function, but very precise content (e.g. academic successes or romantic moments) of one's most accessible memories.

Studying AM is tremendously challenging. Tracking recall processes may be particularly arduous. The smells experienced when walking into a restaurant in midtown Manhattan, for example, could lead a person to remember a former lover, a bout with food poisoning, and the events of Sept 11th in less than a minute. There may be a great difference between what an individual can report in the lab and what one is actually recalling moment to moment. And, what are the criteria to judge these memories as important and useful in retrospect? We have only scratched the surface of this complex and sometimes illusive cognitive process. The special issue is undoubtably an advance toward understanding the field. The presented ideas are likely to generate lively discussion of how this burgeoning sub-field of memory might move toward greater unity in the coming years.

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Could they have known better?

A Special Issue of the Journal Memory: Hindsight Bias. U. Hoffrage and R. F. Pohl (eds). Taylor & Francis, Hove, UK, 2003. No. of pages 275, 329–504. ISBN 1-84169-938-1. Price £23.95 (paperback).

It is often that, following the occurrence of a tragic outcome, experts or institutions are blamed for their lack of foresight, sometimes with severe consequences for their status. At the end of last year a newspaper heading read 'US need not have suffered attacks of 9/11: Inquiry chairman calls for sackings over intelligence failure' (*The Guardian*, 19 December 2003). A few months later, another article reporting on the investigation of the death of the two little girls from Soham asked, 'Will fresh criticism of police blamed for Soham failure force chief out?' (*The Guardian*, 11 February 2004).

Could the experts involved in these cases really have known better? Is it possible that their assessors will have been too severe in their post-hoc judgements? There is evidence to show that we tend to overestimate, in hindsight, how predictable an outcome was in foresight. Since its establishment by Fischhoff (1975), the *Hindsight Bias* phenomenon has been the object of numerous studies summarized in extensive literature reviews (Hawkings & Hastie, 1990; Christensen-Szalanski & Willham, 1991).

To illustrate this phenomenon, researchers have used one of two designs, the memory design and the hypothetical design. In the memory design, participants are first asked to produce an estimate. For example, they may be asked to provide a numerical value to difficult almanac questions or to estimate the likelihood that a particular outcome will occur. Later on, the correct answer to the question or the outcome that actually occurred is presented to them. Finally, participants are asked to remember their original estimate *as if* they did not know the correct answer or the actual outcome. In the hypothetical design, the effect of outcome knowledge is manipulated between groups. In an experimental group, individuals are presented with outcome feedback and are asked to estimate their foresight judgement. In a control group, individuals are simply asked to answer the same questions without outcome knowledge. In both designs, hindsight bias typically reflects participants' tendency to provide hindsight judgements that are closer to the outcome feedback provided than their original estimate (in the memory design) or than the estimate of participants without outcome knowledge (in the hypothetical design).

Why are people prone to the hindsight bias? The articles in this special issue discuss the different cognitive, meta-cognitive and motivational mechanisms underpinning this phenomenon. Pohl, Eiseinhauer and Hardt's SARA model proposes that hindsight bias ensues from memory encoding and retrieval processes. Accordingly, their model proposes that estimates are generated by averaging numerical values activated in working memory if they are sufficiently associated with external cues such as the question 'How old was Goethe when he died?' Encoding an anchor (i.e. the correct answer to the question) following the generation of an estimate will change the pattern of associations between external cues and the information in long-term memory (e.g. the possible ages of Goethe when he died). As a result, when asked to recall their original estimate, the sample of values activated will include the anchor, now strongly associated with the question, and the resulting average of the values activated will differ from the original estimate.

Hertwig, Fanselow, and Hoffrage introduce a second model, RAFT, which accounts for the bias in tasks involving binary choices rather than numerical estimates. According to RAFT, choices between two objects (e.g. two competing candidates in an election) result from their comparison based on cues (e.g. charisma or incumbent party) related to an outcome (e.g. winning the election). Cue values can be positive, negative, or unknown. The choice is determined by the application of the 'Take The Best' (TTB) heuristic, according to which the object selected is that for which the most valid and discriminating cue has a positive value. *Cue validity* is defined by the relative frequency of correct predictions of the outcome based on that cue. A *discriminatory cue* is a cue with differing values for the two objects compared.

