How Does Contextual Information Affect our Understanding of Numerical Probabilities

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Abstract

Numerical probabilities representing health risks or treatment benefits are constantly communicated to the general public. These probabilities are often embedded in contextual information in the form of a personal patient narrative or newscasts. Previous research suggest that people's perceptions of risk will be greater when probability information is communicated along with contextual information. In this study, we hypothesized that the presence of contextual information, in the form of a televised newscast, would increase the participant's perception of risk of side effects of the swine flu vaccine. Participants (N = 75) were presented with information about the side effects of the swine flu vaccine. Approximately half the Norwegian population chose to get vaccinated in 2009. We explored how the presence or absence of contextual information and numerical probabilities affected the perception of risk. The participants reported substantially increased risk perceptions when contextual information was present. In its absence, participants reported relatively low perceptions of risk. These results clearly indicate a potential gap in how probability information is presented and the recipient's assessment and perception of it. The under- or overestimation of probability information has important implications for medical decision-making.

Key words: Numerical probabilities; Decision-making; Health risks; Communication; Risk perception; Perception; Numeracy.

Abstrakt - Norsk versjon

Helserisiko eller behandlingsnytte, fremstilt som tallfestede sannsynligheter, kommuniseres kontinuerlig til allmenheten. Disse sannsynlighetene er ofte innlagt i kontekstuell informasjon i form av personlige pasientberetninger eller nyhetssendinger. Tidligere forskning antyder at menneskers vil oppleve en høyere subjektiv risiko når sannsynlighetsinformasjon kommuniseres sammen med kontekstuell informasjon. I denne studien foreslår vi at tilstedeværelen av kontekstuell informasjon, i form av en tv-sendt nyhetssending, vil øke deltakernes opplevde risiko av bivirkninger av svineinfluensa vaksinen. Deltakerne (N = 75) ble presentert for informasjon om bivirkningene av svineinfluensavaksinen som, i 2009, ble tatt av tilnærmet halvparten av Norges befolkning. Vi undersøkte hvordan tilstedeværelsen, eller fraværet, av kontekstuell informasjon og numeriske sannsynligheter påvirket oppfattelsen av risiko. Deltakerne rapporterte vesentlig høyere subjektiv risiko når kontekstuell informasjon var tilstede. I dets fravær rapporterte deltakerne relativt lav subjektiv risiko. Disse resultatene demonstrerer et betydelig gap mellom hvordan sannsynlighetsinformasjon presenteres og vår oppfatning av den. Slik under- eller overestimering av sannsynlighetsinformasjon kan ha viktige implikasjoner for medisinsk beslutningstaking.

Nøkkelord: Numeriske sannsynligheter; Beslutningstaking; Helserisiko; Kommunikasjon; Risiko oppfatning; Persepsjon; Tallkyndighet.

Preface

The idea to this project came about in the fall of 2011 through a dialogue with associate professor Torstein Låg and the author. He suggested looking at people's perception of risks and numerical probabilities. The author's curiosity on the topic relates to his interest in social-cognitive theories and biases, whilst Torstein Låg has experience from the field of cognitive psychology. We agreed to explore the topic further by collaborating on an empirical study by assessing people's perception of risk when exposed to different ways of communicating probability information.

Firstly, the author looked up previous research within the field of risk perception, numeracy and cognition to get a perspective on the history of this topic. Although research has been done on concepts included in this study, relatively little research has been done on the interplay of subjective risk perception, communication formats, and numeracy to date. The process of creating and editing the practical details in this study has been a collaboration between the supervisor and the author. The author developed the questionnaire, with feedback and help from the supervisor. The author also, with the help and guidance of the supervisor, conducted the statistical analysis.

This project has enriched the author by giving valuable insight into the scientific methods and the execution of a larger empirical study. This project has also been a journey into a very fascinating field of science.

Erik Nerva — *Student*

Torstein Låg — *Supervisor*

How Does Contextual Information Affect our Understanding of Numerical Probabilities?

Numerical probabilities representing health risks or treatment benefits, derived from statistics and research, are constantly communicated to the general public. Often these numerical probabilities are embedded in contextual, or narrative, information such as personal patient narratives or a televised newscast. Other times, the newscast or narrative is loosely based on statistics and research, and provides little or no truly informative numerical risk information. Although we do know that interpreting numerical probabilities and risk can be a challenging cognitive task for most consumers of health information, we know relative little about the influence of contextual information, such as a televised newscast, on our perception of risk stated as numerical probabilities. This study, however, aims to uncover how such contextual information affects our perception of numerically stated risks.

Decision-Making

Two of the most well established theories on decision-making are *Expected Utility Theory* by John von Neumann and Oscar Morgenstern in 1947, and *Prospect Theory* by Daniel Kahneman and Amos Tversky in 1979. The Expected Utility Theory was proposed as a normative theory of behavior. The theory is largely based on how people should behave, not how they actually behaved in decision-making situations. The Expected Utility Theory assumes that the decision-maker is capable to understand and calculate the advantages and disadvantages of each choice alternative. There are however, very few of us that are able to operate this way. Because of this, Expected Utility Theory is useful as a normative model, but has its limitations as a descriptive model. While Expected Utility Theory is about utility (benefit and profit), Prospect Theory focuses around the notion of value (gains and losses). In contrast to the Expected Utility Theory, the Prospect Theory is a descriptive model. The theory suggests that people do not make decisions based on the final outcome, but rather the potential losses and gains. Being a descriptive model, the Prospect Theory is more applicable as a framework for understanding how people actually make decisions than the Expected Utility Theory. Kahneman and Tversky (1979) found that people overweighed outcomes that were considered certain relative to those merely probable. This phenomena was coined the *Certainty Effect* and illustrates the limitations of Expected Utility Theory.

The Prospect Theory's use of changes as value (gains and losses) is compatible with basic principles of perception. Human beings are built to perceive changes (from hot to cold, light to dark). We all have a reference point and that reference point defines how we perceive things. You may experience the light outside your apartment as bright or dark depending on the light to which you have adapted to (Kahneman & Tversky, 1979). Similarly, your experience of wealth is dependent on your reference point. A $50 gain would probably mean a lot to someone who is poor, but not as much to someone wealthy. Therefore, rather than the Expected Utility Theory's final states and utility, Prospect Theory emphasize changes in wealth and welfare. Although the Prospect Theory is more descriptive than the Expected Utility Theory, decision-makers are prone to mistakes in judgment. We do, however, have general rule of thumb, or *heuristics*, to help guide us through our decision-making.

Heuristic Biases in Decision-Making

Heuristics reduces the time and effort to make good judgments and decisions. The representativeness heuristic is based on a sample of the population. Sometimes, the sample is not representative of the population. In one interesting study, Kahneman and Tversky (1982) posed a short descriptive text of a woman. The text gave some idea of what the woman was like. Then the participants were asked to indicate which one of two alternative descriptive labels was more likely to apply to the woman. One of the alternatives was a more general statement; the other included more specific attributes. When asked, most people participating felt that the right choice was the more specific one. In fact, almost 9 of every 10 participants chose the more specific alternative, despite the fact that the general alternative included the specific one and would apply to more people. Specific scenarios seem more probable than general scenarios because they are more representative of how we imagine particular events.

The representativeness heuristic is one example demonstrating our tendency to violate the norms of probability theory when processing numerical probability information. In addition, research seems to suggest that we are somewhat prone to both underestimate and overestimate probabilities. Early studies have shown that people tend to overestimate the probability of successful outcomes (Blascovich, Ginsburg, & Howe, 1975). The effect has been coined the gamblers fallacy, or an optimism effect (sometimes referred to as unrealistic-optimism effect (Chambers & Windschitl, 2004). The gamblers fallacy is the belief that a successful outcome is due after a run of bad ones. Imagine you toss a coin ten times and get ten tails. The event would seem rather one-sided and one would think that for the eleventh toss, heads were due. Our perceived probability for heads on the eleventh toss is greater than fifty percent. It is exactly this subjective feeling that is coined the gamblers fallacy. The gamblers fallacy is not limited to wagering games such as blackjack or coin tossing, but apply generally to situations where probabilities and risk are prominent.

Conversely, and of particular relevance to the current study, other studies have found a tendency to overestimate the probability of adverse outcomes, such as being afflicted with disease. In one study, Gurmankin and colleagues (Gurmankin, Baron, &

Armstrong, 2004), presented four hypothetical cancer risk scenarios in three different communication formats to the subjects. They either received the information verbally only; verbal with numerical probability as a percent; or verbal with numerical probability as a fraction. The 217 participants, of whom eighty-one percent were female, were first presented with a scenario describing the patient's symptoms. The second part consisted of a risk communication from a physician to the patient about the risk of cancer (prostate, colon, lung, and breast; four different patients). As hypothesized, the participants showed substantial variation in their risk perception in all four cancer scenarios. The researchers also hypothesized that the presence of a numeric statement would reduce the variability seen in the verbal only condition. Consistent with their hypothesis, the numeric statement somewhat reduced the degree of variation in risk perception, but not very effectively. There were no significant difference between the percent and fraction condition. The study also showed a tendency to overestimate ones risk relative to stated risk. That is, in the numeric versions presenting the stated numeric risk, a systematic overestimation of risk was found. Lower numeracy and lower educational level were associated with the tendency to overestimate ones risk. They tended to think the physician's estimation of risk didn't apply to them; that the physician made a mistake; or that the physician intentionally reduced the risk for them. As the tendency to overestimate ones risk increased, the likelihood of reported intention to get the diagnostic test increased with it (Gurmankin, et al., 2004).

