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Comment on Løhre & Teigen (2016). "There is a 60% probability, but I am 70% certain: communicative consequences of external and internal expressions of uncertainty". *Thinking & Reasoning*

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A number of philosophers and psychologists have observed that uncertainty may take different forms. Perhaps the best known psychological account is an essay by Kahneman and Tversky (1982) called *Variants of Uncertainty*, in which the authors distinguish *internal* uncertainty, which is attributed to one's mind (e.g., whether or not a trivia question was answered correctly), from *external* uncertainty, which is attributed to dispositions of causal systems in the world (e.g., whether or not the home team will win a football match). External uncertainty may further be characterised as either *singular* in which "probabilities are assessed by the propensies of the particular case at hand" (e.g., the relative strength of the teams and how they match up) or *distributional* in which "the case in question is seen as an instance of a class of similar cases, for which the relative frequencies of outcomes are known or can be estimated" (e.g., the proportion of times each team has prevailed over the other in the past; see Table 1, columns 1 and 2).

In their essay, Kahneman and Tversky (1982) make an incidental observation concerning how external versus internal uncertainty tend to be expressed in natural language: "The attribution of uncertainty can sometimes be inferred from a simple linguistic test: Is it appropriate to describe the assessment of the uncertainty as '*the* probability is …' Or should one say *my* probability is … ?'" (p. 151, italics in original). It is important to note that Kahneman and Tversky relied on reader intuitions and presented no empirical evidence of the relationship between language and their internal/external distinction. In this respect, Løhre and Teigen (2016) fill an important gap in the literature.

In their paper, Løhre and Teigen (2016) distinguish *internally focused expressions* such as "I am X% certain" from *externally focused expressions* such as "It is X% certain" or "There is an X% probability". They present five studies

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Table 1. Variants of uncertainty and sample putative linguistic associations.

Kahneman and Tversky (1982)		Ülkümen et al. (2016)		Løhre and Teigen (2016)	
Internal	"My probability is X"	Epistemic	"I am X% certain"	Subjective	"I am X% certain"
External–Singular	"The probability is X"	Epistemic	"I am X% certain"	Objective	"It is X% certain"
					"There is an X% probability"
External–Distributional	"The probability is X"	Aleatory	"I'd say there's an X% probability"	Objective	"It is X% certain"
					"There is an X% probability"

Note: Headings indicate key references, and rows indicate forms of uncertainty that roughly correspond across frameworks with sample linguistic associations proposed by the authors.

suggesting that internally focused expressions "may be viewed as more variable and hence less to be trusted" and are more reflective of the speaker's personal views so that the speaker is more accountable, whereas externally focused expressions appear to be "more objective and accordingly more reliable, but also less informative of the speaker's views" (p. 24). These authors draw generously on Kahneman and Tversky's (1982) framework (notably their distinction between internal and external uncertainty) as well as empirical work on the language of uncertainty previously reported in unpublished manuscripts that we wrote with Bertram Malle (Fox & Malle, 1997; Fox, Ülkümen, & Malle, 2011; the latter paper has since appeared as Ülkümen, Fox, & Malle, 2016).[1] In this work, we distinguish *confidence statements* such as "I am X% sure", "I'm fairly confident", or "I'm very certain" from *likelihood statements* such as "I think there's an X% chance", "I'd say it is fairly likely" or "I think there's a high probability". We present a number of studies suggesting that confidence statements are associated with *epistemic* (knowable) uncertainty that is attributed to missing knowledge, skill, or information, whereas likelihood statements are associated with *aleatory* (random) uncertainty that is attributed to chance or stochastic processes. We note in Fox and Ülkümen (2011) that epistemic (knowable) uncertainty maps roughly onto both Kahneman and Tversky's (1982) internal uncertainty (which would also generally be considered singular) and the singular form of external uncertainty, whereas aleatory (random) uncertainty maps roughly onto the distributional form of external uncertainty in Kahneman and Tversky's framework (see Table 1, columns 3 and 4).[2] Thus, one key measure that differentiates our epistemic–aleatory distinction from Kahneman and Tversky's internal–external distinction is whether the judge's reasoning is singular or distributional.