For example, if it is known that candidate *A* is from the incumbent party whereas candidate *B* is not, and if this cue is the first discriminating cue among the most valid cues, candidate *A* will be predicted to win the election. To explain hindsight bias, RAFT proposes that missing cue values will be updated once the outcome is known. For example, suppose charisma is a more valid cue than incumbent party. Its value was missing for candidate *B* before the outcome of the election was known whereas candidate *A* was known to have no charisma. Thus, the charisma cue was non-discriminatory in foresight and could not be used to infer the choice. Once it is known that candidate *B* won the election, the missing value of the charisma cue for this candidate may be updated with a positive value. Consequently, this cue becomes discriminatory. Since it is also more valid than the incumbent party cue used in foresight, the application of the TTB heuristic in hindsight will result in candidate *B* being chosen as the winning candidate. This corresponds to a shift of choice towards the candidate now known to have won the election, and hence illustrates the hindsight bias.

Both these computational models assume that outcome information will impair automatically and unconsciously association strengths or cue values stored in memory, thus resulting in a biased numerical estimate or choice in hindsight. Another theoretical standpoint consists in assuming that hindsight bias is due to a *biased reconstruction* of the original estimate rather than to an impaired memory. Thus Hardt and Pohl showed that hindsight bias does not occur when the outcome information presented is viewed as irrelevant, where subjective relevance is moderated by *subjective*

anchor plausibility, *subjective ranges of possible answers*, and by *anchor distance* to the participants' ranges of possible estimates. In a similar vein, Schwarz and Stahlberg, akin to Werth and Strack, showed that hindsight bias is moderated by meta-cognitive evaluative processes, such as the *subjective belief in the accuracy of their original estimate*. Hence, these authors conclude, outcome information does not always automatically impair memory. Yet, when outcome information *is* deemed relevant, the question as to whether outcome knowledge impairs memory or whether it is simply used as a basis for reconstructing the foresight judgement remains open. Authors who favour the reconstruction hypothesis imply that meta-cognitive knowledge is used to *draw inferences* about the value of the foresight judgement. Werth and Strack argue that individuals will use their feelings of confidence in the accuracy of their foresight estimate to infer its value. Pezzo argues that when surprised by the actual outcome, people will engage in a sense-making process (i.e. search for possible causal explanations) and use the result of this search to infer the value of their foresight judgement. Finally, Mark et al. and Renner propose that individuals draw inferences about their foresight judgement value based on self-serving considerations. This suggests that a potential crucial difference between the memory impairment hypothesis and the reconstruction hypothesis may lie in the extent to which the mechanisms underlying hindsight bias are accessible to conscious processing. Indeed, memory impairment can be assumed to be automatic and unconscious. It seems implausible to assume, however, that the inferential processes put forward by the tenants of the reconstruction approach would not be accessible to consciousness. Yet the studies advocating the reconstruction hypothesis never attempted to collect direct evidence that individuals actually drew the inferences postulated (although see Pezzo, Experiment 2, for an indirect measure of the sense-making process and Blank et al. for an analysis of self-reported reasons for lack of surprise in the face of the outcome). It is true that the elicitation of the reasoning processes underlying observed judgements represents a methodological challenge (Wilson & Dunn, 2004). Yet their investigation is not only possible but also crucial if we are to make progress towards the elucidation of the mechanisms underlying the hindsight bias, and towards the distinction between the memory impairment and the reconstruction hypotheses.

In sum, this collection of articles represents a great contribution towards the literature on hindsight bias and towards our understanding of the origin of this phenomenon, while opening many interesting new paths for research. Even though research on the hindsight bias was initiated almost 30 years ago, it is remarkable, as the authors themselves acknowledged, that we have yet to uncover fully its underpinnings. Yet, as this special issue once more illustrates, the hindsight bias is pervasive not only in laboratory settings but also in natural environments. For example, Renner demonstrated that patients who receive unexpected information regarding their cholesterol levels later demonstrate hindsight bias; and Blank et al. showed that hindsight bias also occurs in the context of real political elections.

Hence, there is a strong possibility that assessments of experts' judgements such as those carried in the inquiries made *in hindsight* following the 9/11 or the Soham murders may overestimate the extent to which these outcomes were foreseeable. As psychologists, we cannot claim to be in a position to judge those facts, but as this research illustrates, we can shed considerable light on the ways in which real life facts can be (mis)judged.

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