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More than 50% or Less than 70% Chance: Pragmatic Implications of Single- Bound Probability Estimates

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Abstract

Probability estimates can be given as ranges or uncertainty intervals, where often only one of the interval bounds (lower or upper) is specified. For instance, a climate forecast can describe La Niña as having “more than 70% chance” or “less than 90% chance” of occurring. In three experiments, we studied how research participants perceived climate- related forecasts expressed with lower- bound (“over X% chance”) or upper- bound (“under Y% chance”) probability statements. Results indicate that such single- bound statements give pragmatic information in addition to the numeric probabilities they convey. First, the studies show that these statements are directional, leading the listeners' attention in opposite directions. “Over” statements guide attention towards the possible occurrence of the event and are explained by reasons for why it might happen, while “under” statements direct attention to its possible non- occurrence and are more often explained by reasons for why the target event might not appear, corresponding to positive (it is possible) versus negative (it is uncertain) verbal probabilities. Second, boundaries were found to reveal the forecaster's beliefs and could be perceived as indicative of an increasing or a decreasing trend. Single- bound probability estimates are therefore not neutral communications of probability level but might “leak” information about the speaker's expectations and about past and future developments of the forecast. Copyright © 2017 John Wiley & Sons, Ltd.

Introduction

Predictions are inherently uncertain. Deterministic statements about past or future climate are, for instance, rarely possible to make, because of the uncertainty involved in measuring the past and projecting the future climate (Deser, Phillips, Bourdette, & Teng, [2012](#); Harrison, [2013](#)). Climate scientists therefore often assign probabilities to possible future outcomes

(Mastrandrea et al., 2010). Because probabilities themselves can be uncertain, forecasts and projections can come with a range of probabilities, where often only one of the interval bounds is specified. When the chances of El Niño developing during fall or early winter of 2017 is “about 40–45%” (IRI, 2017), a communicator may choose to emphasize only one boundary, by saying that chances are “above 40%” or “below 45%”. In the present paper, such statements will be called *single- bound* probability estimates, describing either the *lower bounds* (e.g., “more than X percent chance”, “above X percent chance”) or the *upper bounds* (e.g., “less than Y percent in chance”, “below Y percent chance”) of a probability distribution. In linguistics, such statements are known as *hedges*, which are words or phrases “whose job is to make things fuzzier or less fuzzy” (Lakoff, 1973, p. 471). Specifically, single- bound phrases exemplify the hedge type *asymmetric approximators* (Ferson et al., 2015; Prince, Frader, & Bosk, 1982), which modify numerals to change the magnitude or precision of an expression, and imply a range of possible values understood to be asymmetrically positioned around a stated value (Ferson et al., 2015).

Single- bound probability phrases are widely used in media reporting about probabilistic events, as can be seen in an overview of media usage in Figure 1. While “more than X%” and “less than Y%” may appear to be two equivalent ways of describing the same likelihood range of “X% to Y%”, a deeper look into their actual usage and reception reveals important differences in communicative function. These differences are the topic of the present paper.

Figure 1
Occurrence frequencies of “more than X percent chance” and “less than X percent chance” in Google News (May 2016). [Colour figure can be viewed at wileyonlinelibrary.com]

Single- Bound Statements Have Pragmatic Implications

Whereas the meaning and usage of single- bound probability estimates have not previously been studied, past research has shed light on how people interpret single- bound estimates of other approximate quantities. Across various domains, such statements are found to convey pragmatic implications in addition to the numeric information (Teigen, 2008; Teigen,

Halberg, & Fostervold, [2007](#)). That is, they lead the listener to infer something that is not explicitly stated or implied in the statement (Brewer, [1977](#)).

Inferences about the speaker

First, choice of single- bound statement affects inferences about the speaker. Consider the following information: “Anders says that his flat is worth ‘more than 1 million’”. Would you say that Anders sounds like a pessimist or an optimist? What about Birte, who says her flat is worth “less than 2 million”? Research participants receiving these statements described Anders as much more of an optimist than Birte—although she was expected to get more money for her flat (Teigen et al., [2007](#)).

Perceived opinions and advice are also inferred from boundary estimates. Participants in another study (Teigen, [2008](#)) were told about a product they considered buying that cost between NOK 600 (\$100) and NOK 900 (\$150). Those who were told that “Julie says that the product costs over 600” assumed that Julie found it expensive. When Julie said that the product “costs under 900,” an overwhelming majority thought she considered it cheap, despite indicating a higher price. “Over 600” was also by most participants considered a warning against purchase, while “under 900” was considered a recommendation.

In line with this, we expect events that are said to have “more than a X% chance” to be considered rather likely, at least by the speaker. Events described as having “less than Y% chance” are, in contrast, considered relatively unlikely, even in cases where $Y > X$.

Information about trends

Not only do single- bound statements shape perceptions of the speaker's attitudes towards a target object but they may also carry information about the object or event itself, by indicating whether the stated value represents an increase or decrease compared with other values. When told that tomorrow's temperature will be “above X degrees”, most people infer that today's temperature is lower. If tomorrow's temperature will be “below Y degrees”, they believe today is warmer (Teigen, [2008](#)). Lower bounds (above statements) imply here an increasing trend, while upper bounds (below statements) imply decreasing values, which may affect expectations of further changes in the future.

In the studies reported in this paper, we explore the trends implied by single- bound probability estimates, expecting probabilities of “more than X percent” to describe a trend towards higher certainty, and probabilities of “less than X percent” as indicating a growing uncertainty about the target outcome.

Attentional focus

Such trend effects seemingly run counter to classical anchoring effects, in which estimates are biased towards initial values (Epley & Gilovich, [2006](#); Harris, Por, & Broomell, [2017](#); Tversky & Kahneman, [1974](#)), but are not necessarily in conflict with them. For instance, we expect “more than 50% chance” to reflect probabilities rather close to 50%. However, when judging the implications of these estimates, listeners may infer opinions and trends that are contrasted with the numeric value. One possible explanation is that single bounds lead listeners' attention in opposite directions, by a process similar to directionality in studies of verbal probability expressions.

Research on uncertainty communication has identified two kinds of verbal probability terms, those pointing to the occurrence of a specific target outcome (T is possible) and those directing the listener's attention to the other side of the coin, namely, that the target outcome may not occur after all (T is uncertain). This positive or negative attentional focus has been labeled *directionality* (Teigen & Brun, [1995](#)) and is found to affect listeners' decisions and judgments (Honda & Yamagishi, [2006](#), [2017](#); Teigen & Brun, [1999](#), [2000](#)). The directionality of verbal probability statements can be revealed by asking for explanations. Positive statements will generally be explained by pro reasons, whereas negative statements suggest con reasons, that is, reasons for why the target outcome may not appear (Teigen & Brun, [1995](#)). Similar effects have been demonstrated for lower- bound and upper- bound statements of quantities (Teigen, [2008](#)).

