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Double Conjunction Fallacies in Physicians' Probability Judgment

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Abstract

We report the first empirical data showing a significant amount of double conjunction fallacies in physicians' probability judgments concerning prognosis and diagnosis. Our results support the hypothesis that physicians' probability judgments are guided by assessments of evidential impact between diagnostic conditions and clinical signs. Moreover, we show that, contrary to some influential views, double conjunction fallacies represent an experimentally replicable reasoning bias. We discuss how the phenomenon eludes major current accounts of uncertain reasoning in medicine and beyond and how it relates to clinical practice.

Keywords

clinical reasoning, conjunction fallacy, probability judgment, reasoning bias

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The judgment that a pair of hypotheses (h_1&h_2) is more likely to obtain jointly as compared to one of them (e.g., h_1) is called *conjunction fallacy* (CF), and it is perhaps the most well-known kind of error in the psychology of probabilistic reasoning. Indeed, the comparison between a conjunction and a conjunct is a simple task, which does not require use of Bayes's theorem or any other challenging computation. Accordingly, since it was first described, the CF has been considered a paramount illustration of the limitations of human thinking (the violation of "the simplest and the most basic qualitative law of probability"[1(p293)]).

The CF has been replicated in various real-life settings. In their seminal inquiry on the topic, Tversky and Kahneman[1] also provided a clear illustration in the medical domain: most internists in their study maintained that a 55-year-old woman was more likely to experience the combination of "dyspnea and hemiparesis" than "hemiparesis" after a pulmonary embolism. In more than 100 studies on the topic, we were able to find only one further CF scenario with medical content: about half of early medical students estimated the probability that a patient with a common cold would have experienced "runny nose and diarrhea" as higher than "diarrhea."[2]

A *double conjunction fallacy* (DCF) occurs when a conjunction of statements is judged more likely than both conjuncts, thus implying two simultaneously fallacious judgments. Most of single CF scenarios, including those from medicine mentioned above, do not support this phenomenon. However, Tversky and Kahneman[1] gave an important illustration of DCF with their "mile run" scenario: when considering the next race of Peter, a young college runner who is training and had already run the mile in 4:06, 48% of participants ranked "Peter will run the second half-mile under 1:55 min and will complete the mile under 4 min" (h_1&h_2) as more probable than *both* single conjuncts "will run the second half-mile under 1:55 min" (h_1) and "will complete the mile under 4 min" (h_2).

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