Overestimation of both beneficial and adverse outcomes may be problematic when dealing with medical decision-making. The existence of such effects also alerts us to the importance of distinguishing between stated probability and risk, and perceived probability and risk. As the study by Gurmankin and colleagues (2004) demonstrated, the intentions of the provider of information may not always match the recipient's perception. Furthermore, the manner in which this information is presented can, and will most likely, affect the recipient's perception in various ways.

Subjective Probability Estimation and Affect

Research on risk perceptions and subjective probability demonstrates clearly that making accurate independent probability estimates is no easy task. We know, for instance, that peoples' perception of risk is affected by the availability of information in memory. The *availability heuristic* function as a guide where people assess the probability of an event by the ease with which occurrences can be remembered (Plous, 1993). As with all the heuristics, the availability heuristic allow the decision-maker to simplify what originally might be a trickier task. With the representativeness heuristic, there are several systematic biases we can encounter whilst using these rules of thumb. Similar systematic biases have also been documented in the availability heuristic. Slovic and colleagues (Slovic, Finucane, Peters, & MacGregor, 2004) explains how the availability heuristic is closely related to the *affect heuristic*. Affective responses occur rapidly and automatically, and the reliance on such feelings when estimating probabilities can be characterized as the affect heuristic. Research suggests that the availability heuristic might not only work through how easily one can recall events, but because remembered events often are connected with affect (Keller, Siegrist, & Gutscher, 2006; 2004). In recent years, several articles connecting affect with risk perception has appeared (Loewenstein, Weber, Hsee, & Welch, 2001; Slovic, et al., 2004). Since the availability heuristic work through how easily one can recall certain events, those events may not be as representative as we think. It is, for instance, easier to recall events that hold some significance and meaning to you (i.e., a personal experience specific to you). So the availability heuristic, although its primary function is to facilitate decision-making, is highly subjective and thus often biased (Peters & Slovic, 2000; Slovic, et al., 2004). Another example is conservatism - the tendency to hold on to your initial formed probability estimate even though new information would advise you to change it (Plous, 1993). In making predictions and judgments under uncertainty, people have a tendency to be affected by biases such as the optimism effect, the base-rate fallacy or conservatism. Heuristics that usually leads to reasonable judgments can sometimes do the opposite. To make the best possible prediction, three types of information are generally considered essential: background information (e.g., base rates); specific evidence regarding the case (descriptive information); and expected predictive accuracy (e.g., the estimated probability) (Kahneman & Tversky, 1973). Ignoring the base-rate is a common mistake when making statistical predictions.

The Base-Rate Fallacy

The base-rate fallacy, or base-rate neglect, refers to people's tendency to ignore the relative frequency with which an event occurs (Martin, Carlson, & Buskist, 2007). The failure to take the base-rates into account when judging probability can lead to erroneous decision-making. When given statistical information for a particular case and a population, they both should be considered together. What people tend to do is ignore, or overlook, the statistical parameters concerning the case. Although knowledge about the base-rate fallacy has existed for some time, it was first studied in a controlled laboratory by Kahneman and Tversky (Bar-Hillel, 1980; Kahneman & Tversky, 1973). Previous research found that people often use base-rate information when it is consistent with their intuitive theories of causality (Ajzen, 1977). Other research suggests that individuating information is favored when base-rate information is present because the base-rate information often is too general and abstract (Bar-Hillel, 1980). Why do people ignore base-rate information? Research has shown that people do appreciate the base-rate information when it is the only information given. However, it seems that when people have to integrate two sources of information (base-rate information and specific information regarding a specific case), they stumble upon some problems. Bar-Hillel (1980) suggests that when people ignore the base-rate information, it is because they believe it should be ignored and that it is irrelevant to the judgment they are making. Even though people tend to ignore the base-rate information, its sole purpose is to assist our decision-making process.

Numeracy: our Ability to Reason With Numbers and Probability

Sometimes probability information concerning choice options is explicitly provided to us. Given that we are somewhat prone to biases when making independent probability estimates, as explained above, one would expect such information to significantly improve our decisions. However, a substantial amount of research indicates that many of us tend to misunderstand or are unable to interpret correctly the information presented to us. This in turn may lead to sub-optimal decision-making when it comes to our own health.

There is much evidence that demonstrates a large variability when we are trying to correctly interpret and evaluate numerical information (e.g., probabilities). Our ability to reason with and use mathematical concepts is called numeracy and people vary a great deal in it (Dieckmann, Slovic, & Peters, 2009). People higher in numeracy tend to make better use of numerical information (i.e., statistical evidence: percentages and frequencies) than do people lower in numeracy. People lower in numeracy tend to rely more on verbal information (i.e., narrative evidence: anecdotal information) rather than numerical (Peters, et al., 2006).

The term numeracy was first coined by Geoffrey Crowther in 1959 and, at that time, referred to a higher level of mathematical reasoning skills (Reyna, Dieckmann, Nelson, & Han, 2009). Today, numeracy, or health numeracy, is usually considered part of the concept literacy or health literacy, and implies a more basic and general knowledge and use of mathematical concepts. Health literacy refers to an individual's capacity to process and understand basic health information. Health literacy has also been defined in a conceptual model, revealing three important aspects or skills: prose literacy (the ability to read and understand text), document literacy (the ability to locate and use information in documents), and quantitative literacy (which is the ability to process numerical information, and is a term often used interchangeably with numeracy) (Baker, 2006; Reyna, et al., 2009). A degree of literacy is needed so that individuals can make the appropriate medical decisions when necessarily. The lack of ability to assess this kind of information has been coined illiteracy. Research on health literacy has mapped out important concepts for making good medical decisions. Our ability to make informed health decisions rests a great deal on our basic numerical understanding (Reyna, et al., 2009).

Peters and colleagues (2006) verified the prospective hypothesis that less numerate people would judge numerical probability information less correctly than more numerate people. In one interesting study, participants were asked to choose between two bowls filled with colored and white jellybeans. Bowl A contained 100 jellybeans (9 colored and 91 white). Bowl B contained only 10 jellybeans (1 colored and 9 white). Participants were then asked to choose one of these bowls to randomly draw a jellybean out of, with the incentive of a $5 prize if they drew a colored jellybean. As hypothesized, the experiment showed that the less numerate participants were much more likely to choose bowl A, which contained only 9 % colored jellybeans, and as such is the objectively worse choice. The more numerate participants tended to choose bowl B. These results demonstrate how less numerate individuals tend to overlook or ignore relevant numerical information and make poorer choices. It is argued that the size of the numerator (the sample size) is emphasized. That is, people tend to prefer a larger sample even when it offers worse or equal probabilities (Reyna & Brainerd, 2008). According to cognitive-experiential theory, low probabilities represents smaller samples. This is an example of the *denominator neglect*, our tendency to ignore the denominator and focus on the numerator instead. Research has shown that even when subjects are presented with different denominator (one reason that people ignore the denominator is because it is often the same), they still perceive the risk as higher where the numerator his higher (9 out of 11, and 10 out of 13) (Reyna & Brainerd, 2008). The subjects tended to choose the latter one, because 10 is greater than 9.

Although the study above was about picking the "right" bowl with the highest likelihood of picking a colored jellybean out of, it illustrates an interesting point in decision-making. Imagine if the two bowls instead were two treatment programs for a given disease. Probability information is presented to them regarding the potential risks of each method. The example above shows how people fail to interpret, understand, and evaluate probability information correctly and thus can lead to more substantial errors than not winning the $5 prize. Research has also been done in more medical settings.

In a study by Sheridan and colleagues (Sheridan, Pignone, & Lewis, 2003), participants answered a three-question numeracy scale about probabilities. The numeracy scale was part of a study where the participants were asked to choose from two hypothetical drug treatments. They were given the baseline risk information and would calculate the effect of one of these drug treatments. They found that 70 % of the participants perceived themselves to be good with numbers. However, the percentage of participants that answered the three numeracy questions correctly was only 2 %. Another study found that physicians tend to overestimate their patients level of literacy (Bass III, Wilson, Griffith, & Barnett, 2002). In this study, the researchers wanted to see how accurately the residents could determine the patients literacy abilities based on clinical interactions. The residents perceived ninety percent of the patients to have no literacy problems, when in fact thirty-six percent of the patients scored six or below on the REALM-R (Rapid Estimate of Adult Literacy in Medicine - Revised). The REALM-R is a revised instrument of the REALM (Rapid Estimate of Adult Literacy in Medicine) and the results in this study provided by the REALM-R correlated with the REALM and the WRAT-R (Wide Range Achievement Test - Revised) at .72 and .78 respectively. These results suggest that both patients and physicians have a tendency to overestimate the patient's level of literacy.

