Effects of Culture and Context on Numerical Interpretation of English Verbal Probability Phrases in Health Risk Communication by Second Language Speakers from The Netherlands and India

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Abstract

The present study attempted to investigate the effect of context and cultural dimensions on the numerical interpretation of English verbal probability phrases by second language (L2) speakers, specifically focusing on Dutch and Indian participants. The primary objectives were to explore how contextual and non-contextual sentences related to health risk communication influence the numerical interpretation of verbal probability phrases and to assess the role of culture in this numerical interpretation. For the study, seven sets of 28 sentences, comprising 14 contextual and 14 non-contextual sentences, were created and recorded. Participants (*N* = 136) were randomly assigned to one of the seven sets and tasked with listening to the 28 audio recordings. Subsequently, they were required to provide numerical interpretations of the probability of events (i.e., disease/side effects) occurring after each audio recording. The findings of the study revealed a higher variation in the numerical interpretation of verbal probability phrases in contextual sentences compared to non-contextual sentences. This phenomenon was attributed to the influence of the base rate effect, particularly in the healthcare scenario. Additionally, culture did not affect the numerical interpretation of verbal probability phrases in the study. This result was linked as a consequence of the uncertainty avoidance dimension of culture not being significant among the Dutch and the Indian participants in the study.

Keywords: Verbal Probability Phrases, Health Risk Communication, Second Language Speakers, Dutch, Indians, Context, Cultural Dimension, Uncertainty Avoidance, Individualism

Effects of Culture and Context on Numerical Interpretation of English Verbal Probability Phrases in Health Risk Communication by Second Language Speakers from The Netherlands and India

Consider a scenario where you, as a second language (L2) speaker of English, seek medical consultation in the Netherlands following the discovery of post-coital blood spotting. Your general practitioner conveys the diagnosis as *somewhat likely* with regard to Chlamydia. In this context, how would you explore the quantitative understanding of the likelihood of Chlamydia contraction, particularly as someone for whom English is a second language. Furthermore, do you think this numerical interpretation of *somewhat likely* would differ if the practitioner applied this in a neutral sentence like *somewhat likely* to be an aftereffect of intake of a tablet. Additionally, do you think this numerical interpretation would differ with individuals hailing from a different cultural background, given their differing sensitivity towards the disease.

This study aims to investigate the quantitative understanding of verbal probability phrases within the domain of health risk communication, specifically from the perspective of individuals for whom English is a second language (L2). Furthermore, this study attempts to explore the effect of context in leading potential variations in the interpretation of these verbal probability phrases. Additionally, this research endeavours to shed light on the influence of cultural factors on the numerical interpretation of verbal probability phrases, with a particular emphasis on comparing Dutch adults to their Indian counterparts.

A substantial portion of health risk communication is carried out verbally with the help of verbal probability phrases (Willems et al., 2020). According to Zimmer (1983), individuals tend to find it more accessible to employ qualitative descriptions of probabilities rather than quantitative figures, as words offer greater flexibility compared to numerical representations. Consequently, this leads to the problematic misalignment of verbal probability phrases by a speaker and a recipient. For instance, in a health context, a practitioner's interpretation of *somewhat likely* could be different from the patient's comprehension of *somewhat likely*. However, verbal probability phrases give decision-making advantages to recipients, allowing them to assume control over their perception of risk, in contrast to numerical values, which are objective and unambiguous (Wallsten, 1990). Therefore, despite variability in the interpretation of verbal probability phrases based on individual differences, people tend to prefer them over numbers.

Many studies have been conducted on the interpretation of probability phrases by native speakers (Reagan et al., 1989; Wintle et al., 2019). Moreover, there have been studies conducted by translating these English probability phrases into different languages including French, German and Chinese and how they vary from their English counterparts (Doupnik & Richter, 2003; Harris et al., 2013; Salleh et al., 2011). Further, several studies have revealed the effect of L2 in decision- making tasks concerned with risk- taking (Hadjichristidis et al., 2015; Gao et al., 2015; Miozzo et al., 2020). However, there have not been many studies conducted with English verbal probability phrases being interpreted by L2 speakers of English, specifically in health risk communication and perception. This is a significant research gap and is an important area to explore as according to Ethnologue 2022 (25th edition), around 300 million people speak English as a L2 which makes the language an imperative part of global healthcare (Eberhard et al., 2022). Therefore, it is significant to comprehend how L2 speakers of English numerically interpret various verbal probability phrases that they encounter in a healthcare context.

Additionally, the context in which the verbal probability phrases are used plays a notable role in creating an individual's perception of various disease risks (Willems et al., 2020). According to Druzdzel (1989), if the probability phrases are provided without any context, individuals tend to construct their own context. For example, in the event that the recipient comes across a statement suggesting a *somewhat likely to have a side effect*, a recipient may interpret this information as experiencing nausea, a common side effect that they may have encountered from prior experiences. This represents an overestimation of risk, as the patient concludes on the nature and probability of side effects based on past events. Conversely, an alternate patient may interpret the statement to imply no side effects, as they have had no history toward general intake of medicines. This interpretation could result in the patient underestimating the associated risk as the side effect in discussion could be an aftereffect of a procedure or a novel medication. Therefore, it becomes an intriguing area of investigation to explore whether the influence of context on the interpretation of probability phrases, differs when comparing contextual and non-contextual sentences in health context.

In addition, Phillips and Wright (1977) initially introduced the concept that culture can significantly shape the cognitive processes inherent in probability assessment. To differentiate cultures and examine their impact on the interpretation of probability phrases, Hofstede's (1980) uncertainty avoidance and individual dimensions can be applied. Notably, nationalities exhibited different preferences towards avoiding uncertainty, from high preference (e.g., Russia, Belgium), to moderate preference (e.g., Netherlands, UAE) to low preference (e.g., India, China). Similarly, different nationalities expressed their preference for individualism with high preference (e.g., Netherlands, Belgium), moderate preference (e.g., US, Japan), to low preference (India, Mexico) for individualism. The low preference for individualism aligns towards a social framework of collectivism (Hofstede Insights). Consequently, it becomes an intriguing area of investigation to ascertain how these cultural disparities might impact the numerical interpretation of verbal probability phrases by individuals from these respective cultures when they are listening to verbal probability phrases in L2.

Hence, this study is oriented towards the investigation of how individuals who are L2 speakers of English, encompassing both Dutch and Indian participants, engage in the numerical interpretation of verbal probability expressions within the context of health risk communication. Furthermore, it aims to discern variations in interpretation when applied to health topics in context and not in context. The study also places particular emphasis on the influence of cultural factors on this interpretational process. The research questions to be addressed are as follows:

RQ1: What are the effects of culture and context on the numerical interpretation of English verbal phrases in health risk communication by L2 speakers of English from The Netherlands and India?

RQ2: What is the impact of health context on the Dutch and the Indians' numerical interpretation of English verbal probability phrases as L2 speakers, specifically sentences categorised as contextual as opposed to non-contextual sentences?

RQ3: What is the impact of culture on the Dutch and the Indians' numerical interpretation of English verbal probability phrases as L2 speakers?

According to Costa et al. (2017), the use of a non-native language can exert an influence on decision-making processes and the interpretation of uncertainty. Therefore, this study will contribute to better understand how national culture may influence the interpretation of verbal probability phrases and how it further impacts decision-making in health-related contexts such as patient-doctor interactions. In addition, the results of this study will provide insight on how health-related contextual information could be communicated in English to L2 speakers of the language. This would help the health professionals and patients to better comprehend the risk information in hand.

Theoretical Framework

Health Risk Communication and Verbal Probability Phrase

Defining Health Risk Communication

Uncertainty is present in every facet of human life (Wakeham, 2015). Uncertainty can be defined as what is known or believed without certainty and what is not known (Wakeham, 2015). Therefore, uncertainty engages with the dichotomy between objective truths and subjective perceptions held by individuals as true. The problematic nature of healthcare with respect to uncertainty has been discussed since the 1950s (Han et al., 2011). Han et al. (2019) categorized uncertainty in healthcare from the source into three fundamental phenomena. These three phenomena are probability, ambiguity, and complexity. Probability, or risk, denotes the unpredictability of future outcomes and is referred to as aleatory or first order risk. This phenomenon of probability or risk is known to arise due to a lack of absolute knowledge regarding the efficacy of a treatment, as exemplified by statements such as "20% probability of benefit from treatment" (Han et al., 2019, p.7). Ambiguity arises when information pertaining to risk is either unavailable or lacks credibility, constituting second order uncertainty. Furthermore, complexity emerges when risk communication comprehension is influenced by the interaction of various factors (Han et al., 2019). This study will specifically concentrate on the first order of uncertainty, namely probability or risk communication, which involves the exchange of health risk information between medical practitioners and patients. This focus is particularly pertinent due to the escalating emphasis on patient autonomy in decision-making within the healthcare context (Politi et al., 2007).

Nicholson (1999) defines health risk communication as a two-way interactive process that involves communicating the magnitude, significance, or control of a risk. The purpose of health risk communication is to inform patients about perceived risks and enhance their understanding of the risk which can consequently motivate behaviour change among recipients (Lipkus, 2007). Medical practitioners frequently communicate the likelihood of risks associated with a disease or the success rates of treatment (Willems et al., 2020). This risk communication is commonly carried out verbally or numerically.

Uncertainty in Healthcare and Use of Verbal Probability Phrases

The quantitative approach to health risk communication provides numerical information about the occurrence of an event (Lipkus, 2007). This method of risk communication is characterized by greater objectivity and credibility (Lipkus, 2007). For instance, articulating a 5% or 5 in 100 percent chance of risk escalation minimises ambiguity, thereby making it more credible. However, despite the evident advantages of using numerical expressions to convey risks, a substantial proportion of individuals, across diverse professional fields, prefer using qualitative expressions over numerical representations (Wintel et al., 2019).

