PSYCHOLOGY

When very likely is not so likely

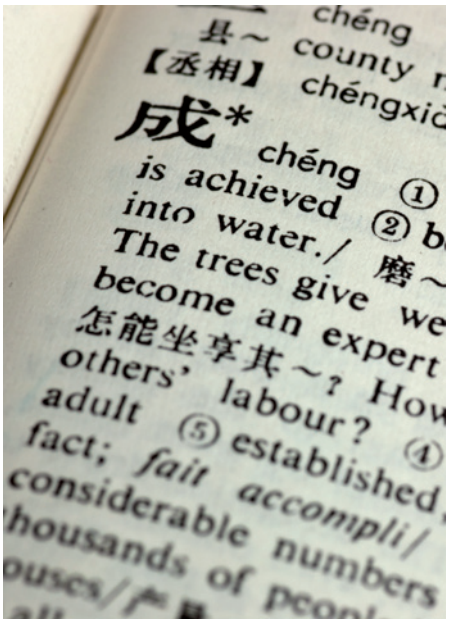
The Intergovernmental Panel on Climate Change has issued guidelines for communicating probabilities with words, but readers all over the world think the words mean something different.

Karl Halvor Teigen

All forecasts, including scientific ones, are fraught with uncertainty. How should scientists communicate their uncertainty to the public in a consistent and reliable way? One solution, favoured by the IPCC, is to qualify forecasts with verbal descriptors — from 'exceptionally unlikely' to 'virtually certain' — accompanied by numeric probability ranges that correspond to these individual phrases. However, this solution is less helpful than one might think. Budescu *et al.*[1] report in *Nature Climate Change* that most readers, in 24 countries around the world, do not understand the verbal phrases as intended despite having the IPCC translations available. For instance, half of them think that a 'very likely' climate change is one that has less than a 70% probability of occurring, instead of a probability beyond 90%, as dictated by the translation standards.

Psychologists in the area of judgment and decision making have known for a long time that lay people's use of numeric probabilities often differs from normative requirements[2]. Even experts hesitate to use numeric estimates for events that cannot be precisely calculated. Instead they prefer verbal phrases, taken from natural language, like 'a good chance', 'not unlikely' or 'almost certain'[3]. But the familiarity of these phrases does not guarantee that they are understood by everyone in the same way. Studies of how people translate words into numerical values indicate that verbal probability phrases are very vague (at least in a probabilistic sense)[4], and that people fail to realize the extent of their vagueness[5,6]. This partial awareness might create an illusion of communication, where communication partners think they understand each other while drawing different inferences from the same messages.

To reduce this vagueness, standard vocabularies have been suggested within domains as diverse as military intelligence, health policy and business risk-auditing. Even if communicators can adhere to a standard, they may not be honoured by recipients of the communication. Budescu and colleagues[7] let a sample of Americans read sentences containing probabilistic



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terms from IPCC reports and found that only a minority of probability judgments matched the IPCC conversion table. The present study[1] replicates these findings in 27 large samples from 25 different countries, with climate report excerpts translated to 17 different languages. For half the participants, the IPCC standard translations were introduced initially and later made accessible for consultation. For the other half, the standard numeric translations were presented alongside each statement. This verbal–numerical procedure made a difference. Whereas participants' translations in the first group complied with the IPCC standard in only 27% of the cases, the percentage of matching responses increased to 40% for the second group. All countries evinced a similar pattern of results, with the samples from India and Israel as the least and the most compliant samples, respectively.

It is puzzling that so many otherwise obedient participants decide to ignore the translations offered to them. Why shouldn't 'very likely' mean a probability above 90% and 'very unlikely' suggest probabilities below 10%? After all, these probabilities are in line with spontaneous translations done by participants in other studies, who are asked simply to convert verbal phrases into numbers of their own choice[8]. Moreover, the phrases used by Budescu *et al.*[1,7] were presented to participants in the context of actual climate report statements. And on the top of that, the instructions stressed that participants should interpret statements according to the meaning intended by the communicator rather than their own views. Yet most translations were 'regressive' — high probability phrases were perceived as less likely and low probability phrases as more likely than dictated by the IPCC standards.

The study was not designed to solve the puzzle of regressive responses, but the vagueness inherent in the statements and the complexity of the subject matter itself may offer a clue. Take an illustrative statement (actually one of the simpler ones): "It is very likely that hot extremes, heat waves and heavy precipitation events will continue to become more frequent." This message asks the reader not only to capture the meaning of 'very likely', as requested, but also to ponder the range of events that qualify as hot extremes, heat waves and heavy precipitation, the frequencies implied by 'more frequent' and to decide what it means for an unspecified trend to continue. Not all of these potential extremes and imaginable frequencies will be more than 90% probable, so perhaps a regressive interpretation closer to a probability of 50% captures the spirit, if not the letter, of such statements.

The present study by Budescu and colleagues[1] is unique in its comprehensiveness, demonstrating that problems of communicating and understanding verbal probabilities are not restricted to one language, one country or one culture. It confirms previous research by showing that the elasticity of language cannot simply be defined away. If we want words to reflect numbers, the numbers have to be given as well.

Perhaps the words convey something additional that numbers can't. Words can

be positive or negative; the positive ones (such as 'likely' or 'a chance') ask readers to consider occurrences regardless of the numerical probabilities involved, whereas negative terms (such as 'unlikely' or 'not certain') ask readers to contemplate the other side of the coin[9]. Positive words are also more often chosen in a context of increasing probabilities[10]. A closer reading of the IPCC reports reveals that the term 'likely' is used 10–20 times more often than 'unlikely'[11]. This makes sense from a pragmatic point of view, as informing the public about what might happen appears more useful than asking them to consider what might not. ❐

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HYDROLOGY

Probing the monsoon pulse

Identification of long-term changes in periods of extreme heavy and weak rainfall during the Indian monsoon season has been elusive. Now, an observational study provides the firmest evidence so far.

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The flooding in northern India in June 2013 was a vivid reminder of the vital socio-economic importance of extreme variations of the South Asian summer monsoon. Given the devastating impact of severe rainfall events on human society and the environment, detecting recent changes in the characteristics of these events is an issue of utmost importance[1]. Understanding recent extreme variability is critical for more reliable projections of future changes[2] and the effective management of future climate-related risks[3]. However, long-term changes in the total precipitation during the monsoon season have received considerably more attention, and existing studies on subseasonal variability have shown rather contradictory results[4,5]. Now, in a study published in *Nature Climate Change*, Deepti Singh and colleagues[6] use a rigorous statistical approach to identify changes in the observed frequency and intensity of extreme monsoon rainfall spells during the past 60 years.

The June–September monsoon season provides up to 80% of the total annual rainfall over the Indian subcontinent, where more than 1.7 billion people (over 25% of the world's population) live and strongly rely on monsoon rainfall for their mainly agrarian societies. Surprisingly, seasonal mean rainfall is remarkably stable from year to year, with variations typically within 10% of the long-term mean[3,5,7]. However, once the monsoon is underway, rainfall is not steady but is punctuated by considerable fluctuations between periods (lasting from days to weeks) of heavy and low rainfall (wet and dry spells)[5,6]. Extremes in these events, which manifest as floods and droughts, have tremendous impacts on agriculture, health, economy and water supply[1]. The prolonged monsoon failure during July 2002, with a 50% rainfall deficit, contributed to a remarkable reduction in agricultural production and the growth rate of gross domestic product.

Figure 1 | During the South Asian summer monsoon season the weather fluctuates between wet and dry spells, which are periods of heavy and weak rainfall. Extreme spells have large impacts on the livelihoods of people living in the Indian subcontinent.