Research has demonstrated gaps in physician-patient risk communication (Gurmankin, et al., 2004). Risk communications from physicians play an important role in patients risk perceptions, especially in light of the various potential pitfalls in risk communication (poor numeracy, unrealistic optimism effect, time constraint, conservatism, and defensive processing of risk information). Another factor that affects how we perceive probability information is how the information is presented (i.e., format manipulations). In Bayesian reasoning, presenting probability information in frequency rather than percentages has been shown to facilitate normatively correct solutions (Gigerenzer & Hoffrage, 1995).

Effects of Numerical Presentation Format

We have seen how making independent probability estimates is hard, and how our numeracy affects our ability to make use of stated probabilities. There is also another important set of influences on our perception of risk, namely how probability information is presented to us. How do people interpret and perceive different numerical formats? In the present study, numerical information involves two formats: natural frequencies (e.g., 1 out of 10) and standard probability (e.g., 10 %). Some researchers have argued that humans find frequencies easier to comprehend because of our evolutionary history (Cosmides & Tooby, 1996; Gigerenzer & Hoffrage, 1995; Reyna & Brainerd, 2008). Frequencies are directly observable and thus easier to understand than artificial concepts such as percentages, which do not occur in nature. While ten percent and one out of ten mathematically mediate the same message, they are not psychologically equal. Gigerenzer and Hoffrage (1995) demonstrated that the frequency format does indeed facilitates Bayesian reasoning.

In probability theory, Bayes theorem is widely known as a theory to calculate single-event probabilities. Bayesian reasoning is our ability to estimate the posterior probability given the necessarily probability information. One example often used to demonstrate Bayesian inference is the so-called mammography problem. It contains all the necessarily probability information (i.e., base rate, hit rate, and false alarm rate) to infer the posterior probability of the subject testing positive in the problem to actually have breast cancer (the positive predictive value of the diagnostic test). However, even physicians struggle with this problem. In one study, a vast majority of physicians estimated the posterior probability of breast cancer to be between 70 and 80 percent, when in fact the correct posterior probability estimate was close to 8 percent (Eddy, 1982; Gigerenzer & Hoffrage, 1995). It is argued that Bayesian reasoning is facilitated by frequencies. Although mathematically speaking, communicating probability information in frequencies or percentages makes no difference. They are, however, not psychologically equivalent. It is argued that, from an evolutionary point of view, people are tuned in to the frequency format rather than the percentage format (Gigerenzer & Hoffrage, 1995). We "prefer" frequency format because it is the information format we have used long before any probability theory emerged. With similar problems as the mammography problem, cognitive biases (e.g., the conjunction fallacy; assuming specific events are more probable than more general ones, and overconfidence bias; when subjective confidence in probability judgments exceeds the objective accuracy) have shown to decrease when the questions were changed to frequency formats, rather than percentages (Gigerenzer & Hoffrage, 1995).

This research implies that natural frequencies facilitate our ability to reason with probabilities. However, some findings indicate that presenting probabilities as frequencies could affect our risk perception in other ways. For instance, another study showed that primarily people high in numeracy benefitted from the natural frequency format manipulation in a Bayesian reasoning task (Chapman & Liu, 2009). This suggests that the frequency format, however natural to us, does require a certain level of numeracy ability in order to be helpful. In another interesting study by Halpern and colleagues (Halpern, Blackman, & Salzman, 1989), they investigated perceived safety when presented with oral contraceptive risk information using six different formats. Although the comparison between probability (percentages) and frequency was not specifically done, data from the study indicates that the two formats did not lead to different perceptions of safety (1989; Siegrist, 1997). This contrasts with a study by Siegrist (1997), which suggests that our willingness to pay for risk-reducing products are affected by the numerical format in which the probability information is presented in. The participant's willingness to pay for a new and safer product was measured across four scenarios presenting the risks associated with an old and a new medicine, either in percentages or frequencies. The results showed that the participants in the high risk and frequency condition were willing to pay more money than participants in both high risk and percentages condition, and low risk frequency condition (Siegrist, 1997). Siegrists´ experiment was similarly designed to that of Stone and colleagues (Stone, Yates, & Parker, 1994), which compared incidence rates (number of new cases per population during a given time period) with the relative risk. While incidence rates contain base-rate information, the relative risk measure does not. Ergo, the two formats do not contain the same amount of information. The subjects presented with the relative risk showed significantly more willingness to pay for improved tires (to prevent car accidents), compared to the subjects confronted with the incidence rate. Similarly, a study where subjects judged the likelihood for patients hospitalized with mental disorder to exert violence a given time after discharge showed that the judges estimated that the patients had higher likelihood of harming someone if that likelihood was derived from a frequency rather than a percentage (Slovic, Manahan, & MacGregor, 2000). The perceived risk associated with the likelihood of a patient harming someone was greater in the frequency format than in the probability format. However, it is argued that frequencies evoked more alarming images. One possible explanation is that people find percentages harder to relate to, whereas frequencies could contain a sample size more manageable and attributable.

Format manipulations have proven to affect how people interpret and perceive likelihood information. The research on Bayesian reasoning seems to indicate that frequencies (relative to percentages) facilitate our ability to reason with probabilities, even though research has also shown that less numerate individuals may not benefit from such format manipulations (Dieckmann, et al., 2009). On the other hand, the study by Siegrist (1997) and Slovic and colleagues (Slovic, et al., 2000) indicate elevated subjective risks when probabilities are given as frequencies (which may or may not be a good thing). To further complicate matters, it is often the case in real life that we are rarely exposed to numerical probability information alone. Usually, numerical probabilities or risks are embedded in anecdotal information about people's experiences or some other kind of narrative contextual information. Currently, very little research exists that evaluate the effects of numeracy and format manipulations on probability or risk judgments in the context of such information.

Contextual or Narrative Evidence Versus Statistical Evidence

As mentioned above, the manner in which numerical probabilities are presented to us can seemingly affect our perception of risk and our ability to reason soundly. Numerical probabilities are, however, rarely presented entirely on their own. Quite often, they are embedded in a richer context of other information, such as anecdotal evidence and personal narratives. Narrative information, such as an eyewitness testimony, is suggested to have more influential power than do statistical information.

Base-rate information is essential when deriving statistical information and probabilities about risk. However, studies have shown that people tend to ignore this important information. In a classic study on the so called vividness effect, Borgida and Nisbett (Borgida & Nisbett, 1977) presented undergraduates with mean course evaluations given by students who previously took the course. These course evaluations were either supported with base-rate information (i.e., they were given as mean evaluations of a large sample of previous students), or given face-to-face (by a few previous students). Base-rate information proved to have very little effect on choice of course, whereas subjects in the face-to-face condition were very influenced. Why do people ignore base-rate information in favor of more concrete and vivid information provided by only a few individuals? One reason may be that people feel they can relate more to narrative information given by a few. Base-rate information can also seem abstract, distant and preprocessed. Borgida and Nisbett argued that processing information with your own senses (e.g., the face-to-face condition above) makes it feel like it was collected firsthand rather than simply observing preprocessed numerical probabilities and base-rates (1977). And as in the affect heuristic described earlier, one can argue that people attach importance to events invoking emotions. Concrete and vivid information (narrative evidence), as opposed to abstract information (statistical evidence), is likely to be more detailed and thus making it seem more probable and real (Anderson, 1983; Ross, Lepper, & Hubbard, 1975).

Related to conservatism, *Belief Perseverance* refer to peoples tendencies to hold on to their initial beliefs even when that belief is logically inferior (Anderson, 1983). This tendency is associated with the availability heuristic; abstract information could be less memorable than concrete and vivid information. Even if the concrete information is statistically and logically inferior, belief perseverance is stronger when initial beliefs is based on concrete and vivid information (Anderson, 1983). Concrete and vivid information also tend to be richer in details, which may make it more believable. Interestingly, in Andersons study, beliefs based on weak, but vivid and concrete information were more prevalent in perseverance than abstract information.

A more recent, and particularly interesting, study tested the use of narrative and statistical evidence in subjects varying in numeracy (Dieckmann, et al., 2009). Decision-makers are rarely presented exclusively with either numerical or narrative information, but rely on both sources. After they have been presented with this information, it is up to the decision-makers to judge the degree to which the information is accurate and trustworthy. A key factor in Dieckmann and colleagues´ study is numeracy. Research has shown that less numerate subjects are more prone to format manipulations - mathematically equal probabilities presented in frequency and percentages where interpreted differently - and they are more affected by nonnumeric information sources (Dieckmann, et al., 2009; Peters, et al., 2006). Several studies support this tendency, but one demonstrates the opposite effect. Chapman and Liu (2009) showed the reverse effect - the high numerate participants were more affected by format manipulations than the less numerate. One reason could be individual differences in interpretation of frequencies. One study reported that a majority of participants interpreted frequencies as single-event probabilities (Brase, 2008). However, Dieckmann and colleagues hypothesized that less numerate subjects would display a greater variance in perceived risk, and that they would be more affected by format manipulations (probability and frequency). They hypothesized that the presence of narrative evidence would affect the less numerate more. It is, however, expected that decision-makers vary in numeracy. And as demonstrated in their study, people low in numeracy could put more emphasis on other sources of information since they don't quite know how to handle numerically stated probabilities. Equivalent probability information communicated in different ways (contextual or statistical; frequencies or percentage) may lead to subjects reaching entirely different conclusions, or probability estimates.

