



## Base Rate Neglect Bias: Can it be Observed in HRM Decisions and Can it be Decreased by Visually Presenting the Base Rates in HRM Decisions?

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**Abstract:** The aim of this experimental research was to explore if the future HR managers are susceptible to the base rate neglect (BRN) bias and if the visual presentation of the base rates improves their reasoning. The BRN bias is a tendency to disregard a priori probabilities that are explicitly given for the class of observed objects. In this study, BRN is seen as the case of decision-making bias in the work-related context. Although it is inevitable part of the decision-making processes concerning employees, the topic is not sufficiently studied. A total of 65 participants, enrolled in the master studies of HRM, were subjected to 4 different types of BRN tasks, in which five different HR activities were described. They were varied within subjects, representativeness of description, and format of base rate. Within each task there were five different situations that make 20 tasks in total. The two-way repeated-measures ANOVA revealed that the proportion of biased answers was significantly higher on the representative tasks when the tasks presented visually, with no interaction between representativeness and format of task. Results are in line with previous studies that observed an effect of BRN on decision-making process. Yet, unexpectedly, visual presentation of base rates did not facilitate unbiased reasoning implying that some other form of presentation might be more appropriate for the task.

**Keywords:** *base rate neglect, cognitive bias, HRM, decision-making, ecological rationality.*

### Introduction

As a part of everyday private and work life, humans have to reason about different problems and situations. Irrespective of whether our reasoning is based on its functionality or exactness, scholarly attention is turning toward studying the viability of decision-making practices and the validity of their outcomes. Given the costly consequences of ineffective decisions, decision-making in business-like contexts are of special interest, and scholars and practitioners struggle to find strategies to optimize them. The particularly sensitive part is when it concerns people at workplace often challenging human resource managers rationality.

The fact that human resource managers oversee recruitment, selection, employee appraisal, career development, promotional decisions, training, and compensation and all these activities involve decision-making as a function of perceptions and judgments (Storm et al. 2023). The consequences of such decisions in this domain might be felt at the individual level — affecting someone's future career (Swider, Harris, and Gong 2022), at the process level — rejecting potentially effective candidates and accepting ineffective ones (Whyte and Sue-Chan 2002), as well as on the organizational level leading to unintentional expenses (Ceschi et al. 2019). Therefore, it seems to be of great importance to identify and account for different factors that impact effective decision-making for human resources management. If we focus on individual decision-makers in this context, we see that they must make decisions rapidly in restrained circumstances using very limited cues about concrete objects of perception, which is typical situation of using heuristics in the social context (Marsh 2002).

Over decades of research, cognitive psychologists identified numerous heuristics that individuals

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utilize in decision-making contexts. Dale (Dale 2015) describes several fundamental heuristics: availability, anchoring and adjustment, representative simulation, peak-and-end, base rate, and AIM (affect-as-information). As HRM activities occur in a social setting, common biases are based on the social phenomenon of focusing on the similarities with other individuals. Marsh (2002) identified the following heuristics in the HRM context: search, assessment, and selection. Ceschi and colleagues (2019) use factor analysis to extract three factors referring to biased decision-making: mindware gaps, valuation biases (positive illusions and negativity effect), and anchoring and adjustment.

Palmucci (Palmucci 2023) claims that the most detrimental effect of bias comes in the form of individuals developing a “blind spot,” in which an individual holds an illusion that he/she is immune to biases. As a matter of fact, errors are often based on a systematic bias due to an individual sticking to an unsuccessful strategy. These errors happen when an individual sticks to a prior preconception while ignoring alternatives and is insensitive to outcome probabilities. Similarly, Sartori and colleagues (Sartori, Costantini, and Ceschi 2020) found that two key cognitive biases in employee assessments are the illusion of control and the overconfidence effect.