We extend this logic to single- bound probability estimates and expect upper and lower probability statements to have opposing attentional focus. Lower boundaries are predicted to direct attention to the potential occurrence of an event, whereas upper boundaries draw attention to its potential non- occurrence.

Single- bound estimates as frames

Communicating lower versus upper bounds of an interval can be seen as alternative ways of framing the same facts. As demonstrated by a vast research literature, different ways of framing numerical information can lead to highly divergent judgments and decisions (Levin, Schneider, & Gaeth, [1998](#); Teigen, [2015](#); Tversky & Kahneman, [1981](#)). For example, ground beef that is described as 75% lean is judged to be tastier and healthier than beef that is 25% fat (Levin & Gaeth, [1988](#); Sanford, Fay, Stewart, & Moxey, [2002](#)), medical treatments described in terms of survival rates are more likely to be approved than treatments described with the corresponding mortality rate (e.g., Marteau, [1989](#); Wilson, Kaplan, & Schneiderman, [1987](#)), and situations described in terms of success rates are judged more favorably than the same alternative described with failure rates (e.g., Davis & Bobko, [1986](#); Dunegan, [1993](#)).

Likewise, “more than 50% chance” and “less than 70% chance” may be considered different ways of framing a probability in the 50–70% range. The classical studies of *attribute framing* cited previously involve a target object that is described on a single bipolar dimension and require the two alternative descriptions to be formally equivalent (Teigen, [2015](#)). The chances in our example are not entirely complementary, as “more than 50%” could in principle include probabilities above 70% as well. However, most people will think that both statements convey a similar probability (around 60%), and the phrases therefore loosely meet the requirement of formal equivalence.

The question often posed in framing research is how frames affect the listeners' judgments and decisions regarding the target object. Recently, researchers have begun to ask not only how frames are interpreted but also how they are produced (Honda & Matsuka, [2014](#); Teigen & Karevold, [2005](#)). What are the speaker's reasons for framing the information in one specific way, rather than another? And which inferences do listeners draw about the speaker based on her frame selection?

McKenzie and Nelson's ([2003](#)) *reference point hypothesis* posits that frames are selected as a function of their reference points (the norm, a previous state, or an expectation). Speakers choose the frame that describes what has increased relative to the reference point. If a cup used to be empty and is filled up halfway, speakers prefer calling it half full (its fullness has

increased). A previously full cup is rather described as half empty (its emptiness has increased).

Sher and McKenzie (2006) argue that although a half full and a half empty cup contain the same amount of liquid and therefore are *logically* equivalent frames, they are not *informationally* equivalent. The frames carry implicit information in addition to their explicit content—they “leak” information about reference points, perceived valence and the direction of a change. Listeners make correct inferences about reference points based on frame selection and assume that a half empty cup was previously fuller (McKenzie & Nelson, 2003). The leaked information is thus “absorbed” by the receivers.

Analogously to McKenzie and Nelson's (2003) analysis of framing effects, Teigen et al. (2007) suggested that single- bound estimates function as *provisional reference points*, which can explain their connotative meaning. By describing an amount as “above X” or “below Y”, the speaker provides a standard of comparison that makes the amount more easily *evaluable* (Hsee, 1996; Hsee & Zhang, 2010). Relative to this reference point, a product that costs “more than \$100” must be regarded as costly, as all prices beyond this arbitrary value are large in a comparative sense. Recently, Honda and Yamagishi (2017) applied the reference point hypothesis of McKenzie and colleagues to verbal probability phrases of different directionality and showed that listeners make inferences about speaker's reference points based on the directionality of a verbal probability statement.

Likewise, we propose that single- bound probability estimates make probabilities more evaluable than they would otherwise have been. An outcome claimed to be “more than 30% likely” indicates a chance that is substantial and should be taken into account. If, in contrast, the likelihood is “less than 50%”, it appears more insignificant and less to bother about—or at least, that this is what the speaker wants us to think.

Single- Bound Probability Statements in Everyday Discourse

In the present studies, findings from research of single- bound estimates of approximate quantities (prices and other magnitudes) are extended and adapted to people's understanding of single- bound estimates of numerical probabilities. We predict that lower- bound statements like “more than/over/at least X percent chance” will be used to indicate probabilities that should be considered large, or increasing, and conversely, that upper- bound statements like “less than/under/at most X percent chance” mean that the probabilities in question should be regarded as small, or decreasing.

It follows that speakers will use lower- bound phrases mainly with probabilities that are nominally large (i.e., from 50% and upwards), whereas upper- bound phrases will be used more often with nominally small probabilities (from 50% and downwards). This was confirmed by internet searches of Google News displayed in Figure 1 and replicated by searches in Retriever, which is a database of 332 Norwegian and Swedish magazines and newspapers. The corpus counts indicate that lower- limit phrases (over and more than) are more common with probabilities above than below 50%, whereas upper- limit phrases (under and less than) occur primarily in a context of low probabilities. Additionally, “more than” phrases are generally more frequent than “less than” phrases, as has been found previously in other domains (amounts of money, estimates of time and distances, Halberg & Teigen, 2009,

and comparative statements, Hoorens & Bruckmüller, [2015](#)). In addition, 50% stands out as particularly prominent number, reminiscent of the “50% blip” found in lay chance estimates (Fischhoff & Bruine de Bruin, [1999](#)).

The Present Studies

We report the results of three studies where the pragmatic implications of upper- bound and lower- bound probability estimates are explored in a climate change domain, where uncertainty is often expressed probabilistically (Mastrandrea et al., [2010](#)). The present research supplements past findings (Harris et al., [2017](#)) by studying the pragmatic in addition to the quantitative information conveyed in single- bound statements. It also extends findings on the pragmatic implications of quantity estimates (Teigen, [2008](#); Teigen et al., [2007](#)) to probability estimates. Specifically, it aims to show that one- sided statements about uncertain values have pragmatic implications and affect beliefs about the speaker and about trends also in the area of probability estimates. Moreover, the concept of attentional focus, or directionality, hitherto primarily explored for verbal probabilities, is applied to single- bound numeric probability intervals. We test two main hypotheses: an attentional focus hypothesis and a trend hypothesis.