The use of phrasal terms such as *uncertain, impossible*, and *likely* to inform the occurrence of an event is called verbal probability phrases (Juanchich & Sirota, 2019). One of the reasons for preferring verbal probability phrases over quantitative expressions can be attributed to the flexibility, in terms of tone and manner, offered by the use of verbal probability phrases (Juanchich & Sirota, 2019; Zimmer, 1983). Furthermore, verbal probability phrases empower recipients with more decision-making autonomy concerning how they perceive risks compared to direct numerical probabilities, which are inherently objective (Wallsten, 1990). However, the employment of verbal probability expressions has its own demerits. Firstly, individuals may employ different sets of lexicons or words to describe their uncertainty, which may not align with those used by others. Secondly, people's interpretation of uncertainties can vary based on their subjective associations with the specific instance under discussion, rendering it highly context-dependent (Wintle et al., 2019). This misalignment in communication can potentially compromise predictive accuracy and thereby undermine decision-making processes (Wintle et al., 2019). The subjective factors that influence decision making include language (Del et al., 2022; Hadjichristidis et al., 2015), context (Brun & Teigen, 1988; Timmermans, 1994; Wallsten et al., 1986; Weber & Hilton, 1990), and culture ((Yates & de Oliveira, 2016; Hofstede, 2011) among others.

L2 speakers of English and Verbal Probability Phrases

Studies have been conducted to comprehend how individuals interpret English verbal probability phrases differently and how such interpretations impact risk decision-making (Andreadis et al., 2021; Büchter et al., 2014; Heyman & Gelman, 1998). For example, extensive research has been conducted on how native English speakers interpret verbal probability phrases, as evidenced by studies conducted by Wintle et al.(2019) and Reagan et al.(1989). In the study by Wintle et al.(2019), encompassing the field of Climate Science, participants (native English speakers) numerically interpreted seven probability phrases. The results of the study revealed substantial variation in the interpretation of verbal probability phrases as a consequence of individual comprehension and association with the climatic condition in mention.

Moreover, studies have explored the translation of verbal phrases into different languages, including Chinese, French, German, and Dutch, examining how native speakers of these languages interpret them (Doupnik & Richter, 2003; Harris et al., 2013; Salleh et al., 2011; Willems et al., 2020). Harris et al. (2013) for instance, made a comparative study on how the British and the Chinese groups of participants differently interpreted the verbal probability phrases used by the Intergovernmental Panel on Climate Change in communicating risks. The variation from the standard set by IPCC was higher for the Chinese population than for the British. This variance was attributed to the absence of a direct translation of certain English verbal probability phrases into Chinese and the cultural differences in interpreting uncertainty. Thus, these studies underscore that the translation of specific phrases can yield diverse numerical interpretations in different cultural contexts.

However, there is limited research on how L2 speakers of English will interpret English probability phrases without resorting to translation.

English is spoken as a second language by 300 million people worldwide. Hence, it is significant to incorporate English language education as a significant component of healthcare (Eberhard et al., 2022). According to Molina and Kasper (2019), one-third of graduating medical students report the need for global health experience. Several studies in the field have demonstrated that language barriers have a negative impact on the quality of healthcare (Al Shamsi et al., 2020). For instance, a qualitative study of 59 nurses in England highlighted that communication was a crucial aspect of healthcare and that it affected the timely care of patients with limited English proficiency (Ali &Watson, 2018). In addition, Wu et al. (2022) emphasize that the aftermath of the COVID-19 pandemic has led medical professionals to realise the importance of communicating with patients from diverse cultures and national backgrounds.

In addition to comprehending the language, health risk communication involves conveying emotionally charged and potentially severe information that often requires a compassionate approach. Hence, it is crucial to comprehend the impact of articulating these health risks rather than merely reading them (WHO, 2021). In alignment with this perspective, the current research study centers on the examination of how L2 speakers of English, particularly those from the Netherlands and India, interpret verbal probability phrases in English while listening to the message.

Previous studies have found that the interpretation of numerical probability phrases varies greatly between individuals and that there cannot be a fixed number that can be assigned to any particular verbal probability phrase. Based on this, the first hypothesis of the study is formulated as follows:

H1: The numerical interpretation of the chosen English verbal probability phrases will demonstrate variability by L2 speakers of English.

Effect of Context on Numerical Interpretation of Verbal Probability Phrases

Research findings indicate that the context of the sentence significantly influences the numerical interpretation of probability phrases (Brun & Teigen, 1988; Timmermans, 1994; Wallsten et al., 1986; Weber & Hilton, 1990). There exists a disparity in quantifying probability phrases based on whether they are presented in isolation or within a context. As discussed earlier, Druzdzel's (1989) study revealed that a lack of contextual information made participants invent their own context based on their prior experience. Consequently, this leads to greater variability in the numerical interpretation of verbal probability phrases. For instance, the sentence, *It is expected that you will be cured of this disease,* can be overestimated or underestimated by people depending on the disease that first comes to their minds. The absence of a specific disease context enables individuals to form an ailment, closely associated with them. One person might interpret the phrase about common cold while another to cancer, shaping the numerical interpretation accordingly. However, if the sentence is framed as, *It is expected that you will be cured of Chlamydia*, the numerical interpretation gains further clarity by providing Chlamydia as the context in the interpretation process.

However, it is essential to note that even within contextual sentences, individuals demonstrate unique differences in interpreting health risks based on their understanding of the base rate effect. The base rate effect refers to the anticipated frequency of an event typically occurring, suggesting that the likelihood of one event occurring may be greater than that of another event (Wallsten et al., 1986). Wallsten et al. (1986) provided an illustrative example using the same verbal probability phrase *probably* in two sentences: "The couple will probably have at least one child after being married for one year" and "The couple will probably have at least one child after being married for five years" (Wallsten et al., 1986, p. 4). Despite the consistent use of the verbal probability phrase, the contextual understanding of the base rate indicated that the likelihood of a couple conceiving a child after five years was considered more plausible than after one year of marriage. Furthermore, this contextual comprehension of the base rate may be influenced by cultural factors and proximity to the event in question. Therefore, in the example given above of the contextual health sentence, *It is expected that you will be cured of Chlamydia*, the interpretation of verbal probability phrases may vary based on individuals' comprehension of Chlamydia and their previous association with the specific disease. Moreover, if the same sentence was repeated by replacing the disease Chlamydia with cold, the numerical interpretation of the verbal probability phrase may change with respect to an increased base rate of people being aware and cured of the common cold. A study conducted by Al-Haddad et al. (2016) among Arab adults, found that 75% of the sample population (N = 1487) knew viruses as the cause of the common cold and 50.4% of the sample conveyed that they get the common cold 1-3 times in a year (Al-Haddad., 2016). Therefore as noted by Weber and Hilton (1990), base rate effected the numerical interpretation of sentences but it varied with respect to medical conditions. Therefore, irrespective of the diseases mentioned, it is plausible that non-contextual sentences will show higher variation than contextual sentences. Based on these studies, the second hypothesis is formulated as follows:

*H2**:** The numerical interpretation of verbal probability phrases by L2 speakers of English will exhibit more variation in non-contextual sentences than in contextual sentences.*

Effect of Culture on Numerical Interpretation of Verbal Probability Phrases

Definition of Culture

Studies have investigated the influence of culture on the interpretation of verbal probability phrases in the context of risk communication. For example, Flynn et al. (1994)

conducted a study that introduced the concept of the white male effect, which showcased that white males perceive risks as lower compared to individuals from other ethnic groups. This perception was attributed not only to their societal dominance but also to their socio-political worldviews, encompassing factors such as institutional trust and individualism (Chauvin & Mullet, 2018).

According to Hofstede (2011), culture is the collective programming of the mind that distinguishes members of one group or category of people from another. He states that the essence of culture resides in values, often unknown to the beholder, making the process of understanding culture difficult. Nevertheless, Hofstede contends that values can be comprehended by observing how individuals from diverse backgrounds react in various circumstances. Hofstede's examination of cultural dimensions gave rise to a quantifiable framework for cultural dimension theory. He identifies six dimensions of particular significance, including power distance, uncertainty avoidance, individualism versus collectivism, masculinity versus femininity, long-term versus short-term orientation, and indulgence versus restraint (Hofstede, 2011).

This study will specifically concentrate on two out of the six dimensions, namely uncertainty avoidance and individualism. These dimensions were chosen due to their connection to ambiguity avoidance and disclosure attitudes which are associated with risk-taking behaviours. Existing literature in the realm of entrepreneurship and risk-taking draws a correlation between a high uncertainty avoidance culture and the individual inclination to avoid ambiguity and a heightened fear of failure (Gaganis et al., 2019; Tran, 2019). Consequently, this research aims to investigate the connection between cultural uncertainty avoidance and the numerical interpretation of verbal probability phrases in the context of health risk comprehension and risk-taking behaviour. Individualism, as a cultural dimension, is defined as the inclination to value individual choices and accomplishments, in opposition to adhering to group values (Hofstede, 2011). This dimension has been linked to risk-taking behaviours, as individualism fosters the ability for individuals to pursue their own path without fearing societal condemnation. Conversely, collectivism influences group dynamics and a reluctance to deviate from collective opinions, leading to a tendency toward low-risk attitudes (Chen, 2021). While the former is linked to an individual's direct perception of risk-taking behaviour, the latter delves into the desire of individuals to conform to group risk-taking behaviours (Hofstede, 2011).

Probability Assessment and Uncertainty Avoidance

The inclination to avoid harm is inherent in human nature. While certain fears, such as the fear of falling, are hardwired, other fears develop over time through cultural associations (Nguyen-Phuong-Mai, 2019). Uncertainty arises when there is no specific outcome fixated. Over centuries, societies have addressed this uncertainty by relying on rules, with each culture imposing regulations to mitigate uncertainty or ambiguity. A lower score on uncertainty avoidance indicates a culture where less action is taken to avoid uncertainty, whereas a higher score suggests a culture that actively seeks to avoid uncertain situations (Hofstede, 2011).

In Hofstede's cultural dimension of uncertainty avoidance, India has a score of 40, while the Netherlands has a score of 53, signifying a slightly greater inclination toward uncertainty avoidance in Dutch culture compared to Indian culture (Hofstede Insights). Verbal probability phrases are known to provide a certain kind of ambiguity through quantitative information (Timmermans, 1994). Therefore, in this study of verbal probability phrases in health risk communication, it can be anticipated that individuals from the Dutch culture will prefer to avoid uncertainty more than Indians and thereby will assign higher numerical values to verbal probability in comparison to individuals from Indian culture.

