

Modeling the Subjective Perception of Uncertainty

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Introduction

When people make decisions, people may face two types of uncertainty: **Epistemic** and **aleatory uncertainty** [1,2,3].

Epistemic uncertainty stems from a lack of knowledge about something that is in principle knowable. **Aleatory uncertainty** stems from random variation or stochastic variability. Theoretically, these two types can occur **independently** of each other [1] and may constitute two dimensions of a situation's **general uncertainty**.

But how do people subjectively perceive these types of uncertainty? Specifically, we aimed to answer the following RQs.

How specific are people's subjective perceptions of epistemic and aleatory uncertainty?

To what extent are perceived epistemic and aleatory uncertainty related to a person's general perception of uncertainty?

Methods

Participants ($N = 185$) were randomly allocated to a 2 (epistemic uncertainty: low vs. high) \times 2 (aleatory uncertainty: low vs. high) **between-subjects design** and completed **four choice scenarios** and **four lotteries** (random order). For each and before making decisions and/or sampling, they evaluated their perceptions of **epistemic**, **aleatory** and **general uncertainty** (see Fig. 1).

To **introduce different levels** of epistemic and aleatory uncertainty, we **manipulated** both the choice scenarios, as well as the lotteries (for more information, see Fig. 2).

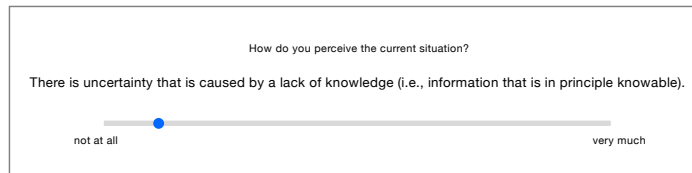


Fig. 1. Evaluation of perceived uncertainty (in this case perceived epistemic uncertainty).

A

Imagine you are considering making an investment, a decision that could impact your financial future. You face the following choice:

Option A: You could not invest your money.

Option B: You could invest your money in a company that promises substantial profits. However, it could also happen that you lose your money with that investment. Keep in mind the following:

- In the current market, investment outcomes are unpredictable.
- You have access to historical data and market analyses for the investment option.

B

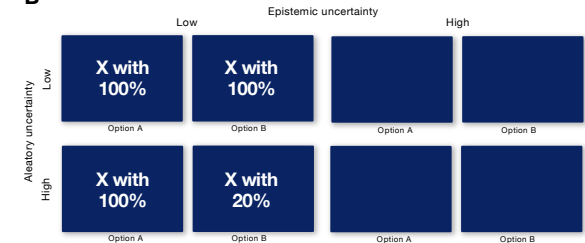


Fig. 2. Panel A shows an example choice scenario describing a financial decision. Indented **information was manipulated** to introduce low vs. high **epistemic** and **aleatory** uncertainty. Panel B shows a schematic display of the manipulation of the lotteries. **Type of lottery** (DFE vs. DFD) was manipulated to introduce low vs. high **epistemic** uncertainty. **Probabilities associated with high-value outcome** (here Option B) were manipulated to introduce low vs. high **aleatory** uncertainty.

Results

Participants' **subjective perceptions of epistemic and aleatory uncertainty were unspecific (i.e., they were correlated)**. Instead, when confronted with any type of uncertainty, participants perceived **both increased epistemic and aleatory uncertainty**. Moreover, both types of uncertainty were related to perceived **general uncertainty**.

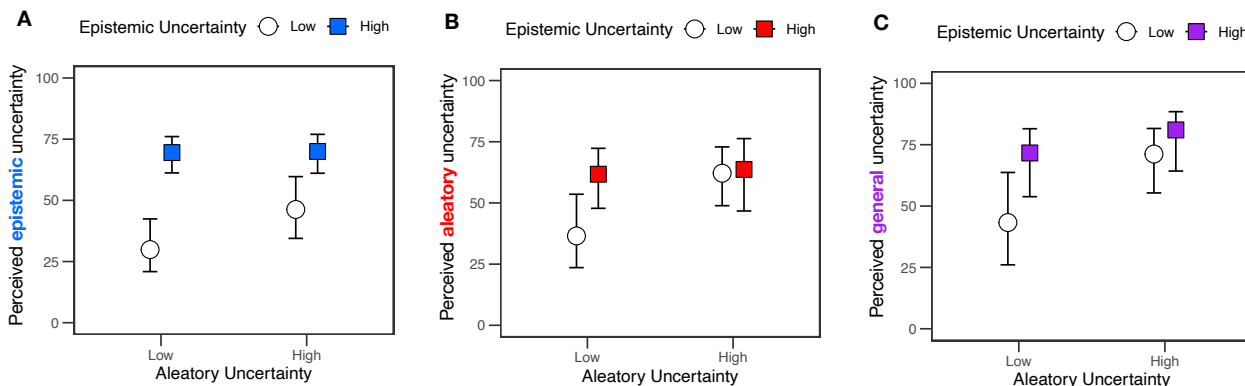


Fig. 3. Model-estimated conditional effects of perceived epistemic, aleatory and general uncertainty on the respective levels of the predictors. Error bars indicate 95% highest density intervals.

Conclusion

Epistemic and aleatory uncertainty are not independent dimensions of subjectively perceived uncertainty. This suggests that people's perceptions of the two types are correlated, which might have important consequences for people's search or sampling behavior, as well as their decisions.

Overall, these findings contribute to the **conceptual debate on the structure of perceived uncertainty** and inform research how to manipulate and measure uncertainty perceptions.



Find the preprint here
<https://cbdr-lab.net/redirect/structuncert>

Key References

- [1] Fox, C. R., & Ülkümen, G. (2011). Distinguishing two dimensions of uncertainty. In Brun, W., Kirkeboen, G., and Montgomery, H. (Eds.), *Essays in Judgment and Decision Making* (pp. 21–35). Universitetsforlaget.
- [2] Hacking, I. (1975). All kinds of possibility. *The Philosophical Review*, 84(3), 321–337. <https://doi.org/10.2307/2184116>
- [3] Ülkümen, G., Fox, C. R., & Malle, B. F. (2016). Two dimensions of subjective uncertainty: Clues from natural language. *Journal of Experimental Psychology: General*, 145(10), 1280–1297. <https://doi.org/10.1037/xap0000202>