Although base rate neglect is well known phenomenon, previous studies were more focused on some other domains of decision-making processes in medicine (Stengård et al. 2022), law (Dahlman, Zenker, and Sarwar 2016) or banking industry (Kang and Park 2019). As Swider and colleagues' (Swider, Harris and Gong, 2022), claim that biases in work context have their own pace, purpose, and, there are some indices that they have to be analyzed more thoroughly in order to gain understanding of its patterns and mechanisms and potential contextual particularities.

### *Biases in Human Resource Management HRM*

Although it seems to be an important practical issue, there are fewer studies of the problem than might be expected. Yet, as it is already stated, almost all aspects of organizational life are susceptible to biased decision-making, especially those concerning people, or employees. For example, Swider and colleagues (Swider, Harris and Gong, 2022) in their comprehensive study of first impression effects identify its occurrences in the processes of selection, socialization, leader-subordinate relationships, job performance and in team dynamics.

In the employee recruitment processes, biases could occur at any stage, starting with biased evaluation of candidates' resumes, forming biased impressions that result in ineffective decisions (Derous and Ryan 2019). Several studies confirm the similar effect between recruiters and candidates (Erlandsson 2019). Especially sensitive situation for biased decision-making to occur is selection interview. In such short time circumstances, people are prone to use heuristics, such as relying on information that comes easily to mind (Huffcutt, Van Iddekinge, and Roth 2011). Also, assessors might formulate assumptions as a function of the information, they review before making decisions (e.g., formulating assumptions from information gathered prior to conducting a candidate interview), or they might be under the effect of subjects' attractiveness (Anderson, Adams, and Plaut 2008; Swider et al. 2022). Thus, researchers should analyze the perspective of interviewed candidates that were “victims” of halo effect, personal prejudice, first impression and central tendency errors (Karunaratna et al. 2010). Nevertheless, the majority of studies focus on the effects of gender, race, and minority stereotypes on personnel decision-making process (Auster and Prasad 2016; Guillén, Mayo, and Karelai 2018), not only in the context of selection but along the worklife of employees.

Special attention should be paid to the process of performance appraisal, as one of the key HRM activities with consequences that goes beyond individual engagement. Lance and colleagues (Lance et al. 2008) in their study of 360-degree feedback refer to discrepancies of assessments between raters on different positions, implying that it is the result of different evaluators perspectives and judgment goals. Also, in one experimental study it was found that rating scores of subordinate employees were higher when raters are exposed to an anchor of higher value, while higher scores on one dimension initiated higher score on another just among female evaluators (Belle, Cantarelli, and Belardinelli 2017). Ordoyan (Ordoyan 2021) in his dissertation explores occurrences and effects of bias in appraisal process in one company focusing on spillover effect, halo, effect, horn effect, leniency and central tendency effect, the recency and primacy effect, as well as the effect of personal biases.

Swider and colleagues found the first impression effect explaining how people reason when judging

others focus on potential salient characteristics (cues based on appearance, communication, content and behavior), and then on motives. Similarly study of Dagger and colleagues (Dagger et al., 2013) corroborates the idea that some attributes are more relevant for forming biased decision. They demonstrate selective halo and spillover effects of side-personnels' interpersonal skills to other, less obvious aspects of health services.

Finally, these studies more or less explicitly impose the question of balance between accuracy and efficacy, vaguely concluding that it might be achieved by focusing on information with higher diagnostic validity and neglecting the irrelevant ones that are misleading. Furthermore, as part of employee staffing processes. Additionally, there is a strong effect of on decision-making. In one study, the idea that some attributes are more and others less susceptible to biases.

### *Controversies in interpreting biases in Human Resource Management (HRM)*

Considering preceding empirical data and theoretical considerations, the discourse surrounding the potential utility or detriment of heuristics and biases, both in a general context and within the HRM domain, remains inconclusive. Currently, there are at least two different broad perspectives on this problem. One group of theorists considering HRM topics advocate the idea that heuristics in human cognitive processes are economically sound, use as least as possible time and information (Marsh 2002) resulting in a sufficiently good solution (Gigerenzer 2008; Krabuanrat and Phelps 1998). Others see this path rather problematic (Deros and Ryan, 2019; John Bernardin et al., 2016; Karunarathna et al., 2010) leading toward decision errors and discrimination (Auster and Prasad, 2016).