Probability Assessment and Individualism

Humans are inherently social beings with a universal desire to belong to groups (Allen et al., 2021). As individuals mature, they continually strive to belong to various in-groups, such as gender, culture, language, and ethnicity. Some cultures emphasize the significance of being part of a group and adhering to cultural norms, while others prioritize individualism over group attachments (Schwartz, 2012). Previous studies have found a correlation between cultural worldviews and risk perceptions (Dake, 1991; Peters & Slovic, 1996, Brenot et al., 1998). Brenot et al. (1998) found that the more individuals believed in group association, the more risk- averse they were to technological, environmental or health-related issues. Each cultural view hence helps people navigate through uncertain situations (Chauvin, 2018).

In Hofstede's cultural dimension of individualism, India scores a modest 24, reflecting a greater emphasis on collectivism, while the Netherlands scores 100, indicating the highest preference for individualistic characteristics (Hofstede Insights). In the context of the current study, where verbal probability phrases related to health risks are individually interpreted, it is hypothesized that the Dutch with highest individualism will exhibit considerably more variation in their interpretations of verbal probability phrases in health risk communication compared to Indians who belong to the collective worldview. Consequently, grounded in the theoretical framework, the third hypothesis of the study is formulated as follows:

H3: *The numerical interpretation of verbal probability phrases by the Dutch L2 speakers of English will exhibit variation from the Indian L2 speakers of English.*

*H3A**:** The numerical interpretation of verbal probability phrases by the Dutch L2 speakers of English will exhibit a higher score than the Indian L2 speakers of English*

*H3B**:** The numerical interpretation of verbal probability phrase by the Dutch L2 speakers of English will exhibit a greater variability than the Indian L2 speakers of English.*

Method

Design

The present study employed a mixed research design. This approach involved the manipulation of two independent variables, namely (1) context (contextual vs. non-contextual sentences) as a within-subject factor, and (2) cultural dimension (Dutch vs. Indian) as a between-subject factor. The dependent variable was the numerical interpretation of the verbal probability phrases.

Participants

The survey was exclusively accessible to adults above 18 and who were L2 speakers of English from either India or the Netherlands. To enhance the understanding of the data, potential confounding variables, such as age, gender, and educational qualification, were collected by the researchers. Participants were recruited through online channels using a snowball sampling technique. It is important to note that participation in the study was voluntary and without compensation.

Materials and Measures

Verbal probability phrases

To examine the potential influence of contextual factors and culture on the interpretation of verbal probability phrases, the measure employed was adapted from the study conducted by Willems et al.(2020). Specifically, 14 verbal probability phrases were selected from a pool of 29, with five phrases rated as high probability phrases (e.g., *certain, almost always, high chance, likely* and *expected*) four as moderate probability phrases (e.g., *possible, maybe, doubtful, chance*), and five as low probability phrases (e.g., *uncertain, unlikely, impossible, rarely, almost never*).

Table 1

Selection of Fourteen Verbal Probability Phrases Based on Willems et al. (2020)

Verbal probability phrase	Mean numerical interpretation (in %) from Willems et al. (2020)
Certain	96
Almost always	*87*
High Chance	78
Likely	75
Expected	75
Uncertain	*60*
Possible	47
Maybe	41
Chance	40
Doubtful	34
Unlikely	16
Almost never	13
Rarely	13
Impossible	6

(Non-)Contextual Health Risk Sentences

Regarding context, seven sentences were carefully selected and subsequently utilized in both contextual health risk sentences and non-contextual health risk sentences. The contextual health risk sentences were developed with consideration given to sensitive health topics, including Chlamydia and blood cancer. Chlamydia as a sexually transmitted infection (STI) is often associated with sensitive health topics due to the stigma attached to the infection (Morris et al., 2014; ten Hoor et al ., 2015). Cancer is regarded as a disease that not only affects the patients physiologically but also psychosocially (Barre et al., 2018). Hence, it is considered one of the highly stressful diseases (Krishnasamy et al., 2023). There were also health context sentences developed with some topics that may not be regarded as highly sensitive, such as the consumption of Benadryl or UTI. Benadryl or Diphenhydramine is available as an over-the-counter medication making it easily accessible and used to treat a variety of conditions including common cold, and motion sickness (Sicari & Zabbo, 2023).

Similarly, Urinary Tract Infection (UTI) is one of the most common bacterial infections with almost 150 million cases reported globally in a year, and can be easily treated with proper medical care (Kucheria et al., 2005).

Furthermore, the diseases mentioned in the specific sentences were experienced in varying age groups, from diabetes to Chlamydia, to avoid the possibility of a specific disease acting as a confounding factor in the experiment. In terms of developing non-contextual sentences, all specific disease names, treatment methods and side effects were replaced by neutral terms such as "disease", "treatment", or "side-effect. This was to ensure that the sentences' focus will be on the verbal probability phrase mentioned within the health context. Table 2 provides the seven contextual sentences developed based on different health topics and simultaneously their paired non- contextual sentences by replacing disease names and side effects with neutral terms.

Furthermore, each contextual and subsequent non-contextual sentence was repeated twice comprising of 14 contextual sentences and 14 non-contextual sentences. Moreover, each probability phrase was added to a contextual and its paired non-contextual sentence. In addition to this, to ensure that the verbal probability phrases are randomly assigned to the sentences, seven sets of 28 sentences were created ensuring that all 14 verbal probability phrases were inserted in all the seven contextual and non-contextual sentence structures, thereby avoiding any kind of bias of interpretation of verbal probability phrases based solely on the context of the sentence in which it was presented. The detailed version of the seven sentence sets can be found in Appendix A.

Table 2

Framework of Context and Non- Context Health Risk Sentences

Non-contextualized health risk sentences	Contextualized health risk sentences
It is … that you will experience **a side effect** from the **treatment**	It is …that you will experience **mild nausea** from taking **Benadryl**
It is … that you will be cured of **this disease**	It is…that you will be cured of **Chlamydia**
It is … to survive **this disease**	It is… to survive **blood cancer**
It is… that you will have **permanent complaints from this disease**.	It is … that your foot will be **amputated from diabetics**
It is….that your symptoms of **this disease** will pass	It is ….that your symptoms of **UTI** will pass
There is a … that you will die from **this disease**	There is a …that you will die from **covid**
It is….that you will be cured completely of **this disease**	It is …that you will be cured completely of **Parkinson**

Note. The blanks in the sentences will be filled by the 14 verbal probability phrases (see Appendix A).

The 28 sentences of seven sets comprising a total of 196 sentences were narrated and recorded by a native American who is a research scholar working at Cornell University. The link to the audio repository can be found in Appendix B. This was done to ensure that the sentences will be heard as spoken by a native English speaker and will be interpreted by both the Dutch and the Indian speakers without any biases.

Cultural Dimensions: Uncertainty Avoidance and Individualism

The assessment of *uncertainty avoidance* was conducted utilizing a validated scale devised by Yoo et al. (2011). This was undertaken to ensure the application of cultural dimensions at an individual level rather than relying solely on Hofstede's scoring, which has been criticized for being misapplied at the individual level compared to the national level (Brewer & Venaik, 2012).

The scale developed by Yoo et al. (2011) comprised five items designed to assess individual preferences regarding the provision of instructions or rules in the work environment, thereby indicating their inclination to avoid uncertainty in a broader context (e.g., “It is important to have instructions spelled out in detail so that I always know what I’m expected to do.”). These items were measured on a 7-point Likert scale (1 = *strongly disagree*, 7 = *strongly agree*). The items can be found in Appendix C (Table C1). The reliability of the test was measured using Cronbach’s Alpha coefficient which was .722 and it indicated that the participants’ responses were consistent.

The measurement for *individualism* was taken from a validated scale developed by Yoo et al. (2011). This scale consisted of six items which measured individual preference of protecting self-interest over group interest in a work environment which gave an idea of their individualistic characteristic (e.g., “ Individuals should sacrifice self-interest for the group.”)

All items were measured on a on 7-point Likert scale (1 = *strongly disagree*, 7 = *strongly agree*). The items can be found in Appendix C (Table C2). The reliability of the test was measured using Cronbach’s Alpha coefficient which was .780 and it indicated that the participants’ responses were consistent.

Numerical Interpretation of Verbal Probability Phrases

Numerical interpretation of the verbal probability phrases was measured by asking the question “After listening to each audio, kindly use the slider to answer the question asked” Each question was formatted according to the sentence that participants listened to by including the specific disease name/ side effect in case of contextual sentences (e.g., “After listening to the audio, what do you think is the percentage probability of experience a mild nausea after taking Benadryl") and neutral disease/ side effect in case of non-contextual sentences (e.g., "After listening to the audio, what do you think is the percentage probability of experiencing a side effect from the treatment?"). Participants provided their point estimates in percentages by using a slider that ranged from 0% to 100% (with 10% bins). Note that participants were not bounded to these bins, but they could put the slider on any percentage score (e.g., 17%).

Procedure

Data collection took place in November and December 2023. The data was collected through an online survey developed on the Qualtrics platform. Participants were provided with instructions and had to agree to the informed consent to take part in the survey. They were specifically instructed in the survey to find a quiet place as they will be listening to 28 different audio files (see Appendix D). After agreeing to the consent form, a few basic demographic details were collected, which included age, gender, level of education and nationality (see Appendix D).

The participants were then asked to fill in a questionnaire to measure cultural dimensions of uncertainty avoidance and individualism. Furthermore, the participants were randomly assigned to an audio set out of seven sets. Each set consisted of 28 audio files comprising of 14 contextual sentences and 14 non- contextual sentences. After listening to each sentence, the participants were asked to score the possibility of the event/ disease occurrence from 0-100 (see Appendix D).

At the end of the survey, the participants were debriefed about the purpose of the survey by informing them that the focus of the survey was to investigate if cultural dimension and context of the sentence influenced the numerical interpretation of verbal probability phrases (see Appendix D). The survey took approximately 10-15 minutes to complete.

