Journal of Experimental Social Psychology 49 (2013) 1059–1077

Contents lists available at ScienceDirect

Journal of Experimental Social Psychology

journal homepage: www.elsevier.com/locate/jesp

Intuitive judgments of social statistics: How exhaustive does sampling need to be?☆

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HIGHLIGHTS

- We examine the role of noncompensatory processing in instance-based inference.
- We propose a heuristic for judging the relative frequency of events.
- The heuristic performs competitively in describing people's frequency judgments.
- In computer simulations we examine the ecological rationality of the heuristic.
- The heuristic performs competitively in clustered and skewed environments.

ARTICLE INFO

Article history:
Received 25 June 2012
Revised 1 July 2013
Available online 13 July 2013

Keywords:
Sampling
Frequency
Decision strategy
Heuristics
Availability

ABSTRACT

One way to make inferences about social statistics, such as the frequencies of health risks in the population, is to probe relevant instances in one's social network. People can infer, for instance, the relative frequency of different diseases by probing how many members of their social network suffer from them. How are such instance-based inferences cognitively implemented? Noncompensatory strategies based on lexicographic and limited search have been extensively examined in the context of cue-based inference. Their role in instance-based inference, by contrast, has received scant attention. We propose the *social-circle heuristic* as a model of noncompensatory instance-based inference entailing lexicographic and limited search, and test its descriptive and prescriptive implications: To what extent do people rely on the social-circle heuristic? How accurate is the noncompensatory heuristic relative to a compensatory strategy when inferring event frequencies? Two empirical studies show that the heuristic accurately predicts the judgments of a substantial portion of participants. A response time analysis also supports the assumption of lexicographic search: The earlier the heuristic predicted search to be terminated, the faster participants classified as using the social-circle heuristic responded. Using computer simulations to systematically investigate the heuristic's prescriptive implications, we find that despite its limited search, the heuristic can approximate the accuracy of a compensatory strategy in skewed and in spatially clustered environments—both common properties of distributions in real-world social environments.

Introduction

In myriad domains of social life, people's decisions are influenced by their observations of others. In fact, imitating the behavior of others is a powerful and versatile heuristic that helps us to navigate the trials and tribulations of complex social environments (e.g., Hertwig & Herzog, 2009; Hertwig, Hoffrage, & the ABC Research Group, 2013; Richerson & Boyd, 2005). Knowing what others do, want, like, or have can help us make decisions in the face of such diverse issues as whether or not to adopt "green" behavior (Goldstein, Cialdini, & Griskevicius, 2008), whether to engage in helping behavior (Fischer et al., 2011), which cultural products (e.g., books, movies, TV shows, and music) to purchase and consume, and how satisfied we are with our income (Boyce, Brown, & Moore, 2010). In Salganik, Dodds, and Watts's (2006) investigation of simulated cultural markets, for instance, individuals' music preferences were substantially altered when given frequency information about the choices of other individuals in the market.

☆ We thank Florian Steinmann for collecting the data in Study 1, Henrik Olsson and Lael Schooler for their many constructive comments, and Laura Wiles, Valerie Chase, and Susannah Goss for editing the manuscript. This research was supported by a grant from the German Research Foundation (DFG) as part of the priority program "New Frameworks of Rationality" (SPP 1516) to Ralph Hertwig and Thorsten Pachur (HE 2768/7-1).

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0022-1031/$ – see front matter © 2013 Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.jesp.2013.07.004

Sometimes we have the benefit of explicit information about the frequency of others' behaviors (e.g., how many people have visited a website or seen a movie on the opening weekend). In many real-life situations, however, we have no such objective social statistics at hand, and thus need to rely on much more limited counts of experiences stored in memory. In May 2011, for instance, German consumers may have wondered whether to stop consuming raw tomatoes, fresh cucumbers, and leafy salads, as recommended by the German Federal Institute of Risk Assessment after a sudden increase in life-threatening infections caused by Shiga-toxin-producing *Escherichia coli* (STEC; ECDC, 2011). Unable to look up an official count of others' choices in the same situation, consumers could gauge the frequency of recommendation-compliant behaviors among the members of their close social network (e.g., friends and family).

Compensatory and noncompensatory processing

Accessing frequency information in terms of instances experienced by one's proximate social network has been proposed as a key mental tool for inferring the frequency of behaviors or characteristics in the population (Fiedler & Juslin, 2005; Galesic, Olsson, & Rieskamp, 2012; Tversky & Kahneman, 1973). It is implicitly or explicitly assumed that this instance knowledge is processed in a *compensatory* fashion. Compensatory strategies consider all available information and process it such that conflicting pieces of evidence can be traded off against each other. Undeniably, compensatory strategies have been successful in describing people's frequency judgments (e.g., Hertwig, Pachur, & Kurzenhäuser, 2005; Pachur, Hertwig, & Steinmann, 2012). However, also *noncompensatory* strategies play a major role in human judgment and decision making (Ford, Schmitt, Schechtman, Hults, & Doherty, 1989; Gigerenzer, Hertwig, & Pachur, 2011). Noncompensatory strategies ignore parts of the information, with the consequence that a piece of evidence that supports one option cannot be compensated for by another piece that favors the other option but is ignored (e.g., Katsikopoulos, Pachur, Machery, & Wallin, 2008). Due to their limited search, noncompensatory strategies respect the boundaries of human information processing (Gigerenzer, Todd, & the ABC Research Group, 1999; Simon, 1990).

