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Hypothesis generation, probability judgment, and individual differences in working memory capacity

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Abstract

This research examined the role of working memory (WM) in probability judgment and hypothesis generation using a simulated task that involved estimating the likelihood that particular menu items would be ordered by customers at a dinner. Five main findings were observed. First, judgments of the likelihood of individual items were made relative to alternatives retrieved from long-term memory. Second, the number of alternatives retrieved was positively correlated with a measure of WM-capacity (the operation-span task). Third, participants' probability judgments were subadditive (summing to well over 100%). Fourth, the degree to which participants' judgments were subadditive was affected by the number and strength of the alternatives retrieved from long-term memory. Fifth, the degree to which participants were subadditive was negatively correlated with WM-capacity. The results suggest that individual differences in WM-capacity are fundamental to hypothesis generation and probability judgment.

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1. Introduction

Hypothesis generation is an important component of many real-world tasks: Physicians generate disease hypotheses prior to issuing diagnoses (Barrows, Norman, Neufeld, & Feightner, 1982; Elstein, Shulman, & Sprafka, 1978), mechanics generate hypotheses for auto failures (Mehle, 1982), and auditors generate hypotheses regarding accounting errors (Libby, 1985). The hypothesis generation process has obvious, and often profound implications for a variety of decision tasks, affecting physicians' treatment decisions, auditors' decisions to invest time and money pursuing possible sources of errors in accounting records, and mechanics' course of action in repairing automobiles. In all of these cases, the ultimate course of action rests heavily on the decision maker's ability to generate the correct cause underlying an observed pattern of symptoms. As Barrows et al. (1982) has shown, one is unlikely to consider causes or hypotheses that are not initially generated. Thus, the hypothesis generation process is critical for accurate judgment.

Intimately tied to the hypothesis generation process is the process of evaluating the probability or likelihood of specific hypotheses—the process of hypothesis evaluation. When one evaluates the likelihood of a particular hypothesis, it presumably is evaluated relative to other alternative or rival hypotheses. These rival hypotheses must be retrieved or generated from memory (Dougherty, Gettys, & Thomas, 1997; Gettys & Fisher, 1979; Koehler, 1994).

The assumption that the judged probability of a focal hypothesis is made by comparing it to an alternative or alternatives is embodied in several recent theories of probability judgment. For example, Tversky and Koehler's (1994) support theory assumes that the judged probability of a focal hypothesis is assessed by comparing the strength of the evidence for the focal hypothesis to the strength of the evidence of alternative hypotheses. Similarly, Windschitl and Wells (1998) proposed the comparison heuristic, whereby probability judgments were assumed to be based on a comparison of the strength of the focal hypothesis with the single strongest alternative (see also Windschitl & Young, 2001; Windschitl, Young, & Jensen, 2002). Finally, Dougherty (2001; Dougherty, Gettys, & Ogden, 1999) has argued that probability judgments are made by comparing the memory strength of the focal hypothesis with the combined memory strengths of explicitly generated alternatives.

Of both theoretical and practical interest is the question regarding the factors that affect hypothesis generation and hypothesis evaluation. Whereas there has been considerable research investigating hypothesis *evaluation* in both the cognitive and social literatures (Koehler, 1991; Sanbonmatsu, Posavac, Kardes, & Mantel, 1998), relatively little research has examined the process of hypothesis *generation*. Hypothesis generation is the logical precursor to hypothesis evaluation, since the outcome of the generation process determines which hypotheses ultimately are evaluated.

Although relatively little research has been done on hypothesis generation, what has been done has yielded a consistent pattern of results. Of particular importance is the finding that participants generate only a fraction of the total number of plausible alternatives (Fisher, Gettys, Manning, Mehle, & Baca, 1983; Gettys, Pliske, Man-