Data Analysis

Given the variable nature of the data (i.e., large variation in participant's numerical interpretation of the verbal probability phrases), it was decided to uncover potential effects or patterns through visual inspections of the data. A ridgeline density plot was employed to simultaneously visualize the distribution of multiple groups, presenting their densities aligned to a common horizontal scale for easy comparison. In the study, 14 verbal probability phrases were plotted against a shared x-axis, expressing numerical interpretations as percentages. This approach was extended to overlapping density plots, facilitating a comprehensive comparison between two variables: contextual versus non-contextual, and Dutch versus Indian culture. This methodology enhanced the comprehension of the interpretation of the 14 verbal phrases within the dimensions of (1) context and (2) culture.

The statistical significance of cultural dimensions, namely uncertainty avoidance and individualism among Dutch and Indian participants were assessed with the help of independent *t*- tests. Specifically, an independent *t*-test was conducted to determine whether the cultural dimension of uncertainty avoidance (dependent variable) significantly differed between the Dutch and the Indian nationalities (independent variable). Similarly, another independent *t*-test was performed to assess if the cultural dimension of individualism (dependent variable) exhibited significant differences between the Dutch and the Indian nationality groups (independent variable).

Furthermore, an independent *t*-test was employed to evaluate whether the numerical interpretation of verbal probability phrases (dependent variable) displayed significant differences among the culture groups the Dutch versus the Indian (independent variable) for all 14 verbal probability phrases in the study.

Results

Participants' characteristics

The survey was accessible for participation from November 23, 2023, to December 24, 2023. Over this period, 169 participants engaged in the survey; however, 5 opted not to partake. Moreover, 21 individuals did not select English as a second language or responded negatively to the question. Additionally, 15 participants did not indicate their nationality. Upon the exclusion of these data points that did not meet the inclusion criteria, the dataset comprised 136 participants. Nonetheless, not all 136 participants attempted the 28 sentences, resulting in variations in participant numbers for each verbal probability phrase within the seven sets.

The female participants comprised 73 percent of the sample (100 females and 36 males). Most of the participants were either graduates or undergraduates, comprising 89.8 percent of the population and 3.6 percent were doctorates. Moreover, 98.9 percent of the population were between 18 years and 33 years with one person who was 57 years old. The average age of the Dutch population was 24.4 years (*SD* = 5.80) and that of the Indian population was 26.93 years (*SD* = 3.43). The distribution of population with respect to gender, educational qualification, and age in comparison to the two different nationalities are presented in Table 3.

Table 3

Characteristics of Both Dutch and Indian Participants

Variables	Dutch (*N* = 41)	Indian (*N* = 95)
Gender		
Male	13	22
Female	28	72
Other	0	1
Age (SD)	24.41 (5.80)	26.93 (3.43)
Education		
High school	3	3
Graduate	25	32
Postgraduate	11	55
Doctorate	1	3

Variables	Dutch (*N* = 41)	Indian (*N* = 95)
Other	1	2
Cultural dimension		
Uncertainty avoidance	35	86
Individualism	36	79

Numerical Interpretation of Verbal Probability Phrases

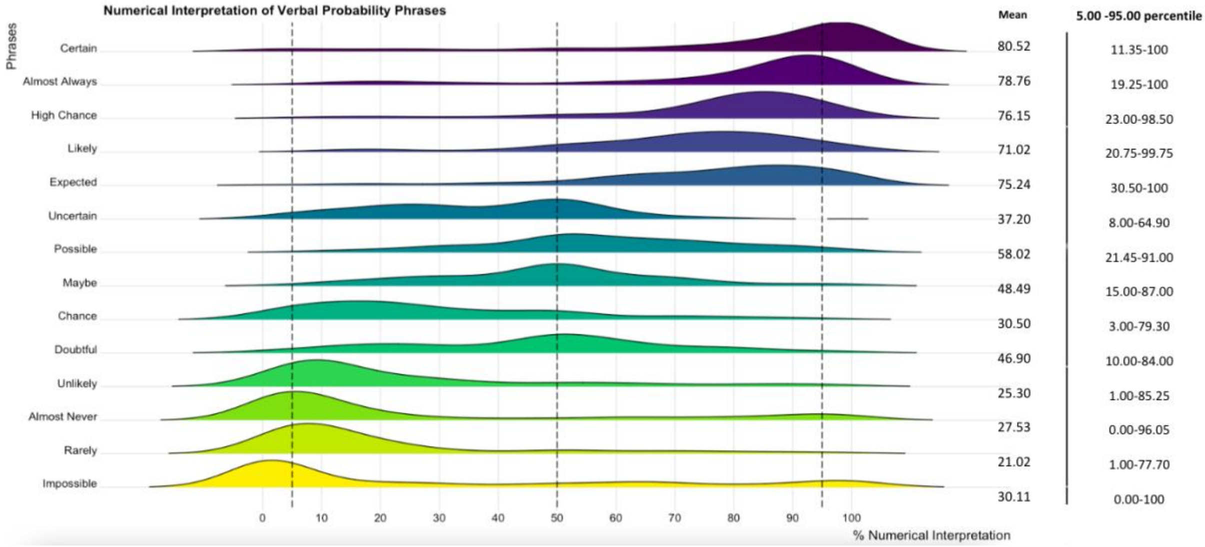
The distributions of the interpreted percentages of each of the verbal probability phrases are displayed by the ridge density plot in Figure 1. Their corresponding mean values and 95% confidence intervals are positioned on the right-hand side of the plot. The 5% and 95% indicate the range of interpretation of participants.

The figure shows that the numerical interpretation of 14 verbal probability phrases shows variations. However, the extreme words at both ends of the graph did not exhibit a consensus, contrary to findings in the study by Willems et al., (2020). For instance, while the phrase *certain* yielded a 95% CI from 11.35% to 100%, *impossible* at the other extreme had a 95% CI from 0% to 100 %. Additionally, even phrases with extreme negative connotations, such as *almost never* and i*mpossible*, were interpreted at percentages ranging between 20-30%, with numerical values of 25.7% and 26.2%, respectively. Similarly, phrases on the extreme positive side, including *almost always*, *certain*, and *high chance*, were numerically interpreted at no more than 80.5%.

Nevertheless, as observed from figure 1, all verbal probability phrases show variation in numerical interpretation, thereby supporting the first hypothesis positing that the numerical interpretation of the selected verbal probability phrases will exhibit variation among L2 speakers of English.

Figure 1

Numerical Interpretation of Verbal Probability Phrases along with Mean and 95% Confidence Intervals



Effect of Context on Interpretation of Verbal Probability Phrases

One of the primary objectives of the study was to understand how context influences the numerical interpretation of English verbal probability phrases by L2 speakers of English, namely Dutch and Indians. The second hypothesis postulates that non-contextual sentences are expected to manifest a higher degree of variability compared to contextual sentences. This expectation stems from the liberty afforded to individuals in generating context for non-contextual sentences, a factor that can contribute to a more pronounced divergence in numerical interpretations.

The distributions of the interpreted percentages of each of the verbal probability phrases in context and non-context are displayed by two overlapping ridge density plots in Figure 2. Based on visual inspection of the data, there does not seem to be a difference in the interpretation of each verbal probability phrase concerning contextual and non-contextual sentences. However, upon scrutinizing the standard deviation of these phrases in both context and non-context settings, contextual sentences exhibit a slightly greater deviation than non-contextual sentences, as detailed in Table 4. Consequently, this contradicts the second hypothesis, suggesting that the numerical interpretation of verbal probability phrases by L2 speakers of English will be more variable in non-contextual sentences compared to contextual sentences.

Figure 2

Numerical Interpretation of Verbal Probability Phrases in Context and Non Context Sentences