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[1]The unpublished studies of Fox and Malle (1997) were cited by Fox and Irwin (1998). Related studies by Fox et al. (2011) were cited by Fox and Ülkümen (2011).

[2]We note that the internal-external distinction is logically independent from the epistemic-aleatory distinction, as both epistemic and aleatory uncertainty could, in principle, be attributed to internal or external sources (see Ülkümen et al., 2016, p.1281), though in most contexts we expect these dimensions to be empirically related in the way characterized in Table 1, columns 3 and 4. Likewise, the subjective-objective distinction is logically independent from the internal-external distinction, though we expect them to be empirically related in the way characterized in Table 1, columns 5 and 6 (see Ülkümen et al., 2016, footnote 3).

The purpose of this Comment is to clarify differences between Løhre and Teigen's (2016) work and our own (Ülkümen et al., 2016), and in so doing show how these accounts complement each other. We begin by noting that Løhre and Teigen's key distinction between "internally focused expressions" and "externally focused expressions" appears to turn on the use of the personal first person active voice (I am) versus impersonal third person passive voice (it is) which appears to convey subjectivity versus objectivity and may suggest internal versus external forms of uncertainty, respectively (see Table 1, columns 5 and 6). While Løhre and Teigen's Studies 2 and 3 deliberately confound first person active versus third person passive with use of confidence versus likelihood terms (e.g., "I am X% certain" versus "There is an X% probability"), their Studies 1 and 5 hold the term "certain" constant and manipulate only voice (e.g., "I am X% certain" versus "It is X% certain"). Meanwhile, Study 4 manipulates both voice and terms – though not in a fully crossed manner ("I am X% certain" versus "It is X% certain" versus "There is an X% probability"), obtaining similar results for the two third-person formulations. Nowhere do these authors identify the impact of "% certain" versus "% probability" terms on perceived variants of uncertainty independently of first person active (I am) versus third person passive (there is) formulations.

Our work, in contrast, focuses specifically on the association between different linguistic terms and different representations of *subjective* uncertainty, and we therefore deliberately use a subjective formulation for all expressions (e.g., "I am 90% certain" versus "I'd say there is a 90% probability"). Løhre and Teigen (2016) appear to view this as a liability because they see likelihood statements (e.g., "There is a 90% probability") as suggesting external/aleatory uncertainty, so that our subjective (I'd say) formulation weakens this association because it may be interpreted as "a statement about one's internal uncertainty about an external uncertainty" (p. 5) and because they think that it is "not very realistic" that people always use such subjective qualifications of likelihood statements. We believe that this misses the point of our research because our aim was to examine the effect of confidence versus likelihood terms while holding subjectivity constant so as not to confound these variables.[3]

In sum, we assert that first person active vs. third person passive formulation (as investigated by Løhre & Teigen, 2016) and confidence vs. likelihood statements (as investigated by Ülkümen et al., 2016) are logically independent dimensions of language that prompt attention to subjective vs. objective and epistemic vs. aleatory dimensions of uncertainty, respectively. To test this notion, we devised a study in which we fully crossed voice (first person active

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[3]This said, we would argue that people sometimes indicate *both* epistemic and aleatory uncertainty verbally—as in "I'm pretty sure there is a high probability of rain today" which could indicate lack of confidence in the adequacy if one's model of the world or one's memory of a weather forecast.