Specific studies of "positive" orientation advocates that in scenarios characterized by certainty and an overwhelming volume of information, heuristics represent the appropriate pathway for reasoning (Hafenbrädl et al., 2016). In line with the interpretation of Gigerenzer and Hoffrage (Lance et al., 2008), the theorists within the first approach see heuristics and biases as the common organizational resource based on experience and captured in organizational routines that makes decisions and task accomplishments easier (Krabuanrat and Phelps 1998). In business like circumstances which refer to HR practice too, heuristics are valuable intellectual assets enabling employees to make decisions with less administration and costs. Due to its minimum requirements, heuristics are a natural choice in situations of limited rationality because they promptly offer the first satisfying solution. Also, it is less sensitive to manipulation from potential candidates or employees due to its simplicity that situational reduces noise and distractors (Hu and Wang 2014). In favor of the idea that heuristics are ecologically valid and thus more flexible, researches show that lack of congruency among multiple rating sources, in the case of 360 degree feedback, is not necessarily proof of error biases. The diverse viewpoints articulated herein reflect the varying perspectives of evaluators occupying different organizational positions and roles. Their disparate objectives shape their perceptions within the context of their respective agendas, affording them ecologically sound appraisals. Therefore, it should be regarded as 'valid general impression' rather than indicative of bias or error (Lance et al., 2008). The main problem then should be finding the optimal relation between the complexity of the situation and the correctness of the solution (Gigerenzer, 2008).

On the other hand, within another line of interpretation authors point to the fact that use of heuristics and biases leads toward specific erroneous outcomes that might endanger the business process and may harm the organization and employees (Auster and Prasad, 2016; Deros and Ryan, 2019; John Bernardin et al., 2016; Karunarathna et al., 2010). Such theorists see decision making based on prejudice and stereotypes as a potential risk and state that such solutions are not optimal for the organization. Therefore, in this research line the efforts are made to achieve the minimization of such reasoning. However, regardless of which perspective we take, it has to be admitted that, although there are cases of misjudgment, a lot of decisions made by heuristics turned out to be correct, in spite of imperfections of the cognitive processes they are based on (Gigerenzer, 2008; Gigerenzer and Hoffrage, 1995; Hoffrage et al., 2002).

Cheschi and colleagues (Cheschi et al., 2019) state that both forms of thinking, the analytic systematic one based on logic, and the one based on heuristics and intuitive cognition are prone to errors but based on a different mind gap and the erroneousness of decision is more the case of the situational unawareness than of using concrete strategy (Cheschi et al., 2019; Gigerenzer, 2008; Palmucci, 2023; Sartori, Constantini and Ceschi, 2020). Even the most sophisticated debiasing strategies using artificial intelligence and algorithms that are expected to be impartial and based on unbiased clear rules, are

actually proven to be an illusion. For example, if we use just quantified information about absenteeism, we might conclude that women are less reliable category of employees and not taking into a consideration the maternity leave, we could make a decision in favor of men (Tuffaha 2023). Similarly, overly and uncritically using scientific modelling of human behavior and mechanistic approaches to decision making problem based on pure algorithms, can lead us to constant and systematic errors. Some scholars call it an illusion in HRM (Vassilopoulou et al. 2022). The lack of recognition and apparent neutrality makes this issue more serious because this fallibility being integrated deep in the system. But the consequences are obvious.