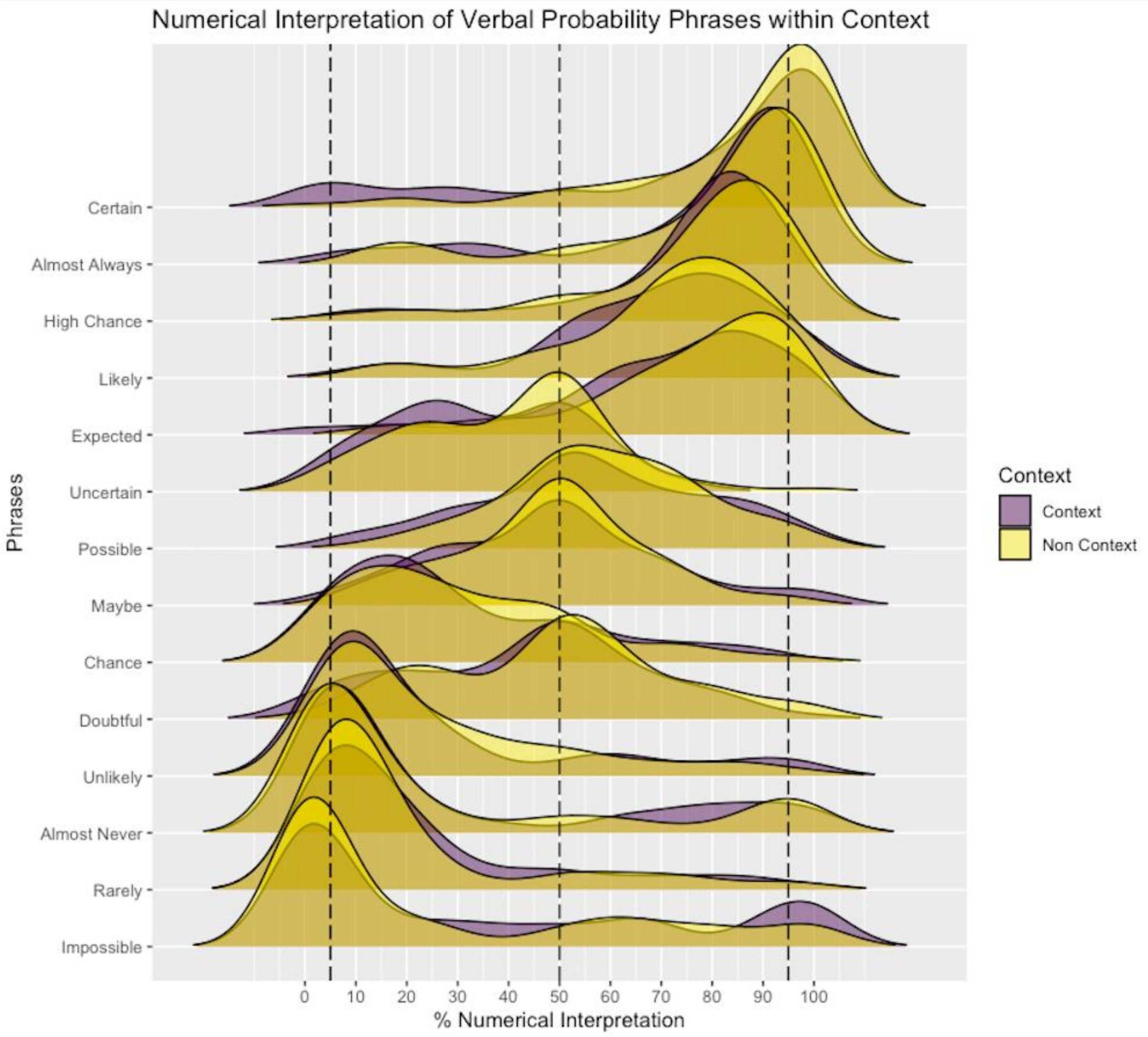


Table 4

Descriptive of Verbal Probability Phrases in Contextual and Non-Contextual Sentences

Phrases	Context	*N*	Mean	*SD*
Certain	Non-Context	87	85.7	21.8
	Context	83	75.1	32.5
Almost Always	Non-Context	84	81.0	22.8
	Context	82	76.5	26.7
High Chance	Non-Context	86	77.0	20.5
	Context	85	75.2	21.5
Likely	Non-Context	83	72.3	19.5
	Context	83	69.7	21.3
Expected	Non-Context	84	77.8	19.5
	Context	83	72.7	23.3
Uncertain	Non-Context	80	39.8	19.0
	Context	82	34.8	18.1
Possible	Non-Context	85	59.6	18.6
	Context	85	56.5	22.9
Maybe	Non-Context	88	48.9	18.1
	Context	83	48.1	22.5
Chance	Non-Context	90	49.8	23.0
	Context	81	43.7	23.3
Doubtful	Non-Context	83	30.7	22.8
	Context	85	30.5	24.0
Unlikely	Non-Context	78	25.4	24.6
	Context	78	25.3	27.2
Almost Never	Non-Context	82	26.1	33.3
	Context	78	29.0	34.2
Rare	Non-Context	85	19.9	24.1
	Context	82	22.2	24.4
Impossible	Non-Context	71	26.3	34.6
	Context	72	33.9	37.8

Effect of Cultural Dimensions on Interpretation of Verbal Probability Phrases

One of the primary objectives of the study was to understand how culture influences the numerical interpretation of English verbal probability phrases by L2 speakers of English, namely Dutch and Indians. The third hypothesis postulates that the numerical interpretation of verbal probability phrases by the Dutch L2 speakers of English will exhibit variation from that of the Indian L2 speakers of English. This variation was postulated to occur because (1) the average numerical interpretation of verbal probability phrases will be higher for Dutch L2 speakers than for Indian L2 speakers. This was hypothesised based on Hofstede's scoring of uncertainty avoidance of cultural dimension for different nationalities. The second variation was postulated because (2) the numerical interpretation of verbal probability phrases by Dutch L2 speakers will show greater variation than Indian L2 speakers. This was hypothesised based on Hofstede's scoring of the individualism dimension for different nationalities.

To assess whether uncertainty avoidance and individualism play significant roles in differentiating the cultures of the Dutch and the Indians, two independent *t*-tests were conducted, using individual participant scores obtained from the 7-point Likert scale developed by Yoo et al.(2011). The use of this scale aimed to ensure a focus on individual characteristics, rather than making assumptions based solely on nationality, as done in Hofstede's approach.

Uncertainty Avoidance and Individualism

To check if uncertainty avoidance scoring was significant among Dutch and Indians, an independent *t*- test was performed. The uncertainty avoidance scoring by the Dutch (M = 5.37, SD = 0.96) was lower than the uncertainty avoidance scoring by the Indians (M = 5.75, SD = 0.92). However, this difference was not significant , $t(121) = -1.16$, $p = .65$. Thus, uncertainty avoidance as a cultural dimension did not differentiate the culture of the Dutch and the Indians in this study, as opposed to Hofstede's findings.

To check if individualism scoring was significant among Dutch and Indians, an independent *t*- test was performed. The individualism scoring by the Dutch (M = 4.24, SD = 0.45) was higher than the individualism scoring by the Indians (M = 3.93, SD = 0.43). This difference was significant , $t(119) = -3.42$, $p < .001$ Thus, individualism as a cultural dimension differentiates the cultures of Dutch and Indians in this study, as provided by Hofstede's findings.

Interpretation of Verbal Probability Phrases by Dutch and Indians

Statistical tests revealed that within the study, distinctions in culture between the Dutch and the Indians were observed specifically in terms of individualism and not uncertainty avoidance. To explore whether this cultural distinction extended to their numerical interpretations of verbal probability phrases, two methods were employed: (1) an independent *t*-test examined whether the average numerical interpretation of each verbal probability phrase differed between Dutch and Indians, and (2) a ridge density plot with overlapping curves representing Dutch and Indians, along with their respective interpreted percentages, was generated.

To check if the numerical interpretation of verbal probability phrases was significant among Dutch and Indians, an independent *t*- test was performed. The results of each of the verbal probability phrases are presented in Appendix E. The numerical interpretation of verbal probability phrases *possible* and *chance* were only significantly different among the Dutch and the Indians out of the fourteen verbal probability phrases. The numerical interpretation of the phrase *possible* was higher for the Indians (*M*=65.4, *SD*= 18.8) than for the Dutch (*M*=49.5, *SD*= 13.5). The difference was significant, $t(85) = 4.11$, $p < .001$. Similarly, the numerical interpretation of the phrase *chance* was higher for the Indians (*M*=53.9, *SD*= 24.3) than for the Dutch (*M*=49.5, *SD*= 18.4). The difference was significant, $t(90) = 2.37$, $p = .02$. The descriptive of the test is presented in Table 5.

Table 5

Descriptive of Dutch and Indians for Each Verbal Probability Phrase

Phrases	Nationality	*N*	Mean	*SD*
Certain	India	56	85.8	22.0
	Netherlands	31	85.5	21.7

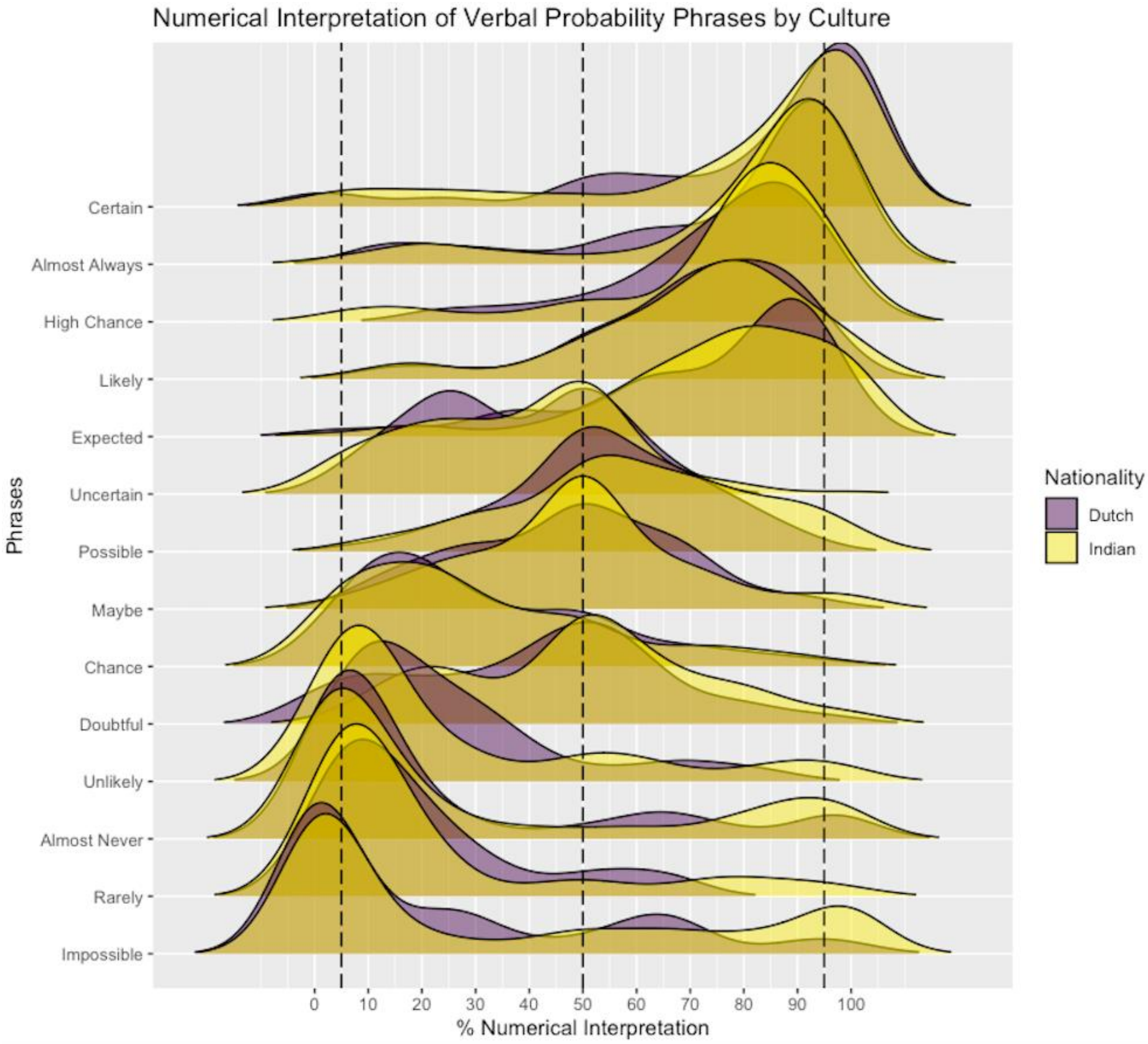
Phrases	Nationality	*N*	Mean	*SD*
Almost Always	India	53	82.8	21.5
	Netherlands	31	77.9	25.1
High Chance	India	55	76.3	22.2
	Netherlands	31	78.4	17.5
Likely	India	53	71.9	19.9
	Netherlands	30	72.9	18.9
Expected	India	53	79.2	17.2
	Netherlands	31	75.4	23.0
Uncertain	India	49	40.8	20.8
	Netherlands	31	38.3	16.2
Possible	India	54	65.4	18.8
	Netherlands	31	49.5	13.5
Maybe	India	57	49.2	18.6
	Netherlands	31	48.4	17.5
Chance	India	59	53.9	24.3
	Netherlands	31	42.1	18.4
Doubtful	India	52	33.9	26.0
	Netherlands	31	25.4	15.1
Unlikely	India	48	28.6	27.5
	Netherlands	30	20.3	18.3
Almost Never	India	52	28.9	36.8
	Netherlands	30	21.4	26.0
Rare	India	55	20.7	25.7