versus third person passive) with term (confidence versus likelihood expression) in composing stems of sentences, and then asked participants to rate those sentences both in terms of the subjectivity versus objectivity conveyed and the extent to which they reflect singular versus distributional thinking. The singular versus distributional distinction allows us to identify forms of reasoning that are uniquely associated with epistemic versus aleatory uncertainty, respectively, when outcomes are determined by causal systems in the world (i.e., are manifestations of external uncertainty; see Table 1). In all cases, we held the expressed belief strength constant at 80%, and we attached the same uncertain event (whether it will rain tomorrow) to all stems. For instance, sentences with *first person active* voice and *confidence* term read "I am 80% certain that it will rain tomorrow". We then asked participants to evaluate each sentence in terms of the subjectivity versus objectivity conveyed and whether the uncertainty pertained to singular versus distributional reasoning. We predicted that the manipulation of voice would influence assessment of subjectivity/objectivity ("I am", "I think", or "I'd say" statements would be rated more subjective and "There is" or "It is" would be rated more objective) but not singular/distributional reasoning whereas the manipulation of terms would influence assessment of singular/distributional reasoning ("confident" and "sure" would be rated more singular and "probability" and "chance" would be rated more distributional) but not objectivity/subjectivity. In this way, we expect to establish the independence of these two linguistic factors.

Method

We recruited 192 participants from Amazon's MTurk platform to complete a five-minute study in exchange for $0.50. Participants evaluated eight sentences, all concerning their uncertainty "that it will rain tomorrow". The study was a 2 (voice: first person active vs. third person passive) × 2 (terms: confidence stem vs. likelihood stem) × 2 (replicate: "confident" & "probability" vs. "sure" & "chance") all administered within-participant (see Table 2 for a list of all sentences rated). We asked each participant to rate all eight sentences on: (1) subjectivity versus objectivity reflected by the sentence ("Please rate the extent to which you think each of the statements below seems to reflect the speaker's *subjective* opinion versus *objective* facts, computation and/or consensus", rated on a four-point scale ranging from 1 = "the speaker's own subjective opinion" to 4 = "objective facts, computation, and/or consensus"), and (2) the singular versus distributional reasoning of the speaker ("Please rate the extent to which you think each of the statements below seems to reflect the speaker's thinking that 'most of the current signs point to rain tomorrow' versus 'most of the time there are signs like this it rains the next day'" rated

Table 2. Sentences rated by participants in the present study.

Sentences	Term	Voice	Replicate
I am 80% certain	Confidence	Active	1
I am 80% sure	Confidence	Active	2
It is 80% certain	Confidence	Passive	1
It is 80% sure	Confidence	Passive	2
I think there is an 80% probability	Likelihood	Active	1
I'd say there is an 80% chance	Likelihood	Active	2
There is an 80% probability	Likelihood	Passive	1
There is an 80% chance	Likelihood	Passive	2

Note: The first column presents the unique stem of each sentence (all sentences ended "that it will rain tomorrow"), the second column indicates the linguistic term used (confidence vs. likelihood), the third column indicates the person and voice ("active" = first person + active; "passive" = third person + passive), and the fourth column lists the instance of confidence/likelihood terms used (1 = "certain" or "probability"; 2 = "sure" or "chance").

on a four-point scale ranging from 1 = "most of the current signs point to rain tomorrow" to 4 = "most of the time there are signs like this it rains the next day").[4] We randomised order in which participants responded to the two measures, as well as the order in which the eight sentences appeared for each measure.

Results

Table 3 displays means (and standard errors) for subjective/objective ratings by condition and Table 4 displays means (and standard errors) for singular/ distributional ratings by condition. A visual inspection of the means in these Tables shows a clear double dissociation: (1) third person passive statements are rated more *objective* than first person active statements (in Table 3, all bolded cells have higher means than corresponding unbolded cells), while there is no similar effect for confidence stems versus likelihood stems; (2) likelihood stems are rated as more *distributional* than confidence stems (in Table 4, all bolded cells have higher means than corresponding unbolded

Table 3. Subjectivity/objectivity ratings listed by stem type.

		First person active	Third person passive
Confidence stems	Certain	2.22 (0.07)	**3.04 (0.07)**
	Sure	2.08 (0.07)	**2.89 (0.07)**
Likelihood stems	Probability	2.01 (0.07)	**3.12 (0.06)**
	Chance	1.81 (0.06)	**3.01 (0.07)**

Note: columns indicate voice, rows indicate term. Cells provide means (with standard errors in parentheses) of subjectivity/objectivity ratings (1 = the speaker's own subjective opinion, 4 = objective facts, computation, and/or consensus).

