SARA: An Associative Model for Anchoring and Hindsight Bias

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Judgment and memory may be systematically distorted through the impact of previously encoded information. Two such phenomena, anchoring and hindsight bias, appear to be robust and well-studied. Yet, their explanations remain largely descriptive and superficial.

In a typical *anchoring* study (e.g., Tversky & Kahneman, 1974), participants are first asked whether the numerical answer to a question is above or below a certain number. This number acts like an anchor because it distorts subsequent estimates towards it. Thus, mean estimates following a numerically high anchor are higher than those following a numerically low anchor. In a typical *hindsight* study (e.g., Fischhoff, 1977), participants first give numerical estimates to a question, are then confronted with the solution, and are finally asked to recall their earlier estimates. Typically, the recalled estimates are closer to the solution than the original estimates had been (see Hawkins & Hastie, 1990, for a review).

This paper introduces a detailed cognitive model (SARA) that allows to explain anchoring and hindsight bias on a deeper level than previous accounts and that, moreover, can be used as a simulation model. SARA borrows from the SAM model ("Search of Associative Memory;" Raaijmakers & Shiffrin, 1980; Shiffrin & Raaijmakers, 1992) and makes assumptions about the underlying memory representation, about retrieval, encoding, forgetting, and reconstructive processes. According to the model, both anchoring and hindsight bias result from *selective activation processes* of one's item-specific knowledge base. In order to reflect this focus, the model was termed SARA which stands for "Selective Activation, Reconstruction, and Anchoring."

To be more precise, SARA explains how a person's pre-experimental knowledge base is altered in the course of an anchoring or hindsight experiment. All processes (i.e., generating, encoding, forgetting, and reconstructing) change the associative pattern between the elements of one's knowledge base and possible retrieval cues, thus leading to a changed probability of retrieval for each of these elements. The central assumption is that the changes in retrieval probability are governed by numerical similarity. Given this architecture, a number of well-known findings can be explained within the same framework. Among these are, for example, (a) effects of level of encoding, (b) effects of retention interval, (c) effects of pre-experimental knowledge, (d) effects of plausibility and surprise, (e) effects of counterfactual reasoning, (f) hindsight bias for recall of solutions, and (g) differences between judgment and memory designs. Besides, some *new* findings are predicted as well. Among these are, for example, (h) results and consequences of anchor evaluation processes, (i) effects of multiple anchors, and (j) effects of time constraints on estimation and recall. None of the previously discussed explanations of anchoring and hindsight bias like "anchoring and insufficient adjustment" (Tversky & Kahneman, 1974) and "immediate assimilation" (Fischhoff, 1975) are able to account for the whole set of these effects.

Running a *computer simulation* with a first version of SARA yielded promising results in that the model closely fitted empirically observed data (Pohl & Eisenhauer, 1996). An ANOVA found neither a main nor an interaction effect with empirical vs. simulated data. Thus, the idea to explain and to model distortions in judgment and memory through selective activation of one's item-specific knowledge base received first support. Of course, the model is based on a number of assumptions and parameters that need careful analysis yet. A satisfying situation will emerge only if the same model will be able to successfully simulate a wide range of data including new findings. We are, however, confident that SARA will stand up to the challenge.

References

Fischhoff, B. (1975). Hindsight ≠ foresight: The effect of outcome knowledge on judgment under uncertainty. *Journal of Experimental Psychology: Human Perception and Performance, 1*, 288-299.

Fischhoff, B. (1977). Perceived informativeness of facts. *Journal of Experimental Psychology: Human Perception and Performance, 3*, 349-358.

Hawkins, S. A., & Hastie, R. (1990). Hindsight: Biased judgments of past events after the outcomes are known. *Psychological Bulletin, 107*, 311-327.

Pohl, R., & Eisenhauer, M. (1996). *SARA a cognitive simulation model for explaining hindsight bias*. Paper presented at the 2nd International Conference on Memory, Padua, Italy.

Raaijmakers, J. G. W., & Shiffrin, R. M. (1980). SAM: A theory of probabilistic search of associative memory. In G. H. Bower (Ed.), *The psychology of learning and motivation* (Vol. 14). San Diego, CA: Academic Press.

Shiffrin, R. M., & Raaijmakers, J. G. W. (1992). The SAM retrieval model: A retrospective and a prospective. In A. F. Healy, S. M. Kosslyn, & R. M. Shiffrin (Eds.), *From learning processes to cognitive processes* (Vol. 2). Hillsdale, NJ: Erlbaum.

Tversky, A., & Kahneman, D. (1974). Judgment under uncertainty: Heuristics and biases. *Science, 185*, 1124-1131.