	Netherlands	30	18.2	21.2
Impossible	India	47	29.8	36.3
	Netherlands	24	19.4	30.7

The distributions of the interpreted percentages of each of the verbal probability phrases by Dutch and Indians are displayed by two overlapping ridge density plots in Figure 3. Based on visual inspection of the data, there does not seem to be a significant variation in the interpretation of each verbal probability phrase by the Dutch and the Indians. Consequently, this contradicts the third hypothesis, suggesting that the numerical interpretation of verbal probability phrases by the Dutch L2 speakers of English will be different from that of the Indian L2 speakers of English.

Figure 3

Numerical Interpretation of Verbal Probability Phrases by Dutch and Indians



Discussion

The main objectives of the study were to investigate the variation in the numerical interpretation of English probability phrases among Dutch and Indian L2 speakers of English within the realm of health risk communication. The study focussed on 14 verbal probability phrases, seeking to comprehend the impact of context and culture on the numerical interpretation of the phrases. This represents a novel exploration in the realm of health risk perception by L2 speakers. While previous studies focused on the interpretation of verbal probability phrases in languages native to the participants, this research delves into the interpretation of verbal probability phrases by second language (L2) English speakers. This investigation contributes to the evolving global landscape where individuals may not reside in their native hometowns and must listen to and understand health risks information presented in their L2. Furthermore, considering that individuals will be listening to health risk information in their L2, it raises questions about how their cultural background, potentially different from that of the medical practitioner, might influence their perception of risks conveyed through verbal probability phrases. Additionally, this study offers a fresh perspective on understanding how health risk sentences, presented both in context and non-context, can impact individuals' perceptions of risk.

Numerical Interpretation of Verbal Probability Phrases

Building upon prior research that examined the impact of numerical interpretation of verbal probability phrases on risk decision-making (Büchter et al., 2014; Andreadis et al., 2021; Heyman et al., 1998), the present study sought to investigate whether variations exist in the numerical interpretation of these phrases among second language (L2) speakers of English. The results of the study show that the numerical interpretation of 14 verbal probability phrases show variations. However, the extreme words at both ends of the graph did not exhibit a greater consensus, contrary to findings in the study by Willems et al.(2020). For instance, while the phrase *certain* yielded a 95%CI from 11.35% to 100% while *impossible* at the other extreme had a 95% CI from 0% to 100 %. Additionally, even phrases with extreme negative connotations, such as *almost never* and i*mpossible*, were interpreted at percentages ranging between 20-30%, with numerical values of 25.7% and 26.2%, respectively. The variation observed in this study, as compared to the research by Willems et al. (2020), may be attributed to differences in the domains where the risk is investigated. Willems et al. (2020) focused on the numerical interpretation of verbal probability phrases within news articles, while the current study concentrated on health risk communication. Research by Grenen et al. (2015) suggests that individuals form risk perceptions based on specific domains. Given that health is a sensitive domain involving individual lives, trust, and genuine engagement (Berg et al., 2021), individuals in this study may have been cautious in assigning higher values to extremely positive phrases, considering the emphasis on careful consideration. Simultaneously, they may not want to completely disregard the consequences associated with extremely negative verbal probability phrases.

Effect of Context on Interpretation of Verbal Probability Phrases

In light of Druzdel's (1989) and Willems et al.(2020) studies', the hypothesis was formulated that the numerical interpretation of verbal probability phrases will exhibit more variation in non-contextual sentences compared to contextual sentences. The rationale behind this proposition was that the absence of context allows participants the freedom to generate their own context, resulting in individual variations. However, the second hypothesis in this study did not receive empirical support, as the observation revealed that the variation in the numerical interpretation of verbal probability phrases was slightly higher in contextual sentences than in non-contextual sentences. This discrepancy may be attributed to the base rate effect, as conceptualized by Wallsten et al.(1986). The base rate effect refers to the anticipated frequency of an event occurring regularly (Wallsten et al., 1986), implying that the likelihood of one event occurring is greater than that of another. In the context of this study, contextual sentences provided participants with specific information about medical conditions or side effects, perhaps enabling them to factor in the base rate of the particular disease or side effect occurring in real-life scenarios. Conversely, non-contextual sentences, without providing specifics regarding medical conditions or side effects, may have allowed participants to focus more on the verbal probability phrase itself, contributing to the observed results.

Furthermore, as previously discussed, the sensitivity of health-related topics may prompt individuals to make decisions intuitively, relying on personal emotions and connections associated with a particular disease or side effect. This inherent emotional response could make contextual sentences more susceptible to variations compared to non-contextual sentences.

Effect of Cultural on Interpretation of Verbal Probability Phrases

The implementation of the uncertainty avoidance scale developed by Yoo et al. (2011) in this study revealed a lack of agreement with the Hofstede scores for the two cultures under investigation, namely the Dutch and the Indians. Notably, Hofstede's (1980) study did not exhibit a substantial difference amongst the two cultures with the Dutch scoring 53 and the Indians scoring 40. Moreover, considering the evolving global landscape and particularly in the post-COVID-19 era, the emphasis on health security and management have heightened (Datta, 2021). Therefore, individuals regardless of cultural differences, tend to display an inclination towards avoiding uncertainty, especially in the health field. However, the cultural dimension of individualism exhibited a significant difference between Dutch and Indian populations, as indicated by Hofstede's scores, with Indians scoring 24 and the Dutch scoring 100. Cultural subjectivity has the potential to influence scientific objectivity within the domain of health (Lancet, 2014).

Therefore, within the sampled population, uncertainty avoidance did not emerge as a notable indicator of cultural distinction, whereas individualism was confirmed as a discernible dimension for distinguishing the culture of the Indians from that of the Dutch. Nevertheless, when examining the cultural disparity between the Indian and the Dutch sample groups, there appeared to be no substantial difference in their numerical interpretations of verbal probability phrases within the health risk domain. This could be attributed to the fact that uncertainty avoidance as a cultural dimension did not show a difference between the two cultural groups.

In a literature review conducted by Bate (2022), the uncertainty avoidance culture has an impact on individuals' risk-taking behaviour in various domains, including finance and entrepreneurship. The review indicates a robust correlation between uncertainty avoidance culture at both individual and national/international levels. Cultures characterized by high uncertainty avoidance tend to display reduced interest in undertaking risky business ventures and seizing new opportunities (Liu et al., 2019). Drawing from this literature, it can be inferred that the lack of differences in uncertainty avoidance between the cultural groups within the study's sample population may explain the absence of significant differences in the numerical interpretation of verbal probability phrases by Dutch and Indians.

Furthermore, considering the sensitive nature of health topics, it is plausible that individualism scores were not the predominant factor influencing their interpretation of verbal probability phrases. As discussed earlier by Datta (2021), given the evolving and globally significant nature of health issues, regardless of individualism, greater emphasis may be placed on avoiding uncertainty in these health risk situations.

Nevertheless, the research revealed a significant disparity in the interpretation of two verbal probability phrases, specifically *possible* and *chance*. This discrepancy could be ascribed to the fact that expressions with a positive orientation, such as *chance* and *possible*, prompt individuals to understand the rationale behind the anticipated outcome (Juanchich et al., 2013). In Juanchich et al.(2013)'s study, they illustrated this with a sentence example: "It is possible that Blacky will win the race because *he is in excellent shape*" (Juanchich et al., 2013, p. 345). Consequently, given the subjective nature of this reasoning, these phrases may exhibit more pronounced variations among the cultural groups of the Dutch and the Indians.

Limitations and Suggestions for Future Research

A major limitation of the current study lies in the environment in which it was conducted. The online survey, involving listening to 28 audio clips, required a silent and focused setting, which could not be controlled identically for all the participants. This could have led to potential mishearing and subsequent misinterpretation of certain verbal probability phrases. Future studies in this field should aim to control environmental factors more effectively to enhance the reliability of results.

Another limitation pertains to the sample size, with a notable disproportion in participants from India and the Netherlands. Additionally, gender distribution in the sample was not proportional, overlooking the well-established role of gender in risk perception, with women often exhibiting greater risk aversion than men (Harris & Jenkins, 2006; Hitchcock, 2001; Nelson, 2012). These imbalances pose potential confounding factors that may have influenced the study's outcomes. Furthermore, the overrepresentation of highly educated individuals in the sample limits the generalizability of the results to broader segments of society. Health literacy can be defined as “the degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions” (Selden et al., 2000, p. vi). Studies have shown a correlation between health literacy and risk perception (Rutherford et al., 2018; Poon et al., 2023). Further, reports suggest that there is a positive association between education and health literacy (Nussbaum, 2013). Therefore as the individuals within the study were mainly in the educated category, the study cannot be generalised to all the communities who might lack the knowledge about the diseases mentioned within the contextual sentences.