The attentional focus hypothesis

Single- bound probability phrases direct the reader's or the listener's attention. Specifically, we expect lower- bound phrases (“more than X% chance”) to point recipients' attention to the occurrence of a target event, while upper- bound phrases (“less than Y% chance”) to point to its non- occurrence. This may play out in two ways:

1. Recipients' explanations of probability statements differ by boundary frame. When people are asked to explain single- bound estimates, we predict that reasons for a probability of “more than X%” for a target event will be positive (in support of why it should occur) and that reasons for a probability of “less than Y%” will be negative (why the target event should not occur), even in cases where the latter probabilities are numerically higher.
2. Opposing boundary frames will fit with verbal probability terms of opposing attentional focus. Lower- bound phrases will be judged as more compatible with positive verbal probabilities (e.g., *it is possible*) and upper- bound phrases with negative verbal probabilities (e.g., *it is uncertain*).

The trend hypothesis

Different foci of attention might also carry information about where we are heading. Single- bound probability phrases may therefore affect trend perceptions. We predict that lower- bound phrases suggest probabilities that are increasing, whereas upper bounds indicate a downward trend. From this general idea, three specific predictions were derived:

1. A forecaster suggesting that an event has “more than X% chance” is more often perceived as expecting the event compared with one giving a “less than Y% chance” of occurrence, even when the two phrases suggest a similar point estimate.
2. Past forecasts are believed to differ from present forecasts in line with the trend suggested by the single- bound statement. A probability that is now estimated to be

- “over X%” may have increased from a lower previous estimate. In contrast, an estimate that is now “under Y%” may have decreased from a higher previous estimate.
3. Future forecasts are expected to change in line with the same implied trend. A probability of “over X%” will increase, while one “under Y%” will decrease.

Testing the hypotheses

In all studies, participants were given an expert's probabilistic forecast expressed with lower or upper bounds and asked which point estimate the expert had in mind, in order to test the quantitative understanding of these phrases.

The attentional focus hypothesis was tested by asking participants about the expert's past (Studies 1–3) and future (Study 1 and 3) estimates on the same topic and whether he or she was believed to expect the event (Study 2 and 3).

The trend hypothesis was tested by asking participants to provide reasons of why the probability of a specific outcome is “over X” or “under Y” percent (Study 1). It was also tested by making participants rate the appropriateness of different positive and negative probability phrases (verbal expressions with known directionality) for conveying the same message in words rather than numbers (Study 1 and 3).

“Less than” and “under” are both upper- bound modifiers that suggest quantities or probabilities to be regarded as small (in contrast to the upper bound value Y). “Almost” is yet another common term that can be used to describe magnitudes lower than Y but this time highlighting their closeness to the upper boundary rather than their contrast to it. *Almost* therefore implies that the magnitude is implied to be high, approaching Y (Kahneman & Varey, [1990](#)), and in a way assimilated rather than contrasted to it. Study 2 included an *Almost* condition in addition to the *Over* and *Under* conditions, to explore whether reception is a function not only of the interval bound but also of whether a term qualifying it is of a contrastive or assimilative nature.

Study 1: Single- Bound Estimates Direct Attention

Studies of verbal probability phrases (it is likely and it is uncertain) have shown that such expressions direct attention and have either a positive directionality, pointing to the occurrence of a target event, or negative directionality, pointing to its non- occurrence. In Study 1, we apply this logic to single- bound numeric probability estimates. In line with the attentional focus hypothesis, we predicted that when people are asked to explain single- bound estimates, they give more positive reasons for a probability of “over X%” than for a probability of “under Y%”. We also expected lower- bound probabilities (“over 30%”) to be more easily translated into positive verbal phrases (e.g., “there is a chance”), whereas negative verbal phrases (“it is uncertain”) would fit better to describe upper- bound probabilities (“under 50%”).

The trend hypothesis was investigated by asking what past and future forecasts might be. “Over X” probabilities were expected to suggest increasing trends and therefore a past forecast that had been lower and a future forecast that would become higher, whereas “less than Y” should be preceded by higher and followed by lower estimates.

Method

Participants

Participants were 98 unpaid volunteers recruited on campus at the University of Oslo (70 women, median age 22 years).

Material and procedure

Participants were randomly assigned to two conditions; the Over condition or the Under condition, by receiving a pen- and- paper questionnaire with either lower- bound (over X%) or upper- bound (under Y%) probability estimates. All questionnaires described projections of reduced glaciers (Scenario 1) and increased sea levels (Scenario 2) by the year 2100. In Scenario 1, participants read that a climate expert, Heidi Knutsen, has issued a report in 2013, where she gives a probability that a Norwegian glacier, Øksfjordjøkulen, will shrink to half its present size within this century. They then completed the following measures, all on the same page:

Reasons

Participants were asked to complete the sentence in a way that made sense to them: “Knutsen thinks it is over 30% [under 50%] probability that Øksfjordjøkulen will be halved, because ...”

Point estimates

Next, they were asked to specify the probability they thought the expert had in mind, with a single number.

Verbal probabilities

They then received four verbal phrases, two positive (a chance and a possibility) and two negative (small probability and quite uncertain), which the expert might use to explain the probability with words rather than numbers (example item: “There is a chance that it [the glacier] will be halved”). Each statement was rated for appropriateness on a scale ranging from 1 (*fits very poorly*) to 5 (*fits very well*).

Future estimates

Participants were told that the expert had started to prepare a new report, to be published in 2018. What would be her point estimate for glacier reduction in this future report?

Past estimates

They were finally asked whether they thought the expert would endorse one or more of the following statements: It [glacier melting] is less likely than before/more likely than before/equally likely/equally unlikely.

On a new page, Scenario 2 described the same scientist's predictions of a future rise in global sea level. In 2013, she predicted a rise of 0.5 m by the year 2100, with a probability of over 50% [under 70%]. Participants were asked to fill in reasons for these predictions, as mentioned previously. The subsequent questions were identical to the questions about glaciers, except that the verbal statements were adjusted to fit a higher level of probability. Two phrases were positive (probable and entirely possible), and two were negative (somewhat uncertain and not completely certain).

Scoring

Sentence completions were in both scenarios classified as pro reasons: explanations for why the target outcome might occur (e.g., “summers will be warmer”); con reasons: explanations for why the outcome might fail to occur (e.g., “temperature rise will take longer time”); and other reasons: ambiguous and unclear explanations (e.g., “because that's what the research shows”). Scoring was performed by two independent coders who were ignorant about the purpose of this research. They agreed on 91.2% of the scores of Scenario 1 and on 87.7% of Scenario 2; disagreements were resolved by discussion.