### *Paradigms of measuring base rate neglect and phenomenon interpretation*

Extensive research has been conducted on this phenomenon over time (Barbey and Sloman 2007; Bar-Hillel 1980; Kahneman 2011; Kahneman and Tversky 1973; Ohlert and Weißenberger 2015; Pennycook et al. 2014; Stengård et al. 2022; Tversky and Kahneman 1974, 1992; Wolfe and Fisher 2013). The number of different methodological and conceptual frameworks for studying base rate neglect has increased over time, somewhat deviating from the initial methodology described by Tversky and Kahneman (1974) and their explanation. In their pioneering work on base rate neglect, these authors identified the phenomenon using experimental and control groups, varying simple probabilities and the stereotype descriptions. They then observed the overestimation or underestimation of these probabilities by participants. In later research, base rate neglect began to be examined in a Bayesian context, where this phenomenon was equated with prior probability. Findings on base rate neglect indicated underestimation, and even ignorance, of prior probabilities, with an excessive reliance on posterior probabilities (Stengård et al. 2022). Apart from experimental approaches, there have been attempts to measure base rate neglect differentially (Teovanović 2013). Specifically, in the context of this attempt, the phenomenon is measured using multiple tasks saturated with stereotypes accompanying explicit base rate information. Any participant response deviating from the explicit probability in the direction of stereotypes is considered biased. The measure of participants is calculated as the proportion of biased responses, and this measurement paradigm has proven to be meaningful conceptually. The rate of biased responses in studies of base rate neglect has varied depending on manipulations of the difference in prior probability between categories (Tversky and Kahneman 1974), the strength of the causal relationship between base rate and described events (Ajzen 1977; Bar-Hillel 1980), and the presence of training or instruction (Goodie and Fantino 1999).

The initial explanation for base rate neglect was proposed by Tversky and Kahneman (1974), postulating the heuristic of representativeness. According to their interpretation, heuristic thinking involves unconscious rules guiding it, making it difficult to deliberately control. It is possible to recognize and learn situations in which thinking is biased, allowing for correction in those situations. Specifically, the representativeness heuristic involves the cognitive system being led by stereotypical rather than numerical information. This interpretation of base rate neglect is part of a broader approach to dual-process theories (De Neys and Pennycook 2019; Neys 2006; Pennycook et al. 2014; Reyna and Brainerd 1995; Tversky and Kahneman 1992). This approach postulates the existence of two types of thinking. Type 1 thinking is fast, intuition-based, not accessible to introspection, and often leads to responses deviating from rational norms. In contrast, Type 2 thinking is slower, deliberative, accessible to introspection, and often results in normatively correct responses. Within the framework of dual-process theories, there are disagreements regarding the interpretation of base rate neglect. For example, proponents of Cumulative Prospect Theory (Tversky and Kahneman 1992) argue that the cause of base rate neglect lies in the inadequate representation of probabilities in the cognitive system. On the other hand, adherents of the Fuzzy Trace Theory (Reyna and Brainerd 1995) believe that the human cognitive system does not actually operate with probabilities but extracts the gist, essential non-probabilistic information serving as a basis for reasoning. Finally, within the dual-process approach, the occurrence of cognitive biases is interpreted as the inability to inhibit fast and intuitive responses activated alongside analytical, correct responses (De Neys and Pennycook 2019; Neys 2006; Pennycook et al. 2014).

In addition to dual-process theories, cognitive biases have been investigated within the framework of ecological rationality approaches (Betsch et al. 1998; Gigerenzer 2008; Gigerenzer and Hoffrage 1995; Hoffrage et al. 2002). Gigerenzer and Hoffrage (1995) argue that heuristics and biases are not errors but adaptive properties of the cognitive system. When environmental information aligns with cognitive needs,

heuristics and biases represent useful and efficient problem-solving mechanisms. However, when the format of environmental information does not align with cognitive preferences, errors occur. For example, if information being reasoned about is presented in the form of absolute numbers, reasoning improves (Cosmides and Tooby 1996; Gigerenzer and Hoffrage 1995). These findings raise an important question related to base rate neglect: is it possible to present environmental information in a way that facilitates rational reasoning?

