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Effects of Domain Knowledge, Working Memory Capacity, and Age on Cognitive Performance: An Investigation of the Knowledge-Is-Power Hypothesis

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Domain knowledge facilitates performance in many cognitive tasks. However, very little is known about the interplay between domain knowledge and factors that are believed to reflect general, and relatively stable, characteristics of the individual. The primary goal of this study was to investigate the interplay between domain knowledge and one such factor: working memory capacity. Adults from wide ranges of working memory capacity, age, and knowledge about the game of baseball listened to, and then answered questions about, simulated radio broadcasts of baseball games. There was a strong facilitative effect of preexisting knowledge of baseball on memory performance, particularly for information judged to be directly relevant to the baseball games. However, there was a positive effect of working memory capacity on memory performance as well, and there was no indication that domain knowledge attenuated this effect. That is, working memory capacity contributed to memory performance even at high levels of domain knowledge. Similarly, there was no evidence that domain knowledge attenuated age-related differences (favoring young adults) in memory performance. We discuss implications of the results for understanding proficiency in cognitive domains from an individual-differences perspective.

Key Words: domain knowledge; working memory capacity; memory; individual differences; age; adulthood.

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Perhaps one of the most influential ideas to emerge in cognitive psychology during the past 25 years is the viewpoint referred to as the *knowledge-is-power* hypothesis. The basic argument of the knowledge-is-power hypothesis is that domain knowledge is the primary determinant of success in cognitive endeavors, whereas ''basic'' cognitive abilities play a less important role. Minsky and Papert (1974) alluded to the knowledge-is-power hypothesis in the following passage:

> It is by no means obvious that very smart people are that way directly because of the superior power of their general methods—as compared with average people. Indirectly, perhaps, but that is another matter: a very intelligent person might be that way because of the specific local features of his knowledge-organizing knowledge rather than because of global qualities of his ''thinking'' . . . which might be little different from a child's. (p. 59)

More recently, Feigenbaum (1989) articulated the premise of the knowledge-is-power hypothesis in a principle as follows:

> The Knowledge Principle states that a system exhibits intelligent understanding and action at a high level of competence primarily because of the specific knowledge that it can bring to bear: the concepts, representations, facts, heuristics, models, and methods of the endeavor. A corollary of the KP is that reasoning processes of intelligent systems are generally weak and not the primary source of power (p. 179).

Domain knowledge—a modifiable ''software'' aspect of the cognitive system—is indeed a powerful determinant of cognitive performance (see Glaser & Chi, 1988). For example, domain knowledge facilitates memory for domain-relevant information, such as chess positions (Chase & Simon, 1973), bridge hands (Engle & Bukstel, 1978), dance steps (Allard & Starkes, 1991), maps (Gilhooly, Wood, Kinnear, & Green, 1988), and music (Meinz & Salthouse, 1998). Domain knowledge contributes to success in many other cognitive tasks as well. To illustrate, Voss, Greene, Post, and Penner (1983) found that domain knowledge was the best predictor of performance in solving ill-structured political science problems (e.g., increase crop productivity in the Soviet Union). Finally, domain knowledge facilitates comprehension and memory of text with domain-relevant content. For example, Spilich, Vesonder, Chiesi, and Voss (1979) found that participants knowledgeable about the game of baseball better comprehended a story about a baseball game than did participants who were low in domain knowledge (see Recht & Leslie, 1988, and Walker, 1987, for additional examples). As another example, in a study by Fincher-Kiefer, Post, Greene, and Voss (1988), participants who were either high or low in knowledge of baseball performed a version of the Daneman and Carpenter (1980) reading span task in which the sentences were either baseball-related or neutral. Fincher-Kiefer et al. found that baseball knowledge facilitated working memory span, but only when the sentences were baseball-related.