Results and discussion

Attentional focus

The statements in the Over condition were almost exclusively completed with pro reasons, that is, reasons for why the outcome (shrinking glacier and increasing sea level) would occur, as shown in Table 1. Statements in the Under condition were more often completed with con reasons, although pro reasons also occurred, especially for high levels of probability. The difference between conditions was highly significant for both scenarios (participants with *other* reasons omitted); Scenario 1: $\chi^2(1, n = 78) = 30.97, p < .001$, Cramer's $V = .63$; Scenario 2: $\chi^2(1, n = 74) = 20.83, p < .001$, Cramer's $V = .53$. Thus, the prediction that “over” statements and “under” statements would be given different explanations was confirmed.

Table 1. Types of reasons (percentages) given for probability estimates framed with lower bound (over 30%, over 50%) and upper bound (under 50%, under 70%), Study 1

	Pro reasons	Con reasons	Other reasons
Scenario 1: Glacier			
Over 30% chance	74.0	6.0	20.0
Under 50% chance	26.1	56.5	17.4
Scenario 2: Sea level			
Over 50% chance	85.7	4.1	10.2
Under 70% chance	40.5	40.5	18.9

Single- bound probabilities (over 30% vs. under 50%; over 50% vs. under 70%) had been selected to ensure that the probability levels implied by the “over” phrases would not exceed the probabilities implied by the “under” phrases. This was confirmed by point estimates. Probabilities “over 30%” were estimated to mean, on average, 36.4% ($SD = 14.4$), whereas probabilities “under 50%” obtained a mean estimate of 48.1% ($SD = 19.6$). In Scenario 2, the corresponding mean estimates were 52.4% ($SD = 14.6$) for “over 50%” and 57.0% ($SD = 18.1$) for “under 70%”. Thus, despite being mostly explained by positive reasons, the “over” statements were taken to indicate probabilities lower than or similar to “under” statements.

When translating the numerical probability phrases to words, participants generally judged positive verbal phrases to be more appropriate than negative phrases, especially in the Over condition. A 2×2 mixed analysis of variance (ANOVA) for Scenario 1 with phrase and condition as the two factors shows a main effect of phrase, $M_{\text{positive}} = 4.03$ versus $M_{\text{negative}} = 2.74$; $F(1, 95) = 106.86$, $p < .001$, $\eta^2_P = .53$, no main effect of condition, but more importantly, a significant interaction, $F(1, 95) = 5.42$, $p = .022$, $\eta^2_P = .05$. For Scenario 2, there is a similar main effect of phrase, $M_{\text{positive}} = 3.86$ versus $M_{\text{negative}} = 2.94$; $F(1, 88) = 38.07$, $p < .001$, $\eta^2_P = .30$, and a significant interaction, $F(1, 88) = 3.94$, $p = .050$, $\eta^2_P = .04$, indicating that the preference for positive over negative phrases is stronger in the Over than in the Under condition, as predicted.

Study 1 thus demonstrates that upper and lower probability boundaries lead attention in opposite directions, in line with the attentional focus hypothesis. This appears in that “over” phrases are largely explained by positive reasons and judged as compatible with positively directed phrases, while “under” phrases are more often given negative reasons and according to participants fit better with negative phrases.

Trends

Most participants in both conditions answered that the expert thought the target event was “more likely than before” and predicted that the probability estimates would remain the same or increase (with a mean of 6.3%) at the time the next prognoses are made. There was no evidence for participants in the Under condition to expect a downward revision of forecasts, neither compared with past estimates or in the future. Thus, the trend hypothesis was not confirmed. Instead, participants in both conditions seemed to think that ice melting and sea level rise was increasingly likely. This may be due to a general strong belief in climate change, which has been demonstrated in other samples from this and similar student populations (Hohle & Teigen, [2015](#)). A fair test of the trend hypothesis might require prediction of issues where participants do not hold strong prior beliefs (see Study 2).

Study 2: Single Bounds Indicate Changed Beliefs

Study 1 demonstrated that upper- bound and lower- bound probability phrases point listeners' attention in opposite directions. This directionality suggests that the probabilities have changed and may continue to change. Study 1 showed similar expectations about change for lower and upper boundaries, but these predictions concerned climatic issues (sea level rise and glacier melting) that are generally associated with an increase. A possible trend effect of single- bound statements may therefore have been overshadowed by participants' prior

expectations about future climate change. To address this concern, the scenarios in Study 2 and 3 described more neutral issues where prior expectations of an increase or a decrease were less likely.

Specifically, participants received scenarios where experts had evaluated the prospects of (1) the Lofoten area in the North Sea being opened up for oil drilling, (2) a proposed windmill park being built in Western Norway, and (3) the weather phenomenon La Niña occurring this year. As these events may take place with or without future climate change (although La Niña events are projected to happen more frequently with global warming; Cai et al., [2015](#)), participants' judgments about their likelihood should not depend upon their climate change beliefs.

In line with the trend hypothesis, we predicted single bounds to imply trends from past to present. Accordingly, participants may infer a probability “over X%” to have increased, while one “under Y%” to have decreased. By foreshadowing the future, the phrases may also reveal the expert's personal beliefs about the target event. Perceived beliefs will naturally be a function of probability level (stronger beliefs for higher probabilities), yet attentional focus of the statement might also play a role. Thus, some participants will believe that the expert expects low- probability events with positive focus (more than 30% chance) to occur, and high- probability estimates with negative focus (less than 70%) may indicate that the event is not expected.

In addition to an *Over* and an *Under* condition, Study 2 included an *Almost* condition, to test the assimilative nature of this frequently used approximate term. “Almost 50%” means to most people a value below 50%. At the same time, it points upwards towards the reference value, suggesting a propensity (Kahneman & Varey, [1990](#)) or an approach (Karevold & Teigen, [2010](#)). Thus, the magnitude of a chance that is “almost Y%” is implied to be high, whereas a chance that is “under Y%” is implied to be low. *Almost* Y should accordingly produce answers and interpretations more similar to *over* X than to *under* Y.

To compare the probabilities implied by lower- bound and upper- bound estimates, participants were also asked to indicate numerical point estimates (the most likely value) implied by the single- bound phrases. Study 1 suggested that a chance of “under 50%” or “over 70%” indicated probabilities rather close to these boundary values, typically within 10 percentage points. Thus, estimates of “over 50%” and “under 50%” were not believed to be numerically far apart on the probability scale.

Method

Participants

Norwegian participants were recruited to answer an online questionnaire through a link distributed on social media. Of the 186 participants, 96 were women, $M_{\text{age}} = 28.1$ ($SD = 10.5$). A majority (66.1%) had completed at least some university or college education. They were randomly allocated to one of three different conditions.