Several studies have aimed to mitigate the effect of various cognitive biases (e.g. Battaglio Jr et al., 2019; Cantarelli, Belle and Belardinelli, 2020; Ludolph and Schulz, 2018; Nagtegaal et al., 2020; Ohlert and Weißenberger, 2015; Singh, 2013). Visual interventions to reduce anchoring bias have proven effective in management reasoning (Nagtegaal et al., 2020). Similar interventions have been fruitful in weakening the effects of base rate neglect in the domain of medical reasoning (Ludolph and Schulz, 2018). These interventions generally presented base rate information in the form of differently colored dots representing absolute numbers, thereby visualizing their differences. However, systematic literature reviews (Korteling, Gerritsma, and Toet 2021) suggest a weak transfer of debiasing intervention effects when it comes to different biases or even the same bias in different reasoning domains.

### *Base rate neglect in HRM*

Within the broad area of cognitive biases investigated, there is one interesting phenomenon understudied in the work related context. Base rate neglect is commonly identified as a cognitive bias that indicates a human inclination to underemphasize or even disregard explicitly provided numerical indicators. Instead, individuals tend to rely on specific stereotypic beliefs when making judgments about probabilities (Bar-Hillel 1980; Kahneman and Tversky 1973; Teovanović 2013; Tversky and Kahneman 1974, 1992). For instance, consider a group of 100 people comprising 30 teachers and 70 developers. The base rate information suggests that the probability of a randomly selected member being a teacher is 0.3. However, when describing a specific member as someone eager to work with people, fond of teaching, neat in appearance, and wearing suits, that member is perceived as more likely to be a teacher than a developer. This judgment is influenced by stereotypic depictions of a teacher, leading to the neglect of explicitly provided numeric information indicating a much higher probability for a random member to be a developer.

One potentially important domain in which the base rate neglect occurs is HRM. Although there are not many studies on the topic, this bias is quite usual in the HRM field. Business tasks are often performed by using different statistical tools and quantitative models to minimize error and maximize gain. This approach is derived from the so called “world of risk”, implying that we are aware of the probabilities of events. Yet, the social reality is more of the world of uncertainty (Hafenbrädl et al. 2016), which implies that the parameters for estimating different alternatives often cannot be measured. In such circumstances it is of great importance to explore to which extent the HRs’ estimations of probabilities are accurate and reliable.

Several studies of base rate neglect study in HRM, considering the concept are unequivocally prove the effect of neglecting the base rate information when facing the informative individual (personalized) data about others. Subjects were prone to make decisions about person’s group affiliation (as engineers or lawyers in this particular study) prevalently on their representative characteristics, neglecting objective probabilities (Argote, Devadas, and Melone 1990; Argote, Seabright, and Dyer 1986; Palmer and Loveland 2008). This tendency becomes stronger after group discussion (Argote, Seabright, and Dyer 1986), implying that this phenomena is susceptible to groupthink. The main problem here might not be the categorization but the consequences of it, as each categorization leads toward some judgment of the member’s attributes and causes of the behavior. It often provokes prejudices and stereotypes. Important findings in the study concern the nature of the personalized information. Argote and colleagues (Argote, Devadas, and Melone 1990) found that if the descriptions were not in the line with popular image (stereotype) of the profession, the base rate information became relevant and its effect to probability judgment was higher.

In one relevant study of the future HR managers’ judgements in the selection process, base rate data about candidates’ categories was less effective cue than it was interview scores (Whyte and Sue-Chan 2002). It was found that individual, personalized information was more relevant for experienced

respondents than prior probability of candidates' potentials to be successful. Although the base rate information is significant indicator of candidates' future performance, even forthcoming HR professionals make decisions neglecting exact statistical data and rely on less precise information. When we are facing, for example, with employees CV in the process of selection, there is information about their group affiliation, their profession and so on. We might have some preconceptions about that, as well as some statistical data referring to it. At the same time, we could gather information about some, apparently side characteristics of their life from LinkedIn or Facebook and decide which criteria are more relevant for us. All these data could then be overweighted related to key information contained in base rate information. Such cases might happen in the situation of performance evaluation or other aspects of HRM activities which are especially salient with concrete impressions, descriptions or behaviors of employees.

