence of such distrust, or of what may be better described as skepticism, is that the public looks elsewhere for information. When there is conflicting information, people often choose to trust information from the 'watchdogs': independent organizations and experts that keep an eye on developments and inform the public about potential consequences (Pidgeon et al., 2010). According to Slovic (1999), in such settings, the bare mentioning of possible links or associations and statements of potential risks outweigh any statement of lack of evidence of causal effects and low probabilities. In the development of the case in this phase, we see all these tendencies.

The responses of the public and the degree of distrust or skepticism

these reflected can be tied to the failure of risk assessors and managers to recognize the role of uncertainties in the way the general public understands risks. The technical language used by those in charge of assessing and managing the risks and the understanding of risk it reflected did not match the public interpretation of the risks. Risk estimates and probabilities do not cover what risk is to most people. The public considers food risks in a broader value context than the technical narrow notion of risks (Jensen and Sandøe, 2002; Fjaeran and Aven, 2019a). An uncertainty-based approach to the communication of risk-related information to a larger degree resonates with the public understanding of risk than the one used in the case. Had risk assessors and managers, for instance, proactively addressed uncertainties of the consequences and knowledge limitations and seriously taken care of these aspects in their communication of the risks related to narasin, one could hypothesize that some of the amplification seen, when the public turned to risk protestors and ‘watchdogs’ for information and advice, could have been reduced or avoided. Using such a perspective as a foundational basis for risk communication one could also potentially ‘block’ or pre-empt some of the amplification generated by distrustful stakeholder groups and those opposing the risks. Following Van Asselt et al. (2009), an unintended consequence of avoiding addressing and not recognizing the importance of uncertainties is the increased distrust among risk protestors themselves. These actors may exaggerate uncertainties and/or misuse information, in ways that may produce unnecessary amplification. If these groups ‘reveal’ camouflaged or downplayed information, presenting risks as mismanaged and attenuated, this may seriously harm public trust. This point illustrates how amplification and the extent of such amplification can be tied to the degree of prior attenuation (Fjaeran and Aven, 2019b; Poumadere and Mays, 2003). Similar points are made by, for instance, Pidgeon et al. (1992) and Kasperon et al. (2003), who state that, if risk and uncertainty are not adequately managed or considered, the occurrence of a risk event can severely impact trust in institutions and may potentially lead to a complete breakdown in trust.

Yet, for an uncertainty-based risk perspective to genuinely impact the extent of amplification and subsequent ripple effects, more is required than an open communication of risk and uncertainty aspects when a risk event occurs. It demands that changes have been made at a much earlier point, from the very start of the risk assessment process when risks are initially framed, as described in Section 4.1. Building public trust demands fair procedures and processes truly involving the public (Trettin and Musham, 2000) including public concerns, values and meaning-making regarding issues at stake (Engdahl and Lidskog, 2014). As we have shown, doing so requires acknowledging the value of what commonly is referred to as distrust, but what may be more correctly an expression of healthy skepticism, throughout the whole risk assessment and risk management processes.

## 5. Conclusion and recommendations

Based on a case concerning the authorization and regulation of narasin, we have shown how a technical, probabilistic understanding of risk goes hand in hand with high levels of both trust between actors and reliance on and acceptance of risk-related information and data. Following the structure of the Social Amplification of Risk Framework, we have shown how such ‘Acceptance/trust’ appears to facilitate the spreading of attenuation from one level or actor to another: from risk producer to risk assessor, from risk assessor to risk managers/regulators, from risk manager/regulators to the members of the public and to the larger society. As shown, such attenuation can go unnoticed for a long time without having any visible consequences, but when a related risk event take place, this attenuation can bring substantial amplification, having far-reaching and negative effects on what is typically referred to as public trust.

Risk events similar to those seen in the second part of the case have led risk managers and authorities to recognize the importance of being open about scientific uncertainties in risk assessments and of involving

stakeholders in risk governance processes when it comes to building trust. This paper argues that, for such efforts to ‘bear fruit’, a broader understanding of the risk concept is required, and trust and distrust must be approached from a different angle. Prevailing concepts of both risk and trust fail to give realistic pictures of how people understand and judge risks and risk-related information and their relationship, as well as their perceptions of the institutions in charge of assessing and regulating risks. These are a lot more nuanced and complex than suggested by conventional conceptualizations.

The dichotomous comprehension of trust and distrust does not, according to Pidgeon et al. (2010), cover the set of subtle and complex relationships, discourses and perceptions that the public holds about risk-managing organizations. As described by others (e.g. Walls et al., 2004; Poortinga and Pidgeon, 2003) and in this paper, different degrees of trust and distrust exist in parallel, and what generally is understood as distrust may actually represent a healthy portion of skepticism. The way the public understands, perceives and relates to risk-managing and regulatory institutions is best described by the notion of critical trust: a pragmatic practical reliance on an institution, paired with a skeptical or critical attitude towards the effectiveness, motivations and independence of this agency (Pidgeon et al., 2010; Walls et al., 2004). Already in 1983, Barber described what he called effective public distrust, arguing that distrust could serve essential functions in a society and that the importance of trust was exaggerated. More recent studies related to the COVID-19 pandemic have also emphasized problems associated with high levels of public trust stating that it may lead to underestimation of losses and reduce the belief in the need to take action to control risks when necessary (Wong and Jensen, 2020). Parkins et al. (2017) reported that ‘critically trusting’ citizens are more likely take part in public engagement and participation initiatives than trusting ones. Although such ideas today have started to gain ground again within risk research, these do not yet seem to be incorporated into contemporary institutional practice or procedures. These continue to be dominated by the conventional understanding of trust as an ideal situation, paired with a technical, narrow conceptualization of risk.

Since trust does not describe how the public perceives and relates to risk-managing institutions and information coming from these, efforts at restoring trust may not be achievable, or even desirable, and may in fact be efforts at restoring something that never was really there in the first place. More than aiming to reduce distrust and build or restore trust, one should, following Tuler et al. (2017), accept distrust and proceed in a middle ground, by promoting and building critical trust, by creating appropriate mixtures of distrust and trust.

The recognition that distrust can be functional or effective carries implications for those responsible for assessing, communicating and managing risks. In this context, independent scientific assessments play an especially important role. For risk assessments to help warrant such balance and critical trust, they must, according to for instance Tuler et al. (2017), be able to address and internalize stakeholder concerns and values and their acceptance of validity of assumptions and information. It is increasingly realized that this requires a risk concept in which uncertainties are acknowledged and systematically addressed. Through this paper, we have shown how an uncertainty-based risk perspective could provide such a conceptualization and foundational basis that contributes to creating conditions for building critical trust within both the risk assessment and risk management processes. Such a perspective corresponds with what Poortinga and Pidgeon (2003) call the skepticism dimension of the trust concept, and the effects on trust introduced by this perspective are closely related to its effects on attenuation and amplification. Compared to the level of risk amplification and attenuation in the case, an uncertainty-based approach to risk and risk-related information involves some amplification from an early stage of the assessment process and may negatively affect trust on a short-term basis. However, by affecting relations between the different actors involved in the authorization process and by changing how these relate to, interpret, process and make use of information, an uncertainty-

based risk understanding can create awareness of attenuation and stop it from spreading, by breaking the ‘chain of attenuation’ identified in the narasin case. In this way, it may serve to reduce or prevent later risk amplification brought on by a risk event, the sort of amplification the SARF is designed to illustrate, the sort that holds a potential for large ripple effects, often proving especially detrimental to what commonly is described as public trust.

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