Procedure and material

Participants in all conditions received three scenarios where experts were reported to have made probabilistic forecasts: an area being opened to oil drilling, a windmill park being

realized, and La Niña occurring within the present year. For each of these prospects, an expert said that “There is now a ... % chance”. In the Over condition, the predictions were “over 30%,” “over 50%,” and “over 70% chance” for these three issues, respectively. In the Under condition, the experts said that the probabilities were “under 30%/50%/70%”. In a third, Almost condition, chances were “almost 30%/50%/70%”.

After each scenario, participants answered three questions:

Point estimate

Which probability does the forecaster more specifically have in mind (written as a number between 0% and 100%)?

Past estimate

The expert also made a forecast about this issue last year (La Niña: last month). What do you think was his/her previous estimate? About the same, lower, or higher (choose one)?

Expert's personal belief

Do you think the expert expects the target event (oil drilling, windmill park, and La Niña) to occur, yes or no?

Results and discussion

When participants were asked which probability they thought the forecaster had in mind, they generally suggested numbers close to the stated upper and lower bounds. About 75% of all estimates in the Over and Under conditions were within 10 percentage points of the stated value. In the Almost condition, the mean estimates were even closer to the stated probabilities, with some answers in fact exceeding the presumed upper bound. These participants might have thought of a downward rather than an upward change, reaching, for instance, 30% from above. This is consistent with a study by Ferson et al. ([2015](#)), in which “almost X” values were by some participants interpreted to include also values above the stated value. Alternatively, they may have tried to guess the forecaster's implicit beliefs, foreshadowing the issue of expectations raised by Question 3. This might explain a subset of answers (about 10%) that were at least 10 percentage points above the “almost” values. For mean responses, see horizontal marks in Figure [3](#).

Trends

Statements seemed to implicate trends from past to present. When asked what they thought the predictions had been at a previous occasion, a majority of participants thought they had changed. If the likelihood was now “over 30%/50%/70%” or “almost 30%/50%/70%”, most participants thought it had been lower, rather than higher or about the same, in the past (see Figure [2](#) for all three scenarios combined). In contrast, participants in the Under condition believed that the earlier forecasts had been higher, even for probabilities that were still high. Responses were very similar across scenarios (30%/50%/70%), with a similar proportion of participants indicating that the past forecast was *lower* or *higher* in the three scenarios (<10 percentage points difference).

Figure 2. Beliefs about past forecast compared with present forecast, Study 2. Mean percentages of respondents in Over, Under, and Almost conditions. Responses in the three different scenarios (30%, 50%, and 70%) are combined. Error bars show the standard error of percentages.

Chi- square tests indicate that the associations between condition and beliefs about past forecasts are significant for all scenarios, 30%: $\chi^2(4, n = 186) = 67.76, p < .001$, Cramer's $V = .42$, 50%: $\chi^2(4, n = 186) = 46.01, p < .001$, Cramer's $V = .35$, and 70%: $\chi^2(4, n = 186) = 46.45, p < .001$, Cramer's $V = .35$. In all scenarios, Bonferroni- adjusted z - tests indicated significant differences ($p < .05$) between the Under and Over conditions, and between the Under and Almost conditions, in the proportion who thought past chances had been higher or lower. The Almost and Over conditions did not differ significantly. Thus, *over* and *almost* both clearly indicate an increasing trend (even if *almost* made participants think about an outcome below the target value), while *under* suggests a decreasing trend. These trends were equally prominent for low and high probabilities.

The present results corroborate previous research showing that one- sided intervals and directional probability phrases indicate that amounts have changed (Juanchich, Teigen, & Villejoubert, 2010; Teigen, 2008). In the same way that people infer reference points from framed quantities (e.g., McKenzie & Nelson's, 2003 half full vs. half empty cups), original levels of probability can be inferred from single- bound probability statements.

At the end, participants were asked whether they thought the speakers personally expected the target event to happen, *yes* or *no*. The answer to this question was clearly a function of probability, as shown in Figure 3. Nearly all of those who knew that the probabilities were over 50% or over 70% answered *yes*, whereas those who had been told that the chances were below 50% or 30% answered *no*. But the boundary term also seemed to affect responses: Forecasters who said that there was *almost* 50% chance of oil drilling were also believed (by 85.5%) to expect this to happen. And those who had been told that the chances were over 30% or almost 30% believed quite often that the expert thought it would happen against the odds,

presumably because of the positive attentional focus. An overall belief score (0–3) was created by adding up the number of yes responses in the three scenarios. A one- way ANOVA of this score showed a highly significant difference between conditions, $F(2, 183) = 64.68, p < .001$. Bonferroni post hoc tests showed that Under differed from both Over and Almost ($p < .001$), but Over and Almost did not differ ($p = .273$).

Figure 3. Inferences about forecaster in Study 2. Bar graphs show percentages of yes answers to the question “do you think the expert expects [the target event] to occur?”. Horizontal marks indicate the probabilities the forecaster is believed to have in mind (mean point estimates). [Corrected version]

These results support the trend hypothesis by suggesting that single- bound statements “leak” information about what probabilities used to be and reveal the forecasters expectations. A limitation of the study is that participants were told that the probabilities are “now” over/under/almost X%. From this, many inferred an upward or a downward change from past to present. But part of this effect may be attributed to the explicit emphasis on the current situation: The word *now* can be read as a contrast to *then*, suggesting that a change has taken place (although it does not indicate in which direction). Study 3 was conducted to address this concern.

Study 3: Single- Bound Statements Indicate Continued Trends

To control for the effect of “now” included in the forecasts in Study 2, a replication study was run without this prompt, this time with an American sample. The study was designed to test the upper- bound and lower- bound effects on past as well as future forecasts in a comparable

way. While half of participants were asked to indicate what they thought the probability had been before, the other half indicated what they thought it would be in a future forecast.

Like in Study 2, the trend hypothesis was also tested by asking participants to judge the expert's personal beliefs, and these were again expected to be a function of both probability level and boundary. Participants also rated the statements' compatibility with different verbal probability phrases. In line with the attentional focus hypothesis, lower- bound statements were expected to be compatible with positive verbal probabilities and upper- bound statements more compatible with negative verbal phrases.

Because climate change, the topic of the forecasts, is a polarized issue in which individual beliefs shape judgment of uncertain information (Budescu, Por, & Broomell, [2012](#); Hohle & Teigen, [2015](#)), we included a measure of belief in climate change to explore whether interpretations of the expert statements varied with attitudes.