The subjects in Dieckmann and colleague´s study were presented with a written intelligence forecast concerning the probability of a terrorist attack, followed by questions about perceived risk associated with this hypothetical attack. The intelligence forecast was presented with or without narrative evidence and the stated probability was either presented in a verbal, frequency, or percentage format. When the narrative was included, less numerate subjects still perceived the risk to be greater than the more numerate subjects. This may be because they paid less attention to the numerical likelihood when the narrative was present. As mentioned earlier, less numerate subjects are thought to focus more on the narrative information even when numerical probabilities are present, and the more numerate subjects on the numerical likelihood. This study is a great example of how risk perceptions are influenced by various information formats. However, Dieckmanns and colleagues´ study used a contrived terrorism forecast scenario to elicit subjective risk judgments. Thus, whether this effect applies in more commonly encountered risk judgment contexts is not known.

The Present Study

Decision-making is no easy process. We are influenced by a series of variables that govern our perceptions and beliefs. Heuristics that primarily should facilitate and aid decision-making has been shown to, on occasions, do the opposite. We have seen how people’s level of numeracy can affect perceptions of risk in health related scenarios and how probability information presented as frequencies or percentages can be interpreted differently. Dieckmann and colleagues, among others, demonstrated how narrative evidence (contextual probability information) could influence our perception of risk. When making decisions, especially in health related situations, it is important to map out the factors that could lead to adverse decision-making.

In this study, subjects were presented with probability information regarding side effects of the swine flu vaccine from 2009. The information was either rich in detail and concrete (contextual information in the form of a televised newscast), bare and only in the form of pure numerical probabilities, or both. Participants were then asked about their subjectively perceived risk. We expected to see a substantial variation in risk perception varying in which of these groups the participants were recruited in.

In 2009, approximately 4.8 million populated Norway, and about 2.2 million of chose to take the vaccine (Rustad, 2009). Of those 2.2 million, 801 reported side effects to the Norwegian Medicines Agency in 2009, of whom 200 were diagnosed as serious. Although deaths did occur that year, per usual, none were traceable to the vaccine.

This study aim do show how contextual information affect our subjectively perception of probability. Therefore, the following hypotheses are stated.

Hypothesis 1: The presence of narrative information in the form of a televised newscast would increase subjectively perceived risk.

Hypothesis 2: The influence of the newscast would be modulated by the participant's level of numeracy, such that those lower in numeracy would be more influenced by the presence of the newscast context.

Hypothesis 3: The format of the numerically presented probabilities would influence subjectively perceived risk such that participants seeing the probability as a frequency would experience higher risk than those seeing it as a percentage.

Method

Participants

The sample consisted of 75 university students, primarily undergraduates, between the ages of 19 and 40 years, of whom 79 % were female (*n* = 59). The experiment had been approved as course requirement for first year psychology students, explaining the 74 % that reported they belonged to the Faculty of Health (*n* = 58). Since no applications were sent to REK (Regional Ethics Committee), only participants associated with the University of Tromsø were recruited.

Sampling Procedures

As mentioned above, the experiment had been approved as course requirement for first year students of psychology. E-mail was sent out to all bachelor- and first year students of psychology registered, containing an explanation of the study's purpose as well as an estimation of time required and reward for completion. "Adverts", containing the same information, were also posted at the University's online course-room and at the University's Facebook-page.

Design

To find out how contextual information affects our subjective perception of risk, participants were randomly selected into one of three levels (or conditions). The three information conditions refer to *Probability Only*, *Probability & Newscast*, and *Newscast Only*; varying in how the information was communicated to the participants (see Appendix A for a complete version of the questionnaire, the other versions were either without the contextual information or without the numerically stated probabilities). Two conditions contained two sub-conditions, a manipulation of numerical probability format (i.e., numerical probabilities as frequency or percentage). In total, five questionnaires were developed to this study. The experiment was run between groups in a 2 x 3 design (format manipulation; and information conditions).

Materials

A written questionnaire was developed for this experiment. It consisted of six to seven parts (subjects in the Newscast Only condition were not presented with a translated version of the source credibility scale, see below).

The front page was dedicated to information regarding the experiment. This included an explanation of the purpose of the study (to see how different ways to communicate numerical probability information leads to different interpretations), what is required by the participants, location and time estimated to complete. It also contained information regarding withdrawal, confidentiality and reward for completion. The participants were notified about a debriefing-sheet (see Appendix B), which they could take with them after completing the questionnaire. The debriefing-sheet contained information and the sources on which the information used in the questionnaire was based.

Page two covered basic questions concerning demographical information (i.e., gender, age, marital status, years of higher education and what faculty each student belonged to). We also included "present life situation" to elaborate whether students held jobs on the side, studied part-time, or similar situations. The manipulations of the experimental design itself were implemented on page three of the questionnaire, where participants, depending on which condition and sub-condition they were in, were presented with contextual information and/or statistical evidence and format manipulations.

All participants were presented with information regarding the side effects of the swine flu vaccine taken by approximately half the Norwegian population in 2009.

In the Probability Only condition, participants were presented with a brief written "fact box" containing numerical probabilities in either frequency or percentage format. In the condition Probability and Newscast, the same "fact box" with numerical probabilities in either frequency or percentage was presented, but was also accompanied with a televised newscast on the relative increase in side effects from 2008 to 2009 caused by the swine flu vaccine. In the Newscast Only condition, the televised newscast was presented alone (the televised newscast can be obtained by contacting the author).

The numerical probabilities in the "fact box" were derived from the annual side effects report of the Norwegian Medicines Agency (2010). The televised newscast was aired on "Morgennytt" in April 2010 by the Norwegian national broadcasting corporation (NRK). The newscast told of a relative increase in the number of side effects from 2008 to 2009 and attributed these to the massive vaccination effort to counter the swine flu epidemic. Although numbers were mentioned in the newscast, no basis for comparison and no base-rate information was provided. Thus, it contained no actual probability information regarding the risk of side effects from the swine flu vaccine.

The next section contained questions concerning perceived risk developed especially for the purpose of this study. Five questions were presented where the participants would rate, for example, how likely they thought they would experience side effects after vaccination. Other questions asked how dangerous they thought the vaccine was, or how willing they would be to take it. For example, when asked how likely they thought it was that they would experience side effects after vaccination, they would answer the questions on a 5-point scale ranging from "very unlikely" to "highly likely".

Question 1 asks the subjects to rate how likely they believed it was that they would experience side effects if vaccinated against the swine flu. Question 2 asks how willing, given the information presented to them earlier, they would be to take the vaccine if a similar situations were to occur in the future, ranging from highly unwilling to highly willing. The third question was about whether they had changed opinion regarding the vaccine after reading the information in the questionnaire about the health risks associated with the swine flu vaccine. Question 4 asks plainly the subjects to rate how dangerous they believe the vaccine to be. The fifth and final question asks the subjects to rate how big or small chance there is that they would personally experience side effects by vaccination against the swine flu.

Subsequently, participants in all but the Newscast Only condition would answer a translated version of the source credibility scale developed by McComas and Trumbo (2001). The five-question scale asked subjects to rate how trustworthy, unbiased, accurate, fair, and whether the information presented in the fact box on page three tells the whole story or not, on a 5-point scale. After completing the source credibility scale, participants in all three conditions were presented with a numeracy scale.

To assess numeracy, the questionnaire contained a translated version of a commonly used numeracy scale was presented to all participants (Lipkus, Samsa, & Rimer, 2001). It contained questions about probabilities and risks. For example, the first question asks the subjects to imagine throwing a coin a thousand times. Then to estimate how many times, of the thousand tosses, the coin would land on heads. Another question asks the subjects which of three options represents the highest risk of getting a disease (two versions of this question was posed; one in frequency and another in percentage). Similar questions constitute the numeracy scale.

Procedure

All participants were presented with information regarding side effects of the swine flu vaccine taken by approximately half the Norwegian population in 2009. The participants were randomly assigned to one of five conditions (see section on Design, above) varying on how the information about the side effects was communicated. The study was presented in form of a questionnaire.

