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The interplay among knowledge, cognitive abilities and thinking styles in probabilistic reasoning: a test of a model.

Chernoff, Egan J. (ed.) et al., Probabilistic thinking. Presenting plural perspectives. Dordrecht: Springer (ISBN 978-94-007-7154-3/hbk; 978-94-007-7155-0/ebook). Advances in Mathematics Education, 195-214 (2014).

Summary: *K. E. Stanovich*, *M. E. Toplak* and *R. F. West* ["The development of rational thought: a taxonomy of heuristics and biases", Adv. Child Dev. Behav. 36, 251–285 (2008)] outlined how people can reach a correct solution when a task besides the normative solution elicits competing response options that are intuitively compelling. First of all, people have to possess the relevant rules, procedures, and strategies derived from past learning experiences, called "mindware" [*D. N. Perkins*, Outsmarting IQ: the emerging science of learnable intelligence. New York: Free Press (1995)]. Then they have to recognise the need to use and to inhibit competing responses. Starting from this assumption, Stanovich and colleagues developed a taxonomy of thinking errors that builds on the dual-process theories of cognition. The present chapter presents a set of experiments designed to test the Stanovich and colleagues' model inside probabilistic reasoning. Since rules concerned with probabilistic reasoning (i.e. the mindware in Stanovich and colleagues' terms) are learned and consolidated through education, we carried on the researches with students of different grade levels. In particular, we assessed the role of the mindware gap (i.e. missing knowledge), taking into account individual differences in cognitive ability and thinking dispositions, and superstitious thinking as contaminated mindware (study 1). Then, we conducted a set of experiments (study 2) in order to investigate the override failure (i.e. the failure in inhibiting intuitive competing responses) in which participants were instructed to reason on the basis of logic or provided with example of logical vs. intuitive solutions of the same task. In this way, we aimed at stressing the need to apply the rules. Our results provide support for the claim that the mindware plays an important role in probabilistic reasoning independent of age. Moreover, we found that cognitive capacity increases reasoning performance only if individuals possess the necessary knowledge about normative rules. Finally, superstitious beliefs seem to have a detrimental effect on reasoning. The overall findings offer some cues to cross the bridge from a psychological approach to an educational approach.

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Keywords: heuristics and biases; dual-process theories; probabilistic reasoning; cognitive abilities; thinking disposition; primary students; secondary school students; high school students; college students; teaching probability
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