The study lacked background questions assessing participants' numerical capabilities and English language proficiency, both of which are known to impact risk perception (Boholm et al., 2015; Reyna et al., 2009). A more comprehensive understanding of these factors could have contributed to a more nuanced interpretation of the results. Additionally, the absence of an analysis of how individual differences toward prior experiences with the mentioned diseases might influence results, independently of cultural factors is a notable limitation.

Despite these limitations, the study has made valuable contributions to the understanding of the role of context and culture in the numerical interpretation of verbal probability phrases among L2 speakers of English. Future research could expand on this by investigating how migrant communities within each nationality perceive health risks when listening to information in their L2. Moreover, studies could explore the impact of a second language used by a medical professionals in communicating risks to a native culture group. This study, therefore, sets the stage for further exploration of how health risk communication should carefully consider cultural and contextual factors in a globalized world.

Conclusion

In conclusion, this study delved into the impact of context and cultural dimensions, specifically uncertainty avoidance and individualism, on the numerical interpretation of English verbal probability phrases by L2 speakers, specifically Dutch and Indians. While the findings partially aligned with existing research, novel insights emerged, offering a nuanced understanding of the subject. The anticipated variability in the numerical interpretation of verbal probability phrases among L2 speakers concurred with previous studies, yet the effect of context yielded unexpected results. Contrary to expectations, there was no greater variation in numerical interpretation in contextual sentences compared to non-contextual ones, attributed to the underplayed base rate effect. Similarly, there was no greater variation in numerical interpretation based on culture. This research serves as a foundational exploration in the domain of health communication among second language speakers, providing valuable insights into how context and culture influence risk perception among L2 speakers. The study's findings contribute to the evolving understanding of health risk communication dynamics in diverse linguistic and cultural contexts.

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Appendix A

Sentence Sets Created for Randomization in the Survey

Table A1

Sentences of Set 1

S.No	Sentences
1.	You will almost always be cured of this disease
2.	It is certain that you will experience mild nausea from taking Benadryl
3.	You will almost always be cured of Chlamydia
4.	There is a high chance that you will survive this disease.
5.	There is a high chance that you will survive blood cancer.
6.	It is likely that you will have permanent complaints from this disease.
7.	It is likely that your foot will be amputated from diabetics.
8.	It is expected that your symptoms of this disease will pass
9.	It is expected that your symptoms of UTI will pass
10.	It is uncertain whether you will die from this disease.
11.	It is uncertain whether you will die from covid.
12.	You will almost never be cured completely of this disease.
13.	You will almost never be cured completely of Parkinson
14.	It is impossible that you will experience a side effect from the treatment
15.	It is unlikely that you will be cured of this disease
16.	It is unlikely that you will be cured of Chlamydia
17.	It is rare that you will survive this disease.
18.	It is rare that you will survive blood cancer.
19.	It is possible that you will have permanent complaints from this disease.
20.	It is possible that your foot will be amputated from diabetics.
21.	Your symptoms of this disease maybe will pass
22.	Your symptoms of UTI maybe will pass
23.	It is doubtful that you will die from this disease.
24.	It is doubtful that you will die from covid.
25.	There is a chance that you will be cured completely of this disease.
26.	There is a chance that you will be cured completely of Parkinson
27.	It is impossible that you will experience mild nausea from taking Benadryl

Table A2

Sentences of Set 2

S.No	Sentences
1.	You will almost always experience mild nausea from taking Benadryl
2.	There is a high chance that you will be cured of this disease

S.No	Sentences
3.	There is a high chance that you will be cured of Chlamydia
4.	It is rare that you will be cured of this disease
5.	It is rare that you will be cured of Chlamydia
6.	It is unlikely that you will experience a side effect from the treatment
7.	It is unlikely that you will experience mild nausea from taking Benadryl
8.	It is likely that you will survive this disease.
9.	It is likely that you will survive blood cancer.
10.	It is possible that you will survive this disease.
11.	It is possible that you will survive blood cancer.
12.	It is expected that you will have permanent complaints from this disease.
13.	It is expected that your foot will be amputated from diabetics.
14.	You will maybe have permanent complaints from this disease.
15.	Your foot maybe amputated from diabetics.
16.	It is uncertain whether your symptoms of this disease will pass
17.	It is uncertain whether your symptoms of UTI will pass
18.	It is doubtful that your symptoms of this disease will pass
19.	It is doubtful that your symptoms of UTI will pass
20.	It is almost never that you will die from this disease.
21.	It is almost never that you will die from covid.
22.	There is a chance that you will die from this disease.
23.	There is a chance that you will die from covid.
24.	It is certain that you will be cured completely of this disease.
25.	It is certain that you will be cured completely of Parkinson
26.	It is impossible that you will be cured completely of this disease.
27.	It is impossible that you will be cured completely of Parkinson

Table A3

Sentences of Set 3

S.No	Sentences
1.	There is a high chance that you will experience mild nausea from taking Benadryl
2.	It is rare that you will experience a side effect from the treatment
3.	It is rare that you will experience mild nausea from taking Benadryl
4.	It is likely that you will be cured of this disease
5.	It is likely that you will be cured of Chlamydia
6.	It is possible that you will be cured of this disease
7.	It is possible that you will be cured of Chlamydia
8.	It is expected that you will survive this disease.
9.	It is expected that you will survive blood cancer.
10.	You will maybe survive this disease.
11.	You will maybe survive blood cancer.
12.	It is uncertain whether you will have permanent complaints from this disease.
13.	It is uncertain whether your foot will be amputated from diabetics.
14.	It is doubtful that you will have permanent complaints from this disease.
15.	It is doubtful that your foot will be amputated from diabetics.
16.	It is almost never that your symptoms of this disease will pass
17.	It is almost never that your symptoms of UTI will pass

18.	There is a chance that your symptoms of this disease will pass
19.	There is a chance that your symptoms of UTI will pass
20.	It is impossible that you will die from this disease.
21.	It is impossible that you will die from covid.
22.	It is certain that you will die from this disease.
23.	It is certain that you will die from covid.
24.	You will almost always be cured completely of this disease.
25.	You will almost always be cured completely of Parkinson
26.	It is unlikely that you will be cured completely of this disease.
27.	It is unlikely that you will be cured completely of Parkinson

Table A4

Sentences of Set 4

S.No	Sentences
1.	It is likely that you will experience mild nausea from taking Benadryl
2.	It is possible that you will experience a side effect from the treatment
3.	It is possible that you will experience mild nausea from taking Benadryl
4.	It is expected that you will be cured of this disease
5.	It is expected that you will be cured of Chlamydia
6.	You will maybe be cured of this disease
7.	You will maybe be cured of Chlamydia
8.	It is uncertain whether you will survive this disease.
9.	It is uncertain whether you will survive blood cancer.
10.	It is doubtful that you will survive this disease.
11.	It is doubtful that you will survive blood cancer.
12.	You will almost never have permanent complaints from this disease.
13.	You will almost never have your foot be amputated from diabetics.
14.	There is a chance that you will have permanent complaints from this disease.
15.	There is a chance that your foot will be amputated from diabetics.
16.	It is certain that your symptoms of this disease will pass
17.	It is certain that your symptoms of UTI will pass
18.	It is impossible that your symptoms of this disease will pass
19.	It is impossible that your symptoms of UTI will pass
20.	You will almost always die from this disease.
21.	You will almost always die from covid.
22.	It is unlikely that you will die from this disease.
23.	It is unlikely that you will die from covid.
24.	There is a high chance that you will be cured completely of this disease.
25.	There is a high chance that you will be cured completely of Parkinson
26.	It is rare that you will be cured completely of this disease.
27.	It is rare that you will be cured completely of Parkinson

Table A5

Sentences of Set 5

S.No	Sentences
1.	It is expected that you will experience mild nausea from taking Benadryl
2.	You will maybe experience a side effect from the treatment
3.	You will maybe experience mild nausea from taking Benadryl
4.	It is uncertain whether you will be cured of this disease
5.	It is uncertain whether you will be cured of Chlamydia
6.	It is doubtful that you will be cured of this disease
7.	It is doubtful that you will be cured of Chlamydia
8.	You will almost never survive this disease.
9.	You will almost never survive blood cancer.
10.	There is a chance that you will survive this disease.
11.	There is a chance that you will survive blood cancer.
12.	It is impossible that you will have permanent complaints from this disease.
13.	It is impossible that your foot will be amputated from diabetics.
14.	It is certain that you will have permanent complaints from this disease.
15.	It is certain that your foot will be amputated from diabetics.
16.	your symptoms of this disease will almost always pass
17.	your symptoms of UTI will almost always pass
18.	It is unlikely that your symptoms of this disease will pass
19.	It is unlikely that your symptoms of UTI will pass
20.	There is a high chance that you will die from this disease.
21.	There is a high chance that you will die from covid
22.	It is rare that you will die from this disease.
23.	It is rare that you will die from covid.
24.	It is likely that you will be cured completely of this disease.
25.	It is likely that you will be cured completely of Parkinson
26.	It is possible that you will be cured completely of this disease.
27.	It is possible that you will be cured completely of Parkinson

Table A6

Sentences of Set 6

S.No	Sentences
1.	It is uncertain whether you will experience mild nausea from taking Benadryl
2.	It is doubtful that you will experience a side effect from the treatment
3.	It is doubtful that you will experience mild nausea from taking Benadryl
4.	You will almost never be cured of this disease
5.	You will almost never be cured of Chlamydia
6.	There is a chance that you will be cured of this disease
7.	There is a chance that you will be cured of Chlamydia
8.	It is impossible that you will survive this disease.
9.	It is impossible that you will survive blood cancer.
10.	It is certain that you will survive this disease.
11.	It is certain that you will survive blood cancer.
12.	You will almost always have permanent complaints from this disease.
13.	You will almost always have your foot be amputated from diabetics.
14.	It is unlikely that you will have permanent complaints from this disease.