The experiment was exclusively held in one of three, almost identical, seminar-rooms, each with the potential to contain up to thirty people. The rooms were primarily chosen by course-schedule since lectures and seminars often were held at these locations, and because it was important to keep the location itself as a constant. These seminar-rooms were chosen because the researcher wanted to carry out the experiment groups-wise, rather than one-by-one. However, the number of participants in each session varied, ranging from one to fifteen. The experiments main manipulation was done over 3 levels, with two of those levels each being further subdivided into two format groups, yielding a total of 5 sub-conditions (see section on Design). The 75 participants were randomly assigned into one of the 5 groups.

After the participants were informed about the experiments nature and purpose, they were given the signal to begin. However, they were instructed to stop when they reached page three (where the manipulations of the experimental design was implemented). After either reading the fact box or viewing the newscast, they were instructed to complete the questionnaire without any further stops. On average, the participants used approximately fifteen minutes to complete the questionnaires. At completion, the participants would receive the reward consisting of two lottery tickets valued 50 NOK.

Analysis of power (measured at the 0.05 significance level) showed that in order to obtain at least .8 in power, the number of participants per condition had to be about 15. With 15 participants in each of the 5 conditions, we obtained a power of .842, meaning an 84 % chance of finding an effect where one exists.

Analyses

Data were collected and entered into SPSS Version 18 using an independent design (between-groups or between-subjects). Meaning, each experimental level or condition included different groups of people. This allows for measure of variability between groups in variables such as risk perception and numeracy.

Prior to main analyses, indexes of subjectively perceived risk and source credibility were compounded by summing the responses to the respective rating questions into two variables.

Before analyzing the data, an assessment of skewness was performed. Values of skewness should be zero, or close to zero, in a normal distribution (the further away from zero the value is, the more likely it is that the data are not normally distributed). All variables had values within an acceptable range (± 2 for skewness), except for age (due to a majority being first year undergraduate students) (West, Finch, & Curran, 1995). A significance level of $\alpha = .05$ were used for all tests.

One-way or two-way between group Analysis of variance or covariance (ANOVA or ANCOVA) was used to evaluate any potential differences in means between the conditions. Post hoc comparisons were performed using a Tukey HSD (Honestly Significance Difference), which is a relative conservative test. The post hoc test shows which specific conditions significantly differ from specific other conditions. The ANOVA also presents descriptive statistics. The descriptive statistics, i.e. mean, standard deviations and confidence intervals, are presented in tables or in text. The Partial eta^2 shows how much variance (in percentage) in the dependent variable can be accounted for by the independent variable, and was also obtained from the ANOVA. Further analysis were done by using both the ANOVA and the ANCOVA (analysis of covariance), which shows whether the conditions differ on a dependent variable while controlling for another variable (covariate).

Results

Sample Characteristics

In the sample (N = 75), the mean age was 22.57 (SD = 3.94, *skewness* = 2.25) and 79 % were female (n = 59). The relative high skewness value for age was expected since the participants mainly were undergraduates and thus relatively young. All participants had completed high school. 72 subjects reported how many years of higher education they had, of whom 71 % had 2 years or less. The 95 % confidence interval for mean Perceived Risk from all conditions ranged from 8.55 to 9.93 (M = 9.24). The distribution of numeracy scores was negatively skewed (*skewness* = -1.28, SE = .27, M = 10.29, SD = 2.82), and the distribution of perceived risk was slightly positively skewed (*skewness* = .17, SE = .27, M = 9.24, SD = 2.99). The negative skewness value for numeracy is most likely the result of the participant's educational level (negative value indicate a majority of high scores). Table 1 shows descriptive statistics for gender, age, and numeracy in the three main levels.

Table 1.

Sample Characteristics by Information Condition

	Gender			
	Male	Female	Mean Age	Mean Numeracy
Information Condition	(n = 16)	(n = 59)	(N = 75)	(N = 75)
Probability Only	10	20	22.97 (4.87)	10.53 (2.70)
Probability & Newscast	5	25	22.03 (3.39)	10.53 (2.73)
Newscast Only	1	14	22.87 (2.85)	9.33 (3.23)

Note. Standard deviations are given in parenthesis.

In order to ascertain a reasonable level of similarity between the experimental groups formed by the Information Condition manipulation, we performed tests of differences between the groups on gender distribution, age, and numeracy. Pearson's χ^2 value of 4.89, p = .09, shows that there is no statistically significant difference in gender distribution between the Information Conditions, despite a somewhat larger proportion of female participants in the Newscast Only condition. As can be seen from Table 1, mean age per Information Condition was nearly the same, and the confidence intervals overlapped substantially. The 95 % confidence interval for total mean age ranged from 21.67 to 23.48 (M = 22.57). No significant differences was found between groups, $F(2, 72) = 0.47$, p = .63. Neither was there any significant difference in numeracy between Information Conditions, $F(2, 72) = 1.09$, p = .34.

Effects of Information Condition on Perceived Risk

Descriptive statistics for perceived risk by Information Condition and Probability Format are presented in Table 2.

Table 2.

Mean perceived risk by Information Condition and Format

Information Condition		N	M	SD
Probability Only	Percentage	15	8.13	2.09
	Frequency	15	7.13	2.67
	Total	30	7.63	2.41
Probability & Newscast	Percentage	15	10.40	2.82
	Frequency	15	9.53	3.14
	Total	30	9.97	2.97
Newscast Only		15	11.00	2.62

Note. Mean perceived risk among Information conditions and Probability Format.

To evaluate the effect of the Information Condition manipulation on Perceived Risk, we performed a one-way ANOVA. The analysis showed statistically significant differences in Perceived Risk between the Information Conditions, $F(2, 72) = 9.676$, $p < .001$, $\eta^2_p = .212$. Thus, Information Condition manipulation account for 21 % of the variation in the participants perceived risk. Figure 1 below shows mean Perceived Risk by Information Condition, and illustrates how contextual information affects our perception of risk even when the numerical probability information is present.

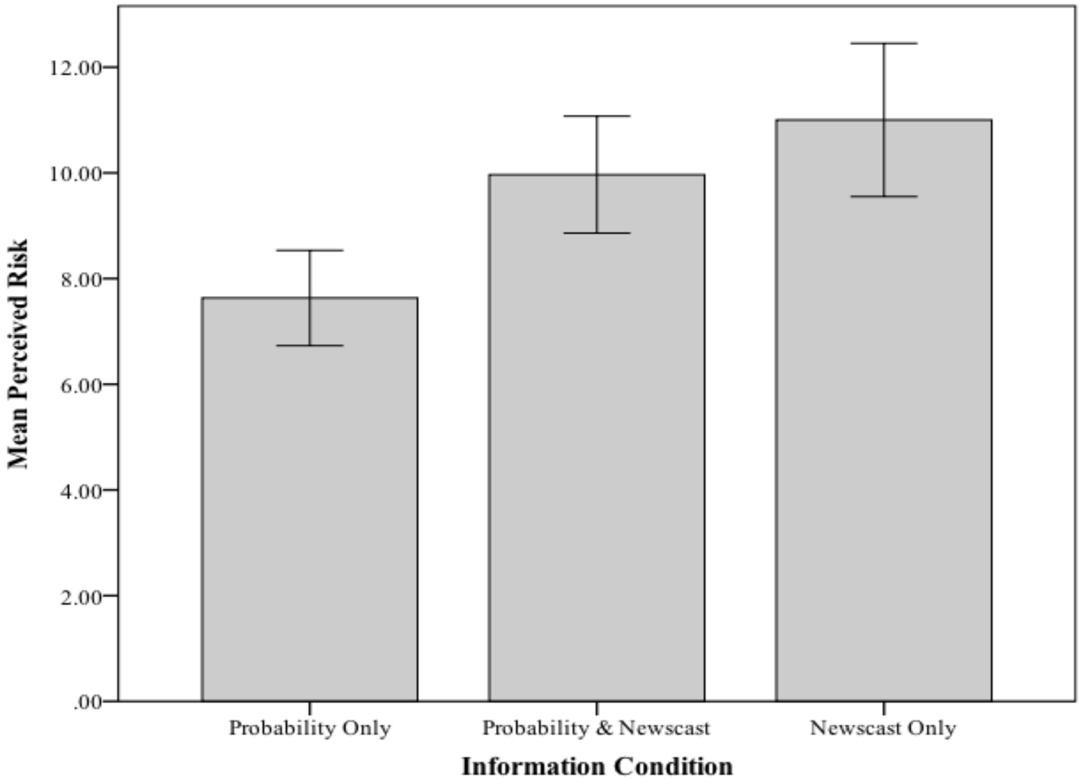

Figure 1. Mean perceived risk by Information Condition. Error bars are set at 95 % confidence interval.

Post hoc comparisons using Tukey HSD test indicated that the mean perceived risk for the Probability Only condition (*M* = 7.6, *SD* = 2.4) was significantly lower than both the Probability & Newscast condition (*M* = 9.9, *SD* = 2.9, *p* = .004), and the Newscast Only condition (*M* = 11, *SD* = 2.6, *p* = .001). However, the Newscast Only condition did not significantly differ from the Probability & Newscast condition (*p* = .45). The participants perceived the risk as significantly greater when they were presented with the newscast.

