

Response to Reviewer #1

I wanted to first thank Reviewer 1 on behalf of Dr. Levine and myself for taking the time to read over the submitted paper. There were a few noted issues that the reviewer had mentioned in their criticism of the paper. Dr. Levine and I attempted to address each issue or offer a means to address the criticisms.

Issue 1: "The main weakness of the paper is related to the conclusions, which lack a more explicit discussion of the authors' viewpoint on the empirical implications of their interpretation. There are only scattered statements on this specific issue. The causal chain going from the existence of fuzzy trace theory and dual system to certainty effect should be complemented with a discussion of the practical implications of this possibility. This point is particularly relevant in the context of the influence of individual characteristics such as age and gender conducted at page 34."

We plan to add a few points to the discussion that will clarify our understanding of the implications of our theory. One of our contentions is that fuzzy trace theory (FTT) provides a better account of the certainty effect than does one of the most influential competing theories, cognitive-experiential self-theory (CEST). CEST tends toward a greater separateness of deliberative (rational) and heuristic (emotional) processes than we believe to be the case. Therefore our account tends to support the strong interconnectedness of emotion and cognition, which is supported by more recent results in neuroscience (e.g., Pessoa, 2008; Pham, 2007).

As far as the effects of age, there are many articles due to Reyna, Brainerd, and their colleagues suggesting that development leads to choices that are more verbatim-based in children and more gist-based in adults, with adolescent choices being intermediate. This means that the certainty effect should be more pronounced in adults than in children as described in Woodhead, Lynch, and Edelman (2011). Fuzzy trace theory at this stage, as we already point out, has little to say about gender differences, or even about individual differences, in risk taking propensity. This is because fuzzy trace theory in its present form does not include a detailed account of the selective attentional processes that determine what a decision maker judges to be the "gist" of a particular option, which the neural network theory of Levine (2012) has begun to address (see also Reyna, 2012). We can draw out both the value and the limitations of FTT more fully in our revision.

Issue 2. "One of the main assumptions of fuzzy trace theory is that memory recollection process is not unitary, but it is rather a dual and parallel process. This effect is commonly known in literature as hindsight bias, according to which current recollections of past judgments tend to be biased by what actually happened since then. This effect should be assessed more extensively in the final discussion."

Fuzzy trace theory is related to both decision making and memory, and its applications to the two different cognitive domains are strongly interacting but somewhat separate. We argue that hindsight bias is mainly of interest in the memory domain and is less important in the decision domain which is our main focus.

Hindsight bias assumes that a decision-maker does not understand the probable outcomes and must only work with available information; this eventually leads to the "I knew it all along" type belief after reporting differently prior to the fact (Roeses & Vohs 2012). When testing for the certainty effect for the single shot gamble or the repeated gambles the decision-maker knows

the probable outcome. This in itself is not in line with the literature on the hindsight bias and how one knew it all along type of outcome, post-hoc. It may better go along with counterfactual thinking, which is not covered in the review because the counterfactual research does not test the certainty effect.

When dealing with false memory research details are altered in memory, but keep in mind the scenarios that are examined by Brainerd and Reyna tend to be based on implicit memory, which is not intended to be recalled or expected. Misremembering, or having an "I knew it all along moment" is reasonable, but when a person must attend to information as in the gambles guided by feedback the possibility of a hindsight bias should be reduced primarily because of the increased cognitive processing to remember gambles that are more or less favorable as well having increased attentional processing.

Keep in mind that the recent psychology literature has de-emphasized the role of memory processing when making a decision and now is focusing more on the ability to reason and plan for the long-term. Memory was once the focus, but research by Reyna and colleagues has been successfully demonstrating the importance of reasoning for over a decade. There are a few articles that discuss the "evolution" of research touching on the mental processing for decision-making (see Reyna, 2004).

In our revised paper, we plan to include in the section on overview of fuzzy trace theory (pp. 26-30) a paragraph toward the end where we refer back to Reyna and Brainerd and say fuzzy traces apply to both memory and decision making but that the two are somewhat dissociable.

Issue 3: Reviewer 1 argued that our introduction to prospect theory, framing effects, and the Allais paradox was too detailed.

The difficulty is that the other reviewer, Reviewer 2, wanted MORE detail on those very topics. However, the focus of our paper is the certainty effect, so these introductory sections were meant more as background than as major points of the paper. In order to accommodate both reviewers, we plan to include a brief mention on the body of the paper at the beginning and move the section as is or as it was originally submitted with even more detail to an appendix section should a reader desire further information about expected utility theory, prospect theory, or the Allais paradox. The appendix will also include a mention to cumulative prospect theory, as Reviewer 2 asked for. We will also mention in our revised discussion that while prospect theory provides good predictions for many phenomena, neither the original nor the cumulative form of prospect theory provides a mechanistic understanding of the decision maker's underlying cognitive processes. FTT comes closer to providing the needed mechanistic understanding.

References for the response

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