S.No	Sentences
15.	It is unlikely that your foot will be amputated from diabetics.
16.	There is a high chance that your symptoms of this disease will pass
17.	There is a high chance that your symptoms of UTI will pass
18.	It is rare that your symptoms of this disease will pass
19.	It is rare that your symptoms of UTI will pass
20.	It is likely that you will die from this disease.
21.	It is likely that you will die from covid.
22.	It is possible that you will die from this disease.
23.	It is possible that you will die from covid.
24.	It is expected that you will be cured completely of this disease.
25.	It is expected that you will be cured completely of Parkinson
26.	You will maybe be cured completely of this disease.
27.	You will maybe be cured completely of Parkinson

Table A7

Sentences of Set 7

S.No	Sentences
1.	It is uncertain whether you will be cured completely of this disease.
2.	It is uncertain whether you will be cured completely of Parkinson
3.	It is doubtful that you will be cured completely of this disease.
4.	It is doubtful that you will be cured completely of Parkinson
5.	It is expected that you will die from this disease.
6.	It is expected that you will die from covid.
7.	You will maybe die from this disease.
8.	You will maybe die from covid.
9.	It is likely that your symptoms of this disease will pass
10.	It is likely that your symptoms of UTI will pass
11.	It is possible that your symptoms of this disease will pass
12.	It is possible that your symptoms of UTI will pass
13.	There is a high chance that you will have permanent complaints from this disease.
14.	There is a high chance that your foot will be amputated from diabetics.
15.	It is rare that you will have permanent complaints from this disease.
16.	It is rare that your foot will be amputated from diabetics.
17.	You will almost always survive this disease.
18.	You will almost always survive blood cancer.
19.	It is unlikely that you will survive this disease.
20.	It is unlikely that you will survive blood cancer.
21.	It is certain that you will be cured of this disease
22.	It is certain that you will be cured of Chlamydia
23.	It is impossible that you will be cured of this disease
24.	It is impossible that you will be cured of Chlamydia
25.	You will almost never experience a side effect from the treatment
26.	You will almost never experience mild nausea from taking Benadryl
27.	There is a chance that you will experience a side effect from the treatment
28.	There is a chance that you will experience mild nausea from taking Benadryl

Appendix B

Link to the 196 Audios Used in The Survey

https://drive.google.com/drive/folders/1pvuED6mp8QQzmoX2W1Ul1eP4zw1Y95Qu?usp=sharing

Appendix C

Items Used to Measure Uncertainty Avoidance and Individualism based on Yoo et al. (2011)

Table C1

The Items Used to Measure Uncertainty Avoidance

Items
It is important to have instructions spelled out in detail so that I always know what I'm expected to do.
It is important to closely follow instructions and procedures.
Rules and regulations are important because they inform me of what is expected of me.
Standardized work procedures are helpful.
Instructions for operations are important.

Table C2

The Items Used To Measure Individuality

Items
Individuals should sacrifice self-interest for the group.
Individuals should stick with the group even through difficulties.
Group welfare is more important than individual rewards.
Group success is more important than individual success.
Individuals should only pursue their goals after considering the welfare of the group.
Group loyalty should be encouraged even if individual goals suffer.

Appendix D

Survey Script

Dear Participant,

You have expressed interest in the Master Thesis experimental research project of Sara David Thottappilly, student of the Department of Communications and Cognition of Tilburg University's School of Humanities and Digital Sciences under the supervision of Dr. Ruben Vromans.

Before you participate in this experiment, it is required that we obtain your declaration stating that you have been informed about the experiment and are willing to participate. It is explained below how the data collected during the experiment will be handled to guarantee your privacy and what your participation in this experiment entails.

Goal of the Experiment

The objective of the experiment is to understand how health related sentences will be interpreted by people differently.

This experiment consists of two sections. In the first section, you will be asked a few demographic questions such as age, gender, education, your native language. Additionally you will also be asked to rate your responses to certain situations. In the second section, you will listen to 28 health related sentences. To play each sentence, press the play button and listen carefully. After each sentence, you will use the slider mechanism to indicate the likelihood of a particular event occurring, ranging from 0-100%. Each audio file lasts approximately 6 seconds. As the experiment involves you listening to 28 audio files, it is important that you are in a quiet place when you take part in the experiment.

Experiment Duration

The experiment will take about 10-15 minutes to complete.

Inclusion Criteria

To participate in the experiment, you must be at least 18 years old and a second language English speaker from either India or the Netherlands. This study specifically targets individuals with a non-native English background to gain insights into how cultural and linguistic factors can affect the numerical interpretation of English probability phrases.

Risks and Benefits

Although there are no known risks associated with participating in this study, it is related to health risk communication and may trigger individuals who have previously undergone a particular disease or have close acquaintances who have. It is important to note that this is not intentional, and you have the right to withdraw from the survey if a particular statement or question triggers you.

Participating in this experiment will not provide you with any direct advantages. However, the results of this experiment can potentially contribute to a better understanding of health risk need to be communicated to second language speakers of English.

Voluntary Participation

Participation in this experiment is completely voluntary. You do not have to give any reason if you do not want to participate. Even if you give your permission now, you can withdraw this permission at any time without having to state any reason. You will not suffer any negative consequences for withdrawing your consent.

Confidentiality
The information collected in this experiment will be treated confidentially and will only be used for research purpose. Your name or any other identifying information will not be associated with your responses. Your data will be stored anonymously at a secured database of Tilburg University for 10 years.

Contact Information
If you have any questions about this study, please contact Sara David Thottappilly at s.davidthottappilly@tilburguniversity.edu.

○ I read the terms and agree to take part in the experiment. (1)

○ I do not agree to take part in the experiment (2)

Section 1

Here you will be asked a few background questions and few questions related to your personal opinion on certain situations/ instances.

Q3 What is your age?

____

Q4 What is your gender?

○ Male (1)

○ Female (2)

○ Non-binary / third gender (3)

○ Prefer not to say (4)

Q6 What is your educational qualification?

◯ High School (1)

◯ Graduate (2)

◯ Post graduate (3)

◯ Doctorate (4)

◯ Other (5)

Q8 **Please note that the experiment is open only to people from India and Netherlands*
What is your nationality?

◯ Netherlands (1)

◯ India (2)

Q9 What is your native language?

____

Q10 **Please note that the experiment is open only to people for whom English is a second or third language.*
Is English your second/ third language?

◯ No (1)

◯ Yes (2)

You will be presented with few statements and are kindly requested to express your level of agreement with each one by sharing your opinion .

To what extend do you agree to the following statements

	Strongly disagree (1)	Disagree (2)	Somewhat disagree (3)	Neither agree nor disagree (4)	Somewhat agree (5)	Agree (6)	Strongly agree (7)
It is important to have instructions spelled out in detail so that I always know what I’m expected to do. (1)	○	○	○	○	○	○	○
It is important to closely follow instructions and procedures. (2)	○	○	○	○	○	○	○
Rules and regulations are important because they inform me of what is expected of me. (3)	○	○	○	○	○	○	○
Standardized work procedures are helpful. (4)	○	○	○	○	○	○	○
Instructions for operations are important. (5)	○	○	○	○	○	○	○

To what extend do you agree to the following statements

	Strongly disagree (1)	Disagree (2)	Somewhat disagree (3)	Neither agree nor disagree (4)	Somewhat agree (5)	Agree (6)	Strongly agree (7)
Individuals should sacrifice self-interest for the group (1)	○	○	○	○	○	○	○
Individuals should stick with the group even through difficulties. (2)	○	○	○	○	○	○	○
Group welfare is more important than individual rewards. (3)	○	○	○	○	○	○	○
Group success is more important than individual success. (4)	○	○	○	○	○	○	○
Individuals should only pursue their goals after considering the welfare of the group. (5)	○	○	○	○	○	○	○

Group loyalty should be encouraged even if individual goals suffer. (6)	○	○	○	○	○	○	○

Section 2

In this section, you will listen to 28 sentences related to health. Please make sure you are in a quiet space, and using headphones is recommended for optimal listening experience.
After listening to each audio, kindly use the slider to answer the question asked.

	0 10 20 30 40 50 60 70 80 90 100
After listening to the audio, what do you think is the percentage probability of experiencing a side effect from the treatment? ()	

	0 10 20 30 40 50 60 70 80 90 100
After listening to the audio, what do you think is the percentage probability of experience a mild nausea after taking Benadryl? ()	

Thank you for taking part in the survey.

The primary aim of this study is to gain insights into how culture and context influence the numerical interpretation of verbal probability phrases by individuals who speak English as a second language.

Our research specifically focuses on understanding the variation in numerical interpretation among English second language speakers from the Netherlands and India. Additionally, we aim to investigate how cultural factors subsequently impact their interpretation of health-related context sentences.

We sincerely appreciate your contribution to this survey. Should you have any further questions pertaining to the study, please feel free to contact us at s.davidthottappilly@tilburguniversity.edu.

Thank you once again for your valuable participation.

Appendix E

Results of Independent t Test of 14 Verbal Probability Phrases Among Dutch and Indians

Phrases	***t***	**df**	***p***	***d***	**95% Confidence Interval**	
					Lower	**Upper**
Certain	0.0622	85.0	0.951	0.0139	-0.4249	0.453
Almost Always	0.9324	82.0	0.354	0.2108	-0.2342	0.655
High Chance	-0.4521	84.0	0.652	-0.1015	-0.5417	0.339
Likely	-0.2140	81.0	0.831	-0.0489	-0.4966	0.399
Expected	0.8533	82.0	0.396	0.1929	-0.2518	0.637
Uncertain	0.5636	78.0	0.575	0.1293	-0.3213	0.579
Possible	4.1185	83.0	< .001	0.9281	0.4619	1.389
Maybe	0.1816	86.0	0.856	0.0405	-0.3970	0.478
Chance	2.3738	88.0	0.020	0.5266	0.0835	0.967
Doubtful	1.6532	81.0	0.102	0.3751	-0.0745	0.822
Unlikely	1.4666	76.0	0.147	0.3413	-0.1191	0.800
Almost Never	0.9745	80.0	0.333	0.2234	-0.2280	0.673
Rare	0.4566	83.0	0.649	0.1036	-0.3418	0.548
Impossible	1.1953	69.0	0.236	0.2999	-0.1955	0.793