Although a preliminary analyses revealed only a very weak and non-significant negative correlation between Numeracy and Perceived Risk for the whole sample (*r* = -.13, *p* = .13), a one-way ANCOVA was also run with Perceived Risk as the dependent variable, Information Condition as independent variable, and

Numeracy as the covariate. The Information Conditions was statistically significant, $F(2, 71) = 9.15$, $p = < .001$, $\eta^2_p = .21$. However, numeracy was not statistically significant, $F(1, 71) = 0.59$, $p = .44$. Comparing the analysis of covariance with a one-way ANOVA reported above, there is practically no difference.

Effects of Probability Format on Perceived Risk

To test for any effects of Probability Format on Perceived Risk (including a possible interaction with Information Condition), a two-way ANOVA was performed using Probability Format (Percentage versus Frequency) and Information Condition (Probability Only versus Probability & Newscast; the Narrative Only condition was naturally excluded from this model, as no numerical probabilities were presented to these participants) as independent variables, and Perceived Risk as the dependent variable. Again, there was a main effect of Information Condition, $F(1, 56) = 11.1$, $p < .01$, $\eta^2_p = .17$, but no significant main effect of Probability Format, $F(1, 56) = 1.78$, $p = .19$, $\eta^2_p = .03$, and no interaction between Information Condition and Probability Format, $F(1, 56) = 0.0$, $p = .92$, $\eta^2_p = .00$. Rerunning this model as an ANCOVA, using numeracy as a covariate did not noticeably alter these results. Figure 2 illustrates mean Perceived Risk by Probability Format and Information Condition.

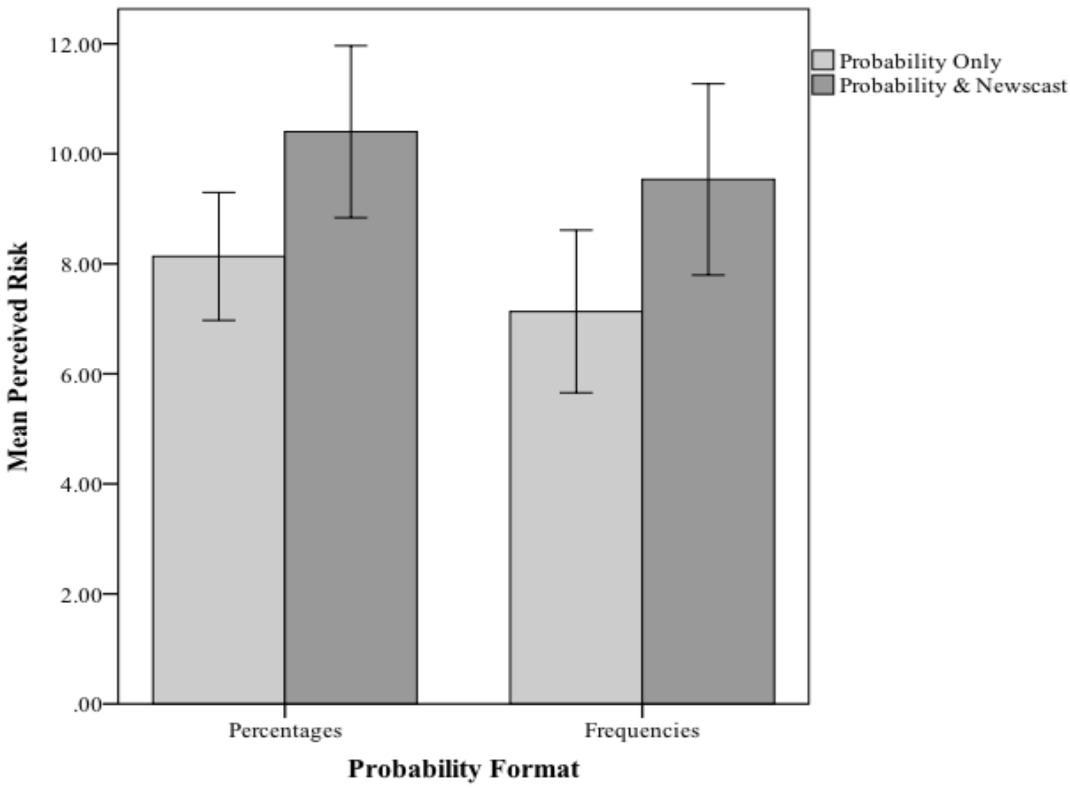

Figure 2. Mean perceived risk by Probability Format. Error bars are set at 95 % confidence interval.

Effects on Source Credibility

The source credibility scale was presented to participants in both the Probability Only and Probability & Newscast condition. It contained five questions were the subjects rated the trustworthiness of the numerical probability information presented in the beginning of the questionnaire on a 5-point scale. The sum of source credibility ranged from 5 to 24 (M = 16.58, SD = 4.09). ANOVAs showed no significant difference between groups in how they rated the credibility of the information source. Whether the participants reported high source credibility or low, it did not significantly affect Risk Perceptions.

Numeracy and Perceived Risk

The participant's score on the numeracy scale had a range of 12 (1 to 13). A cut-off value was set at 11 because the participants were highly educated and thus we expected better performances on the test. Values from zero through ten were labeled as low in numeracy (n = 34, M = 9.24, SD = 2.97), whereas values ranging from eleven through sixteen were labeled as high (n = 41, M = 9.24, SD = 3.04). However, the participant's numeracy level did not significantly affect risk perception, $F(1, 73)$ = 0.0, p = .99. As illustrated by figure 3, the less numerate participants showed a trend toward greater variance in risk perception than did the more numerate.

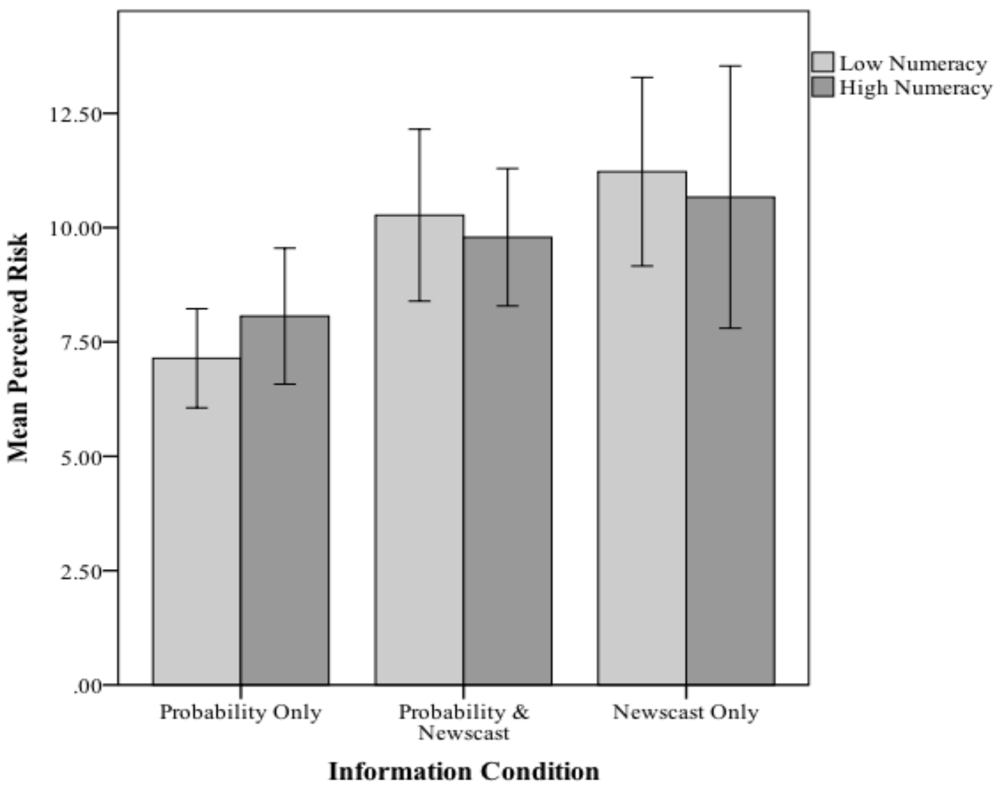

Figure 3. Mean perceived risk by Information Conditions varying in numeracy. Error bars are set at 95 % confidence interval.

Discussion

As a main hypothesis, we expected the risk perception to be modulated by how the information was presented, i.e. the information conditions. Specifically, we expected that the presence of contextual information would increase the participants perceived risk. We also hypothesized that the influence of the newscast would be modulated by the participant's numeracy level. That is, more numerate participants would be able to sort out the relevant probabilities even when presented with the newscast.

The results suggest that contextual information really does affect our perception of numerical probabilities. Specifically, when a newscast is presented along with numerical probability information, people perceive the risk as greater than when the numerical probability is presented alone. What is more, perceived risk is nearly as high when the newscast and the numerical probability both are presented as when the newscast is presented alone without any numerical probabilities. In other words, numerical probabilities do not seem to provide an effective anchor for perceived risk when contextual information is present.