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[4]We developed the singular/distributional reasoning measure specifically for this study. While this construct is a familiar one for judgement researchers, it can be challenging to communicate to participants. Thus, we tried to use colloquial language in expressing evaluation criteria and we asked participants to evaluate these dimensions in a single, familiar context that we thought could potentially lend itself to either form of reasoning (rain tomorrow).

Table 4. Singular/distributional ratings listed by stem type.

		First person active	Third person passive
Confidence stems	Certain	2.28 (0.08)	2.28 (0.08)
	Sure	2.33 (0.07)	2.32 (0.08)
Likelihood stems	Probability	**2.46 (0.07)**	**2.38 (0.08)**
	Chance	**2.47 (0.07)**	**2.40 (0.08)**

Note: columns indicate voice, rows indicate term. Cells provide means (with standard errors in parentheses) of singular/distributional ratings (1 = most of the current signs point to rain tomorrow, 4 = most of the time there are signs like this it rains the next day).

cells), while there is no similar effect for first person active statements versus third person passive statements.

To provide statistical tests of these hypotheses, we created a term dummy (0 = confidence statement, 1 = likelihood statement), a voice dummy (0 = first person active voice, 1 = third person passive voice), and a replicate dummy (0 = sure & chance, 1 = certain & probability) to indicate the nature of each sentence stem. We analysed the data at the level of sentences, with eight data points corresponding to each participant's ratings of the eight sentences. We clustered standard errors by participant.

Subjective/objective ratings. We regressed participants' ratings of subjectivity/objectivity on the term dummy, voice dummy, and replicate dummy. As predicted and consistent with the results of Løhre and Teigen (2016), the overall effect of voice dummy was significant, indicating that participants gave higher ratings of objectivity to sentences that included third person passive voice versus first person active voice ($b = 0.99$, $p < .001$). The effect of replicate was also significant, indicating that the "certain" & "probability" replicate was rated as more objective than the "sure" & "chance" replicate ($b = .15$, $p < .001$). Consistent with our thesis concerning the dissociation between first person active/third person passive voice and confidence/likelihood terms, the effect of the term dummy was not significant ($b = -.07$, $p = .263$; see Table 5, Model 1).[5]

Singular/distributional reasoning. We regressed participants' ratings of distributional reasoning on the term dummy, voice dummy, and the replicate dummy. As predicted and consistent with the results of Ülkümen et al. (2016), the overall effect of term dummy was significant, indicating that participants attributed more distributional reasoning to speakers when their sentences included likelihood stems than confidence stems ($b = 0.13$, $p = .037$). Neither

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[5]We also ran a fully saturated model, where we regressed subjectivity/objectivity ratings on the term dummy, voice dummy, replicate dummy, and all two-way and three-way interaction terms. We find a reliable two-way interaction effect between term and voice ($b = .38$, $p < .001$, contrast value = 0.341), indicating that the effect of objective versus subjective voice is stronger for likelihood terms ("probability", "chance") than for confidence terms ("confident", "sure"). More importantly, we observe a reliable average marginal effect for voice ($dy/dx = .99$, $p < .001$) and replicate ($dy/dx = .15$, $p < .001$), but not for term ($dy/dx = -.07$, $p = .267$).

Table 5. Regression coefficients and significance levels for objective/subjective ratings (Model 1) and singular/distributional ratings (Model 2) as a function of term, voice, and replicate.

