Gerd Gigerenzer is Director of the Max Planck Institute's Center for Adaptive Behavior and Cognition (ABC) and the Harding Center for Risk Literacy in Berlin. Gigerenzer's research on decision making, heuristics and bounded rationality demonstrates that simple approaches to complex problems frequently outperform complex algorithms based on constrained optimization. Gigerenzer interprets *heuristics* as frequently improving human performance but neither inherently rational nor irrational, which depends on the context in which they are used. His demonstrations that heuristics can outperform when optimization problems are not well defined or computationally intractable challenges the widespread interpretation among behavioral economists and psychologists (associated with Daniel Kahneman's work) that heuristics are a form of irrationality, *arationality*, cognitive bias or otherwise some form of predictable error. Gigerenzer's analytic, computational and experimental findings point to simplicity and flexibility as enabling features of successful decision making given the uncertain, unstable and high-dimensional choices that real-world decision makers face. Working in collaboration with economists, biologists, mathematicians and historians, Gigerenzer's research has surprised many who work with optimization models by showing conditions under which forecasters and decision makers perform better by using less information. This less-is-more effect is one of several that Gigerenzer has brought to light across disciplines which include psychology, economics, finance, medicine and public policy.

Gigerenzer views his research program as building on the work of Herbert Simon and uses Simon's term, "bounded rationality," in a way that distinguishes it from common (mis)-interpretations among behavioral economists. In Gigerenzer's view, bounded rationality does not refer to second-best solutions to optimization problems after including cognitive biases and limits on memory in the decision maker's constraint set. Rather, Gigerenzer's program seeks empirical and theoretical descriptions of decision process (*process models* rather than *as-if models*), motivated by his unusual normative approach which he refers to as *ecological rationality*. Gigerenzer investigates adaptive strategies that successful individuals and organizations use in the face of uncertainty and complexity. In contrast to most decision models in psychology and economics, Gigerenzer's approach emphasizes that decision makers typically do not possess exhaustive knowledge of the feasible set of actions they choose from, the mapping from actions to associated outcomes, or the probabilities associated with those outcome. This perspective points to experimentation and innovation in exploring one's choice set as an important function that heuristics contribute to accomplishing.

In *The Empire of Chance*, Gigerenzer and coauthors (1989) published a highly original history of probability, statistics and the amalgamation of contradictory techniques and interpretations by which statistical methodology has been assembled, taught and practiced in contemporary scientific communities. Gigerenzer has continued to write as a critic of "mindless statistics" and the use of *statistical significance* and null hypothesis testing as a largely unilluminating "scientific ritual." Gigerenzer introduced the *tools-to-theory* hypothesis, arguing that statistical tools such as linear regression first appear as computational devices and predictably show up later (in psychology and other social sciences) re-cast as (inaccurate) models of mental process.

With co-author Ulrich Hoffrage, Gigerenzer demonstrated that natural frequencies (which represent conditional probabilities as counts in relation to a constant base population instead of normalized by smaller counts on subpopulations as is the case with conditional probabilities) significantly improve people's performance (from children to medical doctors) when interpreting joint probabilistic information such as the sensitivity and specificity of mammography results used as a screening device for breast cancer. In *Simple Heuristics that*

Make us Smart, Gigerenzer and ABC co-authors (1999) put forward a research program focused on "fast and frugal" heuristics (i.e., easy to use, quick and "frugal" in the sense of requiring very little information to arrive at a decision or action). The take-the-best (TTB) heuristic is one example of a fast and frugal heuristic.

The TTB heuristic makes a binary forecast (e.g., predicts whether turning left or right will result in higher-value foraging opportunities) based on multiple (i.e., a vector of) predictors. TTB makes a prediction on the basis of the single predictor with highest validity (i.e., conditional probability of making an accurate forecast) while ignoring the rest. The surprising accuracy of TTB has been validated in later replication and extension studies describing the characteristics of the joint probability distributions of predictors (referred to in this literature as *cues*) and binary outcomes for which the less-is-more effect—greater objective accuracy while using less information—can be expected to occur.

Gigerenzer's simple heuristics program has tackled challenging applied problems in medical decision making, financial decision making and public policy. Designing the decision making environment to match the repertoire of heuristics that real-world decision makers actually use (based on evolved capacities and limitations) is sometimes referred to as environmental or institutional design. Gigerenzer's work on natural frequencies and risk communication has influenced cancer screening and the training of judges in Germany. Many in finance and banking have been drawn to Gigerenzer's criticisms of optimization models in portfolio choice and his provocative findings in favour of simple heuristics for forecasting, portfolio choice and bank regulation.

The normative concept of ecological rationality is fundamental to Gigerenzer's research program. Ecological rationality requires an adequately successful match between the decision procedures used and the environments in which they are used. In contrast to standard definitions of rationality in economics and psychology based solely on the internal consistency of the decision maker's choice rule, ecological rationality follows Herbert Simon's observation that the rationality of a decision procedure depends on the structure of the environment. This observation leads Gigerenzer to a pluralistic "toolbox" approach to understanding the repertoire of decision rules that successful individuals and organizations require. Rather than applying rationality as a universal (i.e., context-free) set of criteria in isolation from the situations in which they are used, ecological rationality interprets rationality not as an inherent characteristic of the decision procedure but as a characteristic of the *match* between decision procedures and the structure of the environment.

Gigerenzer's ecological rationality is rooted in Herbert Simon's notion of *saticficing*. Whether the task at hand is to design workplace incentives, institutional frameworks for banking regulation, or a spatial arrangement of food inside one's kitchen to moderate carbohydrate intake, ecological rationality as a design principle suggests that optimality is a generally unhelpful goal. Instead, good-enough (i.e., satisficing) heuristics and institutions (i.e., sets of rules) describe what successful individuals and durable or long-lived organizations and institutions typically achieve. Simplicity, transparency, and decentralization are three characteristics of successful and durable (i.e., good-enough) institutions in Gigerenzer's analysis. Having observed those characteristics across numerous decision domains, Gigerenzer has collaborated with political scientists and economists to argue against paternalistic policies where experts attempt to centrally engineer favoured outcome based on social welfare maximization.

Gigerenzer has criticized behavioral economics for relying on neoclassical *as-if* methodology while contradictorily claiming its methodology to be based upon realistic assumptions. Gigerenzer argues that many behavioral models, including Kahneman and Tversky's prospect theory, are better understood as neoclassical optimization models to which "psychological" parameters (e.g., nonlinear transformation of probabilities into decision weights) have been added to more easily fit—but not explain—observational data. In contrast, Gigerenzer's theoretical work eschews constrained optimization and argues for decision trees that specify the process by which decisions are made without relying on free parameters. Gigerenzer's decision tree models lexicographically evaluate cues so that decisions follow simply from a single reason, which Gigerenzer refers to as "one-reason decision making." Although decision tree models can be more challenging to characterize in closed-form algebraic expressions than compensatory models (e.g., linear regression, which allows for trade-offs among weighted integration of all cues), his work uses analytic, computational and experimental data to reveal new insights about decision process.

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