The effect of information condition clearly indicates a potential gap in how probability information is presented and the recipient's assessment and perception of it. The participant's relatively low perception of risk in the condition where numerical probabilities were presented alone could be due to the fact that they were able to distance themselves from the risk. Reading numerical probabilities in form of frequencies or percentages could make the risk seem more abstract and personally irrelevant. This would certainly explain how participants, so similar across all conditions, reported such low risk perception when exposed to numerical probabilities alone compared to when the newscast was included. It is also a possibility that reading such cold and distant numerical probabilities of risks have minimal influence on people, whereas concrete and vivid (probability) information have greater influence (Anderson, 1983; Borgida & Nisbett, 1977). In a study by Gurmankin and colleagues (2004), they found that when presented with probability information in verbal format, a tremendous variation was observed in judgments. One explanation for this variation in perceived risk by how probability information is communicated could be that contextual information involves, in a higher degree, the use of our senses, compared to reading numerically stated probabilities. People do have a tendency to prefer, or emphasize, vivid and concrete information to abstract information (Borgida & Nisbett, 1977; Slovic, et al., 2004). Thus, probability information presented in the form of a patient narrative, for example, would likely elicit stronger reactions from the recipient. In the case of the swine flu epidemic and the vaccine, there were several interviews (i.e., personal narratives) concerning the aftermath. Although these narratives were about a few, more serious, cases where the side effects of the vaccine were more prominent, it is still something that could influence the general publics attitudes and beliefs toward the vaccine and its effect. And research has shown that vivid and concrete information, even if logically inferior to other information sources (such as numerical probabilities), often can prevail (Anderson, 1983).

Anderson (1983), among others, found that vivid and concrete information has significantly greater impact on people’s memory than abstract information. People are much more likely to remember events that hold some significance to them, i.e. relying on the availability heuristic, or affect heuristic (Kahneman & Tversky, 1973; Keller, et al., 2006; Loewenstein, et al., 2001; Slovic, et al., 2004). Concrete and vivid information is generally more available to recollection than abstract information.

Contextual information is also usually richer in detail, which could contribute to its believability. It is suggested that people are much more likely to hold on to initial beliefs when based on concrete and vivid information, even if logically inferior. Thus, contextual information could be perceived as more reliable and valid than numerical probabilities. And since people are so easily affected by contextual information, it could lead to an overestimation of likelihood of risk. This study demonstrated the substantial effect of communicating probability information in contextual form versus numerical probabilities. The tendency to be affected by vivid and concrete information is supported by previous research. The rather large span of risk perceptions between the three ways of communicating probabilities, could also suggest a tendency to overestimate (or underestimate in the case where numerical probabilities were presented alone).

The results found in this study also states that the tendency to perceive lower risk disappears when the newscast is introduced. If the numerical probability information alone guides participants to subjectively lower risk perceptions, it would be reasonable to think that the numerical probabilities would function as an anchor when the newscast was included, keeping the risk perceptions at least somewhat lower than reported. However, this was not the case. In the conditions where both the numerical probability and newscast, and the newscast alone were presented, almost no difference in perceived risk was found. The numerical probabilities presented in the "fact box" included all the necessary information to, at least roughly, infer the estimated probability of experiencing side effects of the vaccine.

The contextual information in this study was a televised newscast from one of the nations oldest and largest radio and television broadcasting companies in Norway. A vast majority of the Norwegian population follows routinely some form of news broadcasts (either the one used in this study or similar ones). It is interesting that something so mundane, aimed to inform and at times educate people, can lead to such alarmingly high perceptions of risk. It is possible that the presence of contextual information have such a great influence on us, that any other information aimed to assist and aid our decision-making is deemed redundant. This could explain the lack of a difference between the two conditions.

Embedded in the study was also a numeracy scale, assessing the participant's comprehension of probabilities of risks and basic probability formats (such as understanding the magnitude of percentages and frequencies when associated with diseases). However, numeracy had no significant effect on risk perception. A possible explanation for this is found in the sample characteristics. The participants were primarily undergraduates, i.e. students with some degree of higher education, thus they do not represent the best possible sample for a more general population. This is supported by the reported skewness values, which were somewhat high and negative, suggesting that the participants scored relatively high on the numeracy scale (i.e., a ceiling effect). Although the tendencies are very small, participants scoring lower on the numeracy scale perceived the risk as less than did those scoring higher on the numeracy scale when presented with only numerical probabilities. On the other hand, those scoring low on the numeracy scale perceived the risk as greater than did those scoring high on both conditions when the contextual information was present. This is consistent with findings from Dieckmann and colleagues (2009); participants scoring low on numeracy would place more emphasis on the contextual information than the numerical probabilities. This tendency, although non-significant, could be due to the samples educational level as mentioned earlier.

The numeracy scale, developed by Lipkus and colleagues (2001), was tested on well-educated participants. The participants struggled with several of the questions concerning risk and numerical probabilities. However, how one performs on a numeracy scale does not necessarily mean that one comprehends the potential consequences of real risk. This study showed a very weak and non-significant correlation between numeracy and perceived risk within the whole sample. As described earlier, numeracy was negatively skewed and perceived risk positively skewed, and this non-significant correlation is likely due to the highly educated sample.

Furthermore, as with numeracy, no significant differences were found between format manipulations (numerical probabilities in frequencies or percentages) in risk perception. This is consistent with some results of previous research, where participants were presented to hypothetical risk scenarios in either frequencies or percentages (Dieckmann, et al., 2009; Gurmankin, et al., 2004). No significant difference was found in perceived risk varying in what format the numerical probability information was presented in. Although the presence of a numeric statement did reduce the variations in risk perception, the effect was minimal. However, it matches less well with the results of Siegrist (1997) and Slovic et al. (2000), who found that numerical probabilities stated as frequencies elicited higher perceived risk than those stated as percentages or standard probabilities.

A study by Dieckmann and colleagues (2009) assessed the source credibility of probability information regarding hypothetical terrorist attack. They found that when the perceived likelihood for the terrorist attack increased, the reported coherence and credibility of the information increased with it. However, this study showed no such effect of source credibility.

This study has demonstrated that equally valid information sources can lead to significantly different risk perceptions. Whether the discrepancy in perceived risk where the narrative was present and where it was not was due to a tendency to over- or underestimate is not known, but we do know that it affects our subjective perception. This could reflect an overestimation when exposed to contextual information, or an underestimation when exposed to numerical probabilities only. It is, however, unknown which is most beneficial.

Limitations and Future Research

This study was approved as course requirement for undergraduate psychology students. That is, students participated in a research experiment as part of the requirements of a course subject. Although there was a skewed gender distribution, no significant difference was found between groups. However, the skewed gender distribution, the relatively low mean age, and the educational level of the participants, as well as the majority of the participants being psychology students, has likely lowered the ecological validity of the study. The sample of research participants is a limitation for generalization of these results. Although the scenario they were presented with is an example of more commonly encountered versions of contextual information, there may be reasons to suppose that young undergraduate students are not a greatly representative of the general public when making judgments about risk. Another variable that could influence participant's performance is prior beliefs and attitudes toward the swine flu vaccine. The probability information presented in the experiment should, by itself, be enough to derive reasonably accurate and objective probability estimate of risk. However, as conservatism and belief perseverance theory has demonstrated, people tend to hold on to initially formed probability estimates even though new information would advise modification of that estimate. When these prior beliefs has been attained through vivid and concrete sources in the beginning, research has shown that it is especially hard to alter ones estimates (Anderson, 1983). Despite this, previous research supports findings attained from this experiment.

In the light of these findings, and this study's limitations, future studies should aim to find out whether people do in fact over- or underestimate the probabilities of perceived risk relative to the actual probability. By letting participants postulate their own estimation prior to the experiment, allowing comparisons to be made, this can be assessed. Furthermore, it would be interesting to investigate people's attitudes and conceptions within the topical domain before one introduces manipulations and information.

To our knowledge, very little research has been done on this particular field, whether contextual information affects our perception and understanding of numerical probabilities, but much is needed. Learning the best possible way to communicate probability information would be beneficial and serve accommodating when assessing risk and making judgments under uncertainty in the future. This study has shown that people have a tendency to be affected by contextual information. The distance in subjectively perceived risk between the conditions where contextual was not present, and where it was presented alone shows how influential it is.

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Appendix A

Forespørsel om deltakelse i forskningsstudie
"Forståelse og opplevelse av helseinformasjon"

Formålet med studien: Mennesker oppfatter beskrivelser og tallpresentasjoner om helse og sykdom svært ulikt. Studier viser at helseinformasjon ofte oppfattes på litt andre måter enn slik formidleren mente. I denne studien ønsker vi å belyse noen mulige årsaker til dette, slik at helse-informasjon kan presenteres på en best mulig måte.

Hva innebærer studien? Du forespørres herved om å delta i studien. Undersøkelsen innebærer at du fyller ut et spørreskjema som stiller en rekke spørsmål om hvordan du oppfatter utvalgte måter å presentere helseinformasjon på. Du vil også få se et nyhetsinnslag hvor informasjon om et helserelatert fenomen presenteres. Deltakelsen varer i ca. 15 minutter.