To date, the comparison of compensatory and noncompensatory strategies has been limited to cue-based inference[1] (Gigerenzer et al., 1999; Rieskamp & Hoffrage, 2008; see also Payne, Bettman, & Johnson, 1993; Tversky, 1972). Yet evidence for the use of noncompensatory strategies in cue-based inference (Einhorn, 1970; Gigerenzer et al., 2011) raises the question of whether and to what extent noncompensatory processing also occurs in the context of instance-based inference.

Limited search and noncompensatory processing may play a role in instance-based inference for several reasons. First, it can reduce processing cost. Indeed, noncompensatory processes are particularly evident in decisions involving information cost, such as cue-based inference from memory (e.g., Bröder & Schiffer, 2003, 2006); instance-based inferences are often memory-based. Second, due to information redundancy in natural environments, limited search can result in decisions that coincide with those based on more extensive search. As shown by Gigerenzer and Goldstein (1996) in the context of cue-based inference, structural aspects of the environment (e.g., intercorrelations between cues) permit simple mechanisms to approximate the accuracy of more complex strategies. Similarly, in a risky choice context, Hertwig and Pleskac (2008, 2010) found that increases in inferential accuracy level off relatively quickly with increasing sample sizes. This decreasing marginal utility of more information may also hold for instance-based inferences of event frequencies. Moreover, Hertwig and Pleskac (2010) demonstrated that small samples facilitate decision making because they permit decision makers to discriminate among options more easily. A final advantage of noncompensatory processing of instance-based knowledge is reliability of knowledge. Specifically, sample spaces may differ in terms of how reliable a decision maker's knowledge of them is. Ordered and noncompensatory processing of these sample spaces elegantly enables the decision maker to prioritize sample spaces with more reliable knowledge.

Our goals in this article are the following. First, we propose a model of a heuristic that represents noncompensatory processing of instances: the *social-circle heuristic*. Second, we investigate to what extent this heuristic is a descriptively accurate model of people's judgments of social statistics (frequencies). Third, from a prescriptive perspective, we determine the price (in terms of accuracy) the heuristic pays for ignoring part of the information. To these ends, we examine how well the social-circle heuristic fares in accounting for people's inferences, relative to a compensatory instance-based heuristic (Studies 1 and 2) and to three cue-based strategies (Study 2). In Study 3, we turn to a systematic analysis of the prescriptive question by addressing the *ecological rationality* of the social-circle heuristic (Todd, Gigerenzer, & the ABC Research Group, 2012). Specifically, we use computer simulations to investigate the environmental structures fostering and hampering the heuristic's performance, relative to that of a compensatory strategy. We begin by describing the established compensatory models of instance-based inference.

Models of compensatory processing of instance-based inference

Perhaps the most prominent account of how people infer the frequency of a class of events (or the probability of an event) is Tversky and Kahneman's (1973) *availability heuristic*. It assumes that when judging the frequency with which an event category occurs in the world (e.g., heart attacks among middle-aged people), people recall the event's occurrences from memory. The likelihood that an occurrence (instance) stored in memory is sampled is a function of its "availability," and this ease of retrieval depends on, for instance, how "vivid" or "dramatic" the instance is. In principle, however, the mnemonic sample space is limited only by the bounds of the decision maker's knowledge and can include directly experienced as well as "virtual" instances (e.g., media reports about a person killed in a shark attack).

Another way to model instance-based frequency judgments is in terms of exemplar models (e.g., Nosofsky, 1986; Pachur & Olsson, 2012). In these models, memory representations contribute to judgments of frequency as a function of their similarity to the class of target events. For instance, Dougherty, Gettys, and Ogden's (1999) MINERVA-DM model assumes that each individual encounter with an instance—regardless of whether the instance is real or virtual—is stored and that the target event category (e.g., heart attack) is compared with these memory traces using a global matching process. Event categories that result in a stronger activation, or "echo," in memory are inferred to be more frequent. Dougherty et al. (1999) showed that phenomena that are usually explained in terms of the availability heuristic can also be accounted for by MINERVA-DM.[2] Like the availability heuristic, exemplar models assume that the sampling space is restricted only by the bounds of a person's knowledge.

[1] In contrast to instance-based inference, cue-based inference relies on semantic properties of an event or object to make an inference. For instance, to judge whether there are more people in Germany who belong to a basketball or a tennis club, a cue-based strategy would consider properties of the respective sports (e.g., whether it is a team sport or an individual sport) as cues.

[2] According to another exemplar model, Juslin and Persson's (2002) PROBEX, inferences about the population frequency of event categories can be made by retrieving knowledge about other, similar event categories. For instance, in order to infer whether tuberculosis or bladder cancer occurs more frequently, PROBEX would retrieve criterion knowledge about the frequencies of other infectious diseases and cancers and integrate this knowledge as a function of their similarity to tuberculosis and bladder cancer, respectively. Because instance knowledge does not enter the processing directly, we will not treat PROBEX as a genuine instance-based model.