### *Problem of this research*

Although base rate neglect is relatively well studied phenomenon among different contexts it is to certain extent understudied in the human resource management studies. Swider and colleagues (Swider, Harris and Gong, 2022) offer a review of studies concerning biases in organizational psychology, but focusing on first impression and related heuristics. Nevertheless, we mentioned one relatively recent study that considers base rate neglect bias in human resource management. Whyte and colleague (Whyte and Sue-Chan 2002) experimentally examined the presence of base rate neglect confirming the expectations based on similar studies in other domains. In order to go further into the understanding of the phenomena while trying to correct some limitations of their experimental design, we conducted our research. We started from the idea that targeting the only one domain of HR should be abandoned, and that the measurement method used by Whyte and Sue-Chan (2002) was considerably more complex and mathematically demanding than other presented. The main criticism towards their method is that it involves several different parameters that participants are supposed to count with. Furthermore, in this study the representativeness, which is considered to elucidate representativeness heuristic, was not varied, but only the proportion of the base rates. Therefore, we consider it important to experimentally investigate the phenomenon in various aspects of reasoning in the field of human resource management. Therefore, we consider it important to experimentally investigate the presence of this phenomenon in various aspects of reasoning in the field of human resource management.

The initial Tversky and Kahneman (1974) procedure is suitable due to the presence of both a control and an experimental group, although it fails to account for individual differences in the manifestation of base rate neglect. On the other hand, Teovanović (2013) successfully addresses individual differences, but a criticism of his measurement procedure could be the lack of a control situation against which the presence and intensity of base rate neglect could be more precisely determined.

Furthermore, although there are studies aimed at reducing the effect of base rate neglect in other reasoning domains, evidence of the weak transfer effect of debiasing procedures across domains (Korteling, Gerritsma and Toet, 2021) necessitates testing interventions with such a goal in this domain. Given that interventions involving visual representation of base rate information have proven fruitful (Ludolph and Schulz 2018) we believe that testing such interventions in the field of human resource management would be productive.

Taking all this into account, the goal of this study was to experimentally test the presence of base rate neglect in human resource management, using a new procedure that combines a design with an experimental and control situation, and to test the effect of visual representation of base rate information. Based on the assumptions of dual-process theories (e.g. De Neys and Pennycook, 2019; Gigerenzer and Hoffrage, 1995; Neys, 2006; Reyna and Brainerd, 1995), as well as research on effects, (a) we expected that in a situation where there is a stereotypical description of a specific person, the manifestation of bias would be higher than in a situation where such a description does not exist. Additionally, (b) we expected that the effect of base rate neglect would be reduced by visually representing base rate information.

## Materials and Methods

### Participants

The sample consisted of 65 participants (86.2% female,  $M_{age} = 23.92$ ,  $SD_{age} = 2.05$ ) – graduate students of human resources management at the University of Belgrade. In return for participating in the experiment, students were rewarded with points. Having in mind their current and future career interests we believed that sample was relevant for the topic.

### Materials

For the purpose of this study, we developed Base Rate Neglect Tasks, so they reflect the issues in the Human Resources Management context. Each participant was exposed to five different hypothetical situations representing different activities in the human resources management domain. For each situation, participants were presented with a vignette and were instructed to imagine that they are human resources managers, supposed to resolve a certain problem. In the first part of each vignette the hypothetical situation was described, whilst the rest of the vignette consisted of the information on the concrete employee, participants were instructed to appraise. When participants completed the vignette reading, they were asked to assess the probability of the concrete employee's behaviour related to the topic described on a scale ranging from 0% to 100%, by swiping the slider over the 10% steps. Each hypothetical situation appeared four times, varying in its representativity and the information presentation format. Representativity referred to the vividness of the information about the concrete employee presented, while format referred to the visual or textual form of information presentation. In essence, the vignettes allowed for the specific depiction of employees either in a representative manner, invoking the representativeness heuristic by vivid description, or in a non-representative manner, by brief description. Information concerning base rates was presented either textually or visually. Consequently, each of the five hypothetical situations manifested in four distinct forms: representative and textual (RT), non-representative and textual (NT), visual and representative (RV), and visual and non-representative (NV). All four forms are shown in the Figure 1.