Hvor gjennomføres studien? Undersøkelsen gjennomføres ved Universitetet i Tromsø (nøyaktig tid og sted avtales individuelt). Du vil sitte i et større rom sammen med andre som har fått samme forespørsel, men du jobber individuelt med å svare på undersøkelsen og har ingen øvrig kontakt med de andre deltakerne. Det vil være en viderekommen masterstudent i psykologi som leder dette, og som gir instrukser om hvordan utfyllingen skal foregå.

Frivillighet: Det er frivillig å delta. Du kan når som helst under deltakelsen trekke deg fra under-søkelsen, om du ønsker det, uten å oppgi noen forklaring og uten konsekvenser for deg. Når du har fullført mottar du et symbolsk honorar i form av to Flax-lodd til en verdi av til sammen kr 50. Deltakelsen din er da avsluttet. Undersøkelsen er anonym, da det ikke blir registrert navn eller andre opplysninger som kan knytte dine svar til din person.

Hva skjer med den innsamlede informasjonen: Data registreres anonymt i et statistikkprogram og analyseres for å teste hypoteser. Resultatene søkes publisert i helsevitenskapelige tidsskrift og på relevante konferanser. Ettersom analysene foregår på gruppenivå, vil ingen enkeltpersoner være identifiserbare i disse fremstillingene. Dersom du har spørsmål til undersøkelsen, kan du kontakte prosjektleder Torstein Låg, eller masterstudent Erik Nerva.

Med vennlig hilsen,

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Bakgrunnsinformasjon

Vennligst fyll ut følgende bakgrunnsopplysninger

Kjønn: ☐ Kvinne
☐ Mann

Din alder: ☐ år

Samlivsstatus

☐ Enslig ☐ Samboer ☐ Gift/partner ☐ Skilt
☐ Enke/enkemann

Dagens livssituasjon

☐ Hjemmeværende ☐ Arbeidsledig ☐ Deltidsarbeid
☐ Fulltidsjobb
☐ Skole/utdanning ☐ Sykemeldt ☐ Rehab/Attføring
☐ Arbeidsufør

Utdanning/arbeid

Fullført videregående skolegang ☐ Ja ☐ Nei

Fullført høyere utdanning ☐ Ja ☐ Nei

Antall år høyere utdanning ☐ år

Antall år i arbeidslivet i 100% stilling ☐ år

Fakultetstilhørighet:

☐ Fakultet for Naturvitenskap og teknologi

☐ Det juridiske fakultet

☐ Fakultet for humanoira, samfunnsvitenskap og lærerutdanning

☐ Fakultet for biovitenskap, fiskeri og økonomi

☐ Det helsevitenskapelige fakultet

☐ Det kunstfaglige fakultet

Vennligst les informasjonen i tekstboksen under nøye.

I følge bivirkningsrapporten for 2009 fra Statens legemiddelverk tok ca. 45% av den norske befolkningen pandemivaksinen. Av disse rapporterte 0,04% ifra om bivirkninger.

1) Hvor sannsynlig mener du det er at man får en bivirkning hvis man tar pandemivaksinen?

	1	2	3	4	5
Svært usannsynlig					Svært sannsynlig

2) Gitt det du nå vet om helserisiko ved vaksinen, hvor villig vil du selv være til å ta pandemivaksinen dersom en tilnærmet lik situasjon forekomme i fremtiden?

	1	2	3	4	5
Høyst uvillig					Høyst villig

3) Etter å ha lest informasjonen gitt i dette spørreskjemaet, eller nyhetsklippet, om helserisiko knyttet til pandemivaksinen, har du endret meninger om å ta vaksinen?

	1	2	3	4	5
Ikke i det hele tatt					i svært stor grad

4) Hvor farlig mener du det er å ta pandemivaksinen?

	1	2	3	4	5
Helt ufarlig					Meget farlig

5) Hvor stor/liten sjanse mener du det er for at du selv ville erfart bivirkninger ved vaksinasjon av pandemivaksinen?

	1	2	3	4	5
Svært liten					Svært stor

6) Statens legemiddelverk er den primære informasjonskilden til denne saken. Tatt i betraktning hva du nå vet, marker med en sirkel rundt den verdien som best beskriver dine følelser rundt denne informasjonen.

Helseinformasjonen presentert i begynnelsen av spørreskjemaet...:

	1	2	3	4	5
Kan ikke stoles på					Kan stoles på
Er unøyaktig/upresis					Er nøyaktig/presis
Er ubalansert					Er balansert
Forteller ikke hele historien					Forteller hele historien
Er uriktig/feilaktig					Er riktig/korrekt

Spørsmål om sannsynligheter, og om risiko for sykdom

Disse spørsmålene besvares på én av to måter: Enten ved å skrive inn ett tall på svarstreken under spørsmålet eller ved å velge ett av alternativene i en av svarboksene under.

1. **Forestill deg at vi kaster kron og mynt 1000 ganger. Hvis du skulle tippe, omtrent hvor mange ganger ville mynten landet på kron på 1000 kast?**
   _____ av 1000 ganger

2. **I pengelotteriet "Gullgryta" er sjansen for å vinne en 10 kroners premie 1 %. Hvis 1000 mennesker kjøper ett lodd hver, hvor mange av disse vil vinne 10 kroner?**

   _____ av 1000 mennesker

3. **Bilfirmaet "Auto" har et lotteri hvor sjansen for å vinne en bil er 1 av 1000. Hvor mange prosent av loddene vil vinne bilen?**

   _____ %

4. **Forestill deg at vi kaster en vanlig terning 1000 ganger. Hvis du skulle tippe, omtrent hvor mange ganger tror du terningen ville lande på et partall (2, 4 eller 6) på 1000 kast?**

   _____ av 1000 ganger

5. **Hvilket av de følgende tallene representerer størst risiko for å få en sykdom (sett kryss)?**

   ☐ 1 av 100 ☐ 1 av 1000 ☐ 1 av 10

6. **Hvilket av de følgende tallene representerer størst risiko for å få en sykdom?**

   ☐ 1% ☐ 10% ☐ 5%

7. **Hvis person A har en risiko på 1% for å få en sykdom over 10 år, og person B sin risiko er dobbelt så stor som A sin, hva er B sin risiko?**

   _____ %

8. **Hvis person A sin risiko for å få en sykdom er 1 av 100 over ti år, og person B sin risiko er det dobbelte av A sin risiko, hva er B sin risiko?**

   _____ av 100

9. **Hvis sjansen for å få en sykdom er 10 %, hvor mange personer skulle man forvente fikk sykdommen**

   A. _____ av 100 personer
   B. _____ av 1000 personer?

10. **Hvis sjansen for å få en sykdom er 20 av 100, så tilsvarer det en**

    _____ % sjanse for å få sykdommen

11. **Sjansen for å bli smittet av et virus er 0,0005. Omtrent hvor mange av 10 000 personer kan man da forvente blir smittet?**

    ______ av 10 000

12. **Hvilket av de følgende tallene utgjør den største risikoen for å få en sykdom?**

    ☐ 1 av 12 ☐ 1 av 37

Appendix B

Litt informasjon om kildene vi har brukt til det som står i tekstboksen først i skjemaet

Bivirkningsrapporten for 2009 fra Statens legemiddelverk er utarbeidet av Legemiddelverket og de fem regionale legemiddelinformasjonssentrene, RELIS. Folkehelseinstituttets avdeling for vaksiner har også bidratt. Informasjonen gitt i boksen i begynnelsen av spørreskjema er primært hentet fra denne rapporten (1).

Det ble totalt registrert 2914 nye bivirkningsmeldinger i 2009, mot 2184 fra 2008. Dette tilsvarer en økning på ca. 33% (differanse på 730 bivirkningsmeldinger). Denne økningen har først og fremst feste i antall meldinger knyttet til pandemivaksinen (801 meldinger i 2009, 59% av alle vaksinemeldingene (1349)). Omtrent 200 av de 801 bivirkningsmeldinger knyttet til pandemivaksinen var av alvorlig art.

Det er estimert at ca. 2.2 millioner nordmenn tok pandemivaksinen Pandemrix. Av disse meldte 801 i fra om bivirkninger hvorav ca. 200 var av alvorlig art. Det ble meldt om 10 dødsfall etter vaksinasjon med Pandemrix, men ingenting tyder på at det er forårsaket av vaksinen. Det ble også rapportert 16 tilfeller av aborter, forsterdød eller dødfødsler etter pandemivaksinasjon i 2009. Det er heller ikke her funnet direkte tilknytning til pandemivaksinen, og i mange av tilfellene forelå annen alvorlig patologi som kunne forklare aborten eller dødfødselen.

(1) Statens Legemiddelverk (2009). Bivirkningsrapport, seksjon for legemiddelovervåkning. Retrieved from: http://www.legemiddelverket.no/templates/InterPage____82456.aspx (september 2011).