THE DARK SIDE OF STATISTICS: NUMERACY AND LUCK IN THE DEVELOPMENT OF PROBABILISTIC REASONING

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In our daily lives we continually confront situations that require making decisions without sufficient information to predict with certainty the consequences of whatever we do. Data and chance are ubiquitous in our everyday and professional lives and statistical reasoning is a crucial component of thinking with data (Lovett & Shah, 2007).

The literature regarding adults' statistical judgment includes many examples demonstrating that (1) adults have severe difficulties dealing appropriately with aspects of probability and (2) people persist in confounding random processes with naïve conceptions of chance and luck. Moreover, some studies have shown that 8-10 year olds seem to reason in a more "rational" way than adults in typical judgment tasks (Reyna & Ellis, 1994). Dual-process theories (Evans, 2008) attempt to account for these findings by proposing two distinct systems of reasoning (the analytical and heuristic systems). Their dissemination within developmental psychology has, however, been limited, and research exploring the development of the two systems has yielded inconsistent results.

The purpose of this research is to shed light on factors that have led to such inconsistencies and to account for elements related to numeracy and everyday decision making that are relevant for statistical education. We investigate task-specific factors involved in decision making problems that constitute the reason for the present conflicting evidence. Individual beliefs play a role when numerical information and beliefs are in conflict.

In Study 1 participants were 276 fifth graders (mean age = 10.57 years, *SD* = 0.41 years), 344 seventh graders (mean age = 12.68 years, *SD* = 0.48 years) and 90 adults (mean age = 23.73 years, *SD* = 2.53 years). The contingency detection problem was used varying: a) probability ratios (equal probability or different probability) and b) superstitious belief (present or absent). When probability ratios were equal, absolute numbers influenced only the fifth graders who judged the greater number to be the more probable outcome. When probability ratios were different, fifth graders responded correctly more often and all age groups (especially adults) made more atypical responses. This effect was due to the presence of the superstitious belief that influenced performance paradoxically when the problem was easily solved.

In Study 2 participants were 275 fifth graders (mean age = 10.57 years, *SD* = 0.25 years), 344 seventh graders (mean age = 12.67 years, *SD* = 0.26 years) and 153 adults (mean age = 23.40 years, *SD* = 1.18 years). A game of chance was revised: the lottery-ticket-exchange (equal or favorable) with the interference of luck (present or absent). Presence of superstitious belief reinforced the heuristic answer (to not trade) only in fifth-graders. The majority of all participants in all age groups realized that the favorable exchange was convenient and they responded normatively. Nevertheless, the proportion of heuristic responses was noteworthy in adults (20%) both for equal and favorable exchanges.

These results emphasize the importance of understanding the developmental trajectory of probabilistic decision making, and these two studies underline the necessity to investigate the task-specific factors that are involved in the interaction between the two systems of reasoning. Individual beliefs and numeracy work together in everyday life and counterintuitive findings resulted from their interaction.

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