Method

Participants

After excluding 12 participants who failed a simple attention check, 238 US participants recruited in Amazon Mechanical Turk remained for analysis. Of these, 111 were women, and 1 did not indicate gender. The average age was 36.9 years ($SD = 11.4$). Most respondents (76.5%) had at least some college education.

Procedure and material

Participants were randomly allocated to one of four conditions in a 2×2 design, the two factors being boundary (lower: “more than” vs. upper: “less than”) and temporal orientation of trend (past vs. future forecast). The temporal orientation factor only differed with respect to one question: whether participants guessed the past or the future forecast (Question 3a vs. 3b in the list below). Most results were therefore analyzed with respect to the two boundary conditions, while the answers to Question 3 were analyzed 2×2 .

The questionnaire was a slightly modified version of the one used in Study 2. In three scenarios, participants were told that an expert had estimated the chances for (1) oil drilling in the ocean outside Pryedge to be more than [less than] 30%, (2) La Niña to develop in 2016 to be more than [less than] 50%, and (3) a wind park being built in Wolcott to be more than [less than] 70%. After each scenario, participants were asked to indicate the following:

- 1 The expert's most likely *point estimate* on a scale from 0% to 100%.
- 2 The expert's presumed *personal belief*. Does the expert expect the target event to occur, yes or no?
- 3a

Past estimate (answered by one- half of the participants). Imagine that the expert also reported on this issue last year (oil drilling scenario) or last month (wind park and La Niña). Do you think the chances at this time were considered higher, lower, or about the same?

- 3b

Future estimate (answered by the other half): The expert will report again on this issue next year/month. Do you think the chances at that time will be considered higher, lower, or about the same?

- 4 *Verbal probabilities*. Rated agreement (1–7) with two statements featuring a positive probability phrase (possible) and a negative probability phrase (uncertain; example item: “Allan thinks it is possible that there will be oil drilling outside Pryedge”).
- 5 *Climate beliefs*, measured by an eight- item scale (Broomell, Budescu, & Por, 2015), adapted from Heath and Gifford (2006; example item: “The main causes of global warming are human activities”). The scale had satisfactory reliability ($\alpha = .95$).

Results and discussion

Mean point estimates were similar to those given in Study 2 (see Figure 4). About 80% of all point estimates were within 10 percentage points of the single- bound value. But which information do the “more than” and “less than” statements express apart from their quantitative meaning: do they call attention primarily to the possibilities or to the uncertainties involved? And what do statements reveal about the speaker's beliefs and the existence of past and future trends?

Figure 4. Inferences about forecaster in Study 3. Bar graphs show percentages of yes answers to whether the expert expects the target event to occur. Horizontal marks indicate the probabilities the forecaster is believed to have in mind (mean point estimates).

Attentional focus

The different boundaries called for different verbal phrases (see Table 2). Results of 2×2 mixed ANOVAs with phrase (uncertain vs. possible) and boundary (more than vs. less than)

as the two factors showed that in the 30% scenario, there was a main effect of both phrase (*uncertain* more appropriate than *possible*), $F(1, 236) = 22.98, p < .001, \eta^2_P = .09$, and boundary, $F(1, 236) = 28.37, p < .001, \eta^2_P = .11$ (higher appropriateness for “more than” compared with “less than”). There was also a significant interaction, $F(1, 236) = 28.64, p < .001, \eta^2_P = .11$. For the 50% scenario, there was a main effect of phrase (*possible* more appropriate than *uncertain*), $F(1, 236) = 22.05, p < .001, \eta^2_P = .09$, and no main effect of condition, but a significant interaction, $F(1, 236) = 148.15, p < .001, \eta^2_P = .39$. For the 70% scenario, there was also a main effect of phrase, $F(1, 236) = 207.61, p < .001, \eta^2_P = .47$ (*possible* better than *uncertain*), and an interaction effect, $F(1, 236) = 107.79, p < .001, \eta^2_P = .31$. The interaction effects indicate that as predicted, the positive phrase was more apt than the negative phrase for “more than” statements but not for “less than” statements.

Table 2. Appropriateness ratings (means and standard deviations) for verbal phrases when probability estimates are framed with lower bound (more than 30%, 50%, 70%) and upper bound (less than 30%, 50%, 70%), Study 3.

	More than	Less than	<i>t</i> (df)	<i>p</i>	Cohen's <i>d</i>
Scenario 1: Oil drilling: 30%					
Possible	4.97 (1.44)	3.44 (1.65)	7.62 (229.74)	.000	1.01
Uncertain	4.88 (1.59)	4.94 (1.57)	0.27 (236)	.786	0.04
Scenario 2: La Niña: 50%					
Possible	6.05 (0.86)	4.32 (1.54)	10.63 (179.88)	.000	1.59
Uncertain	3.91 (1.80)	5.27 (1.25)	6.80 (214.21)	.000	0.93
Scenario 3: Wind farm: 70%					
Possible	6.48 (0.68)	5.06 (1.54)	9.12 (158.71)	.000	1.45
Uncertain	2.90 (1.67)	4.48 (1.54)	7.59 (235.54)	.000	0.99

These results provide further evidence for the attentional focus hypothesis, showing that not only for Norwegian but also for US respondents do “more than X% chance” phrases have a positive attentional focus, while “less than X% chance” have a negative directionality, as reflected in ratings of verbal probability terms.

Trends

As predicted by the trend hypothesis, the expert's presumed belief was a function of both probability level and boundary term. Experts who said “more than 50%” or “more than 70%” were clearly assumed to expect the target event to occur, whereas those who said “less than 30%” or “less than 50%” were not (see bars in Figure 4). For chances that were “more than 30% or “less than 70%”, responses were more mixed. Here, the attentional focus (directionality) implied by the boundary term and the balance of probabilities (above or below 50%) pull in opposite directions. As a result, a majority answered in accordance with the implied probability level for “more than 30%” (64% *no*), whereas a substantial minority based

their beliefs on directionality instead. For “less than 70%”, a majority (60%) answered *no* in line with the directionality. Observe that “more than 50%” and “less than 70%” are taken to indicate similar point estimates (58% and 60%), and yet the first statement made twice as many participants believe that the expert expects the event to happen.

In contrast to Study 2, choice of boundary did not affect beliefs about past forecasts. Lower bounds did not indicate that previous forecasts had been lower, and upper bounds did not suggest that past forecasts had been higher. It appears that the word *now* was crucial to induce trend thinking in Study 2. By removing this word, the present is no longer contrasted with the past.

However, choice of boundary affected beliefs about future trends, even without this hint (Figure 5). Although the modal answer was to expect a future estimate that remained about the same, “more than” statements were more often expected to be followed by higher rather than lower future probabilities, whereas probabilities in “less than” statements were more often expected to decrease. As shown in Figure 5, the trends seemed particularly marked for high upward probabilities (more than 50% and 70%) and small downward probabilities (less than 30% and 50%).