	Model 1: Subjective/objective ratings		Model 2: Singular/distributional ratings	
	b	p	b	p
Intercept	1.99	<0.001	2.34	<0.001
Term	−0.07	0.263	0.13	0.037
Voice	0.99	<0.001	−0.04	0.546
Replicate	0.15	<0.001	−0.03	0.265

of the remaining factors was significant (see Table 5, Model 2) including, importantly, the first person active/third person passive voice manipulation.[6]

Discussion

In their paper, Løhre and Teigen (2016) assert that they manipulate internal versus external focus in their studies "partly by the use of personal pronoun, or voice (*It is* certain vs. *I am* certain), and partly by manipulating voice and terms simultaneously (There is a *X% probability* vs. I am *X% sure*)". They go on to claim:

> This is a contrast to previous studies by Fox and colleagues where the implied source of uncertainty was manipulated by changing the term while keeping the voice constant (e.g., 'I am 60% sure' vs. 'I think there is a 60% probability'). Although we support the idea that some terms are more likely to be associated with external uncertainty and distributional reasoning, while other terms are more associated with internal uncertainty and singular reasoning, our studies show that the voice is perhaps more important. The same (internally focused according to Fox and colleagues) term, certain, is interpreted in a fashion congruent with an external or internal attribution of uncertainty depending on the voice in which it is given (pp. 21–22).

In our view, neither linguistic dimension is "more important"; they are merely associated with different dimensions of uncertainty. A proper empirical test of the claim that voice is "more important" than term necessitates orthogonally manipulating the two factors in order to compare their unique effects on specific variants of uncertainty, a test that is conspicuously absent from Løhre and Teigen (2016). Thus, in the study reported in this Comment, we manipulate term and voice independently and obtain a double dissociation. Confidence versus likelihood terms ("80% certain" or "80% sure" versus "80% probability" or "80% chance") prompt participants to rate sentences as relatively singular (epistemic) versus distributional (aleatory), respectively,

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[6]We also ran a fully saturated model where we regressed ratings of singular/distributional reasoning on the term dummy, voice dummy, replicate dummy, and all two-way and three-way interaction terms. In this model, the only significant effect was the effect of term ($dy/dx = 0.13$, $p = .037$).

whereas first person active versus third person passive voice (e.g., "I am" versus "It is") has no such effect. Meanwhile, first person active versus third person passive voices prompt participants to rate sentences as relatively subjective versus objective, respectively, whereas confidence versus likelihood terms had no such effect.

We note that in our results, the effect of voice (first person active vs. third person passive) on subjective/objective ratings is ostensibly much larger ($b = 0.99$) than the effect of term (confidence terms vs. likelihood terms) on singular/distributional ratings ($b = 0.13$). This difference may reflect the fact that the effects are on distinct dependent measures that vary in their familiarity and scale properties. An extension of the present work could explore the independent effects of term and voice not on ratings but on some common behaviour so that effect sizes are more comparable. For instance, future research might explore communications between doctors and patients to see how voice and terms used to communicate a doctor's uncertainty affect willingness to follow a doctor's advice or desire for a second opinion.

In our work (e.g., Ülkümen et al., 2016), we have chosen to investigate the relationship between language and perceptions of epistemic versus aleatory uncertainty, whereas Løhre and Teigen (2016) have chosen to study the relationship between language and internal/subjective versus external/objective attributions of uncertainty. Although we have argued that these frameworks may be empirically related (internal uncertainty is generally epistemic whereas external uncertainty may be either epistemic or aleatory; see Table 1), the extent to which these two dichotomies diverge will undoubtedly depend on the particular context of study. In the present experiment, we looked for ways to distinguish epistemic/aleatory from objective/subjective attributions by soliciting ratings of singular vs. distributional reasoning in forecasts of future rain. In this context at least, we found evidence of a double dissociation between the impact of voice on objective/subjective perceptions and the impact of terms on epistemic/aleatory attributions.

While we have treated the impact of linguistic term and voice as largely independent, we hasten to add that these dimensions may interact in some contexts. Furthermore, we can imagine that the use of precise numerical rather than qualitative expressions may also influence associations with variants of uncertainty. Thus, the expression, "There is an 87% probability that...", which combines passive voice, likelihood term, and precise quantification, may be perceived as especially external and distributional (or aleatory) compared to the expression "I am pretty sure that..." which combines active voice, confidence term, and vague qualification. Further research is needed to more carefully map out the relationships between these distinct variations in language and cognitive representation of uncertainty.

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