Figure 5. Expectations for future estimate compared with today's forecast. Percentages of respondents in two conditions, three scenarios, Study 3. Error bars show the standard error of the percentages.

There was a significant association between condition (more than/less than) and predicted increase, decrease or no change in future forecasts for all scenarios: 30%: $\chi^2(2, n = 119) = 12.76, p = .002$, Cramer's $V = .33$; 50%: $\chi^2(2, n = 119) = 27.79, p < .001$, Cramer's $V = .48$; 70%: $\chi^2(2, n = 119) = 9.11, p = .011$, Cramer's $V = .28$. Bonferroni-adjusted z -tests indicated that in all three scenarios, “more than” led more participants to expect an increase rather than a decrease of probabilities ($p < .05$). “Less than” led to more predictions of a decrease than an increase for 30% and 50%, but a likelihood of “less 70%” was more often predicted to rise than to lower ($p < .05$). Although there were more participants predicting increases than decreases for the 70% scenario, the difference was much more pronounced for “more than 70%” than for “less than 70%”.

The trend hypothesis was thus partially supported. Users of one- limit statements were taken to expect events more often when saying “more than X% likelihood” compared with “less than Y%”, even when the two frames suggested similar probability levels. Trends seem to be implied in the statements in predictions of future forecasts, but in contrast to Study 2, not in beliefs about past forecasts, suggesting a boundary condition of the trend effect. A perceived trend from past to present may require that the present forecast is explicitly contrasted to the past (e.g., by the word “now”).

Climate beliefs

Participants tended to believe in human- made climate change ($M = 3.98$, $SD = 1.01$). Belief was slightly related to the expert's expectations of La Niña and aptness of *possible* in this scenario. Most other correlations between climate beliefs and individual ratings were low ($r < .20$) and insignificant.

General Discussion

The strength of an expectation (about climate change, or any other uncertain event) can formally (and perhaps ideally) be expressed in terms of numerical probabilities. However, probabilities are often in themselves uncertain and have to be communicated in approximate language, for instance, by verbal phrases or probability ranges. We have in the present paper investigated a common but understudied way of communicating chances, namely, by single-bound (upper or lower) probability estimates. Two main hypotheses were tested: Single-bound probability statements direct listener's attention and suggest trends. The studies provided support for both hypotheses, with some possible boundary conditions.

The hypothesis about attentional focus was checked in two ways. First, Study 1 showed that participants tended to explain probabilities that were “more than X%” with positive reasons, whereas “less than Y%” chances were more often explained in a negative way. Second, probabilities of more than 30%, 50%, or 70% were in Study 1 and 3 described with positive verbal probabilities like *possible*, whereas “less than” statements were more appropriately described with negative phrases like *uncertain*. This indicates a parallel between single-bound intervals and directional verbal probabilities.

The trend hypothesis was tested in Study 2 and 3 by asking participants about the speakers' beliefs, which appeared to depend not only upon the numerical probability level but also on the way it was framed, with “more than” and “almost” statements implying a more positive expectation than warranted by the probability level. Furthermore, participants in Study 1 and 2 (but not in Study 3) believed that boundary statements implied a change in estimates from past to present. Finally, Study 3 gave evidence of expected changes (increasing vs. decreasing probability estimates) in the future, depending on how the present estimates were framed.

Single- bound probability expressions occur frequently in daily language as well as in the media (Figure 1) and even in professional discourse (IPCC, 2007, p. 27). Such expressions are useful by indicating likelihoods in a rough and ready way, perhaps in relation to standard benchmarks (such as 50% or 90%, corresponding to “the balance of probabilities” and “beyond reasonable doubt” in law). A single- bound expression has the appearance of an exact number, but is, literally taken, extremely vague. An outcome that has “more than a 30% chance” of occurring could, in principle, denote any probability between 30% and 100%, so the prediction would remain true even for outcomes that are expected to occur. However, the

present studies show that most people will think of point estimates rather close to the boundary value. Such effects have been reported as instances of anchoring (Harris et al., [2017](#)) but are perhaps more satisfactorily explained by Grice's conversational implicatures (Grice, [1975](#)). His *maxim of quantity* assumes that speakers should provide as much information as required for the purpose of the communicative exchange. If a specific probability level or probability range exists, quantifiers such as *under* or *over* should be used for estimates not too far away from the most likely value.

We show in the present studies that when people receive probabilistic forecasts expressed as single- bound statements, the probability level is only one of the messages they take away. Single bounds are not neutral but carry pragmatic information about three related aspects of the probabilistic message. One is the evaluation issue. Should the probability be regarded as high or low? The second issue relates to whether the event will actually take place. Should attention be directed towards the occurrence or the non- occurrence of the target outcome (the attentional focus hypothesis)? The third issue concerns changes over time. Are the probabilities indicative of an increasing or decreasing trend (the trend hypothesis)?

Is the probability high or low? The evaluation issue

The meaning and value of numerical quantities are sometimes difficult to assess from the numbers alone, without access to other comparison values; they lack *evaluability* (Hsee, [1996](#)). They become easier to evaluate once the distribution information, such as the neutral reference point, the value distribution, and the best and worst possible values are known (Hsee, Loewenstein, Blount, & Bazerman, [1999](#)). Such evaluations are at the same time context sensitive, by being dependent upon which comparison objects or comparison values that are available.

Probabilities, the topic of the present paper, are in one sense highly evaluable (Slovic, Finucane, Peters, & MacGregor, [2007](#)), as probability distributions have a known lower and upper bound representing impossibility and certainty (0% and 100%), and a 50/50 midpoint below which chances are often described as low (less than even) and above which they are high (more than even). But in domains with severe events, like risks, probabilities below 50% might be perceived as very high. Furthermore, probabilities that are not close to these benchmarks may be difficult to process and to discriminate. The diminishing sensitivity principle of prospect theory (the π function) implies that the impact of changes in probability is highest for values close to the endpoints. People overweight low probabilities and underweight moderate and high probabilities and are consequently relatively insensitive to changes in probability in the middle of the range (Tversky & Kahneman, [1992](#)). For affective outcomes, people are even less sensitive to probabilities (Loewenstein, Weber, Hsee, & Welch, [2001](#); Sunstein, [2002](#)). The amount of money people is willing to pay to avoid an electric shock is, for instance, almost unaffected by its probability (Rottenstreich & Hsee, [2001](#)).

Upper- bound or lower- bound statements make evaluations easier. “More than X%” indicates, for chance as for other quantities, that the probability should be regarded as relatively high, whereas “less than Y% chance” means, in comparison, low. Such pragmatic implications have been attributed to a contrast between the expected (unstated) value and the (stated) upper- bound or lower- bound value, the latter functioning as a provisional reference point (Teigen et al., [2007](#)). But single bounds are not always *contrasted* with expectations. Study 2 showed that probabilities of “almost Y%” could be regarded as high, even if *almost*

typically indicate an upper- bound value. Thus, comparisons depend not only on reference point (higher or lower) but also on the relationship to this reference value. We expect contrastive comparisons to occur not only with *exclusive* lower and upper bounds, like “more than” or “less than”, where the boundary values fall outside the uncertainty intervals, but also with *inclusive* lower and upper bounds (“minimum” and “maximum” values), which belong to the interval, although the contrasts may be weaker in the latter case. Assimilative comparisons will have the opposite effect, as terms like *nearly*, *almost*, or *up to* indicate that high values are reachable. Recent studies indicate a similar usage of statements about outcomes that *can* happen (Teigen, Filkukova, & Hohle, [2017](#)). Such statements (“it can be 5 °C warmer”) typically point to the upper extreme of a distribution, while at the same time highlighting this value as a real, obtainable possibility.

Single- bound phrases simplify the processing of probabilistic statements by requiring less thought of what the probability means (e.g., frequencies, propensities, and degrees of knowledge). Instead, they convey the *gist* (Reyna & Brainerd, [1991](#)) of what a speaker is trying to say. When one expert says that the chances are more than 50%, another may say: yes, in fact more than 70%, confirming that chances are substantial, perhaps larger than some other people might have thought. Such statements might be judged to be more compatible and in better agreement than two statements that are probabilistically close but pointing in different directions. In a preliminary study, we found that an expert who had changed her prediction from *over* 30% to *under* 30% chance was judged to have changed her opinions more than a second expert who had changed from *under* 50% to *under* 30%.

Will the target event occur or not? The attentional focus issue

Probabilities are special; they differ from other quantities by describing the truth value or degree of support (Tversky & Koehler, [1994](#)) in favor of the target event. Will La Niña occur or not? $p = 1$ means yes, while $p = 0$ means no. All other values of p are, in principle, ambiguous, or reversible, as they suggest occurrence and non- occurrence at the same time. This ambiguity is not reserved for probabilities at the 50/50 level, even probabilities of 90% contain a seed of doubt and those of 10% give room for a tiny hope. These opposing perspectives have been studied as instances of directionality (polarity) in verbal probability phrases (Honda & Yamagishi, [2006](#), [2017](#); Teigen & Brun, [1995](#)). The present paper found single- limit numerical statements to have an attentional focus (be directional) in the same way, demonstrating that the concept of directionality can be extended to single- bound numerical probability expressions.

Will the probability increase or decrease? The issue of trends

The attentional focus of a verbal or numerical expression implies that people's attention is turned in alternative directions, towards occurrence or non- occurrence of a target event, as discussed previously. But it can also imply a more dynamic message, indicating an upward or a downward development, a *momentum* (Maglio & Polman, [2016](#); Markman & Guenther, [2007](#)) or a *trend*.

Parallel to how single- bound estimates of approximate values are previously shown to imply trends (Teigen, [2008](#)), single- bound probability statements were in the present studies found to lead to trend perceptions but with some possible boundary conditions. Boundary frame affected beliefs about future forecasts, such that “more than” statements were more often expected to be followed by higher probabilities than “less than” statements, which more often

suggested decreasing probabilities. This trend effect was not observed in Study 1, maybe because this study involved predictions in which most participants already expected rising probabilities (sea level rise and glacier melting). “More than” and “less than” formulations may therefore suggest trends only when participants have less pre-existing ideas about the topic. This corroborates results from Hohle and Teigen (2015), where participants expected trend continuation for climate forecasts especially when trends were consistent with more climate change in the future. Moreover, unless the idea of change is made salient by describing current estimates as estimates made *now* (as in Study 2), future developments seem easier to infer than changes from past to present (Study 3).

We live in a changing world; for prediction purposes, it is accordingly important to observe and detect the direction of a change at an early stage. Everyday observations and research show that people do not need much evidence to infer a trend. Two data points may be sufficient to indicate a process of growth or decline and can lead observers to formulate hypotheses of monotonous and even linear increases or decreases (Erlandsson, Hohle, Løhre, & Västfjäll, 2017; Hohle & Teigen, 2015). When probabilities are changed or revised, it is easy to imagine that a process of continued revision will take place. Participants who were told that a climate expert had revised her probability of a 3° temperature rise from 60% to 70% believed that in her next report, she would be even more certain, whereas a downward revision from 80% to 70% indicated that her next estimate would be still lower (Hohle & Teigen, 2015). The present studies go beyond this by indicating that trends can sometimes be inferred from *one single* observation, depending upon the way it is described, or framed. The directionality implied in a single-bound frame does more than drawing the reader's attention towards occurrence or non-occurrence; it reveals the speaker's personal beliefs about what is going to happen and indicates the possibility of a future upward or downward change.

Implications

Single-bound probability statements have surplus meanings in addition to their numerical equivalents. Results from the present studies imply that these statements may be used strategically to make listeners think in desired ways, for instance, to inflate minor chances or downplay large chances.

Although communicators may use the phrases intentionally in accordance with the present findings (to express personal beliefs, direct the listener's attention, or indicate a potential trend), their choice of expression may have other reasons. An expert may give a probability “above 50%” because the upper-bound is unknown, or to round off to the nearest round number, as an alternative to using *ca.* or *about*. In these instances, receivers may without the speaker's intention still be left with a sense of what the speaker wants to say (the “gist”) over and above the stated probability level. Receivers might even find it easier to remember the positive or negative tone of the message than the specific numerical probabilities involved. Reliance on gist information might be especially strong when people are in a hurry or have less cognitive resources to their disposal. It may also be critical for decision makers who rely strongly on their experience-based intuitions or their “feel” for situational demands. Thus, it has been shown that even experienced intelligence professionals are not immune to risky choice framing (Reyna, Chick, Corbyn & Hsia, 2014), precisely because of their skills in extracting the pragmatic implications of a message.

Miscommunication might be avoided by stating both boundaries, the most likely probability value, or the full probability range, although these strategies were not tested in the present

study. A more complete understanding of the implications of upper and lower interval bound statements might be achieved by studies examining the impact they have on the measures people take in preparing for the future, and also how such forecasts are evaluated retrospectively, after the actual outcomes are known.

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