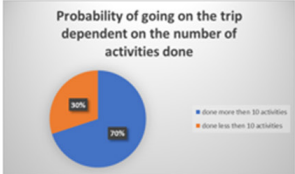
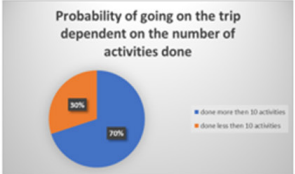
Design and stimuli		representativeness	
		representative	nonrepresentative
format	visual	<p><b>RV</b></p>  <p><b>Sara has finished more than 10 activities in the present month.</b> However, she is not so sociable, and prefers to work on her own. She rarely takes a coffee break with her colleagues</p>	<p><b>NV</b></p>  <p>Sara has finished more than 10 activities in the present month</p>
	textual	<p><b>RT</b></p> <p>The probability that an employee will go on the team building trip is 70%, if he/she has finished more than 10 activities.</p> <p><b>Sara has finished more than 10 activities in the present month.</b> However, she is not so sociable, and prefers to work on her own. She rarely takes a coffee break with her colleagues</p>	<p><b>NT</b></p> <p>The probability that an employee will go on the team building trip is 70%, if he/she has finished more than 10 activities.</p> <p>Sara has finished more than 10 activities in the present month</p>

Figure 1. Task example: The four iterations of base rate neglect tasks

Hence, all participants went through twenty different iterations of tasks. The base rate neglect bias was observed if participants attributed a probability to a particular employee that differed from the provided base rate, particularly when leaning towards a representative description. Conversely, if respondents

assigned a probability equal to or exceeding the base rate to a specific employee, we did not record it as a bias. The participants' scores were computed as the proportion of responses inclined towards base rate neglect related to 5 different situations, and in each of the four task iterations. Hence, for each participant 4 different proportions were counted (scores in RT, TNR, VR and VN stimuli). For example, if a participant answered biased in 4 out of 5 situations in RT form of the stimuli, that means that their proportion in RT form equals .8. Similarly, for this and each other participant, the other three proportions were counted.

Our measurement methodology for Base Rate Neglect (BRN) amalgamates two approaches, one derived from the pioneering research of [Tversky and Kahneman \(1974\)](#) concerning vignette representativeness. The second approach, stemming from endeavors to capture individual variations in the manifestation of cognitive biases ([Teovanović 2013](#)), is embodied in this study through the exposure of respondents to a broader array of situations and the computation of scores based on the proportion of tasks wherein bias was exhibited. We posit that the integration of these approaches is fruitful as it simultaneously provides insights into respondents' predispositions toward base rate neglect in situations where the representativeness heuristic is not directly elicited, as well as those situations where it is, while also attempting to gauge fundamental individual differences in the manifestation of this phenomenon, enabling a more detailed exploration of its correlates.

### Design and procedure

The design employed here is the fully repeated factorial design, with two two-leveled factors: representativity and format. Participants were exposed to the experiment in controlled conditions, specifically in a computer laboratory at the Faculty of Organizational Sciences in Belgrade. Tasks were presented using the online experimental platform "SoSci Survey" (ref). Participants first provided their demographic information before proceeding to the Base Rate Neglect tasks. Given that each of the four versions of the same task comprised five different situations, these situations were presented to participants in a pseudorandomized order, ensuring that the same situation did not appear in two consecutive iterations. These tasks were counterbalanced with respect to both independent variables to nullify any potential effects of primacy and transfer. In this way, four variations of the task order emerged, generated using the Latin square method, as shown in the Figure 2. These four task order variations were created as four distinct questionnaires on the online platform, and the platform's algorithm randomly assigned participants to one of the four groups, with the condition that the number of completed questionnaires was equal across groups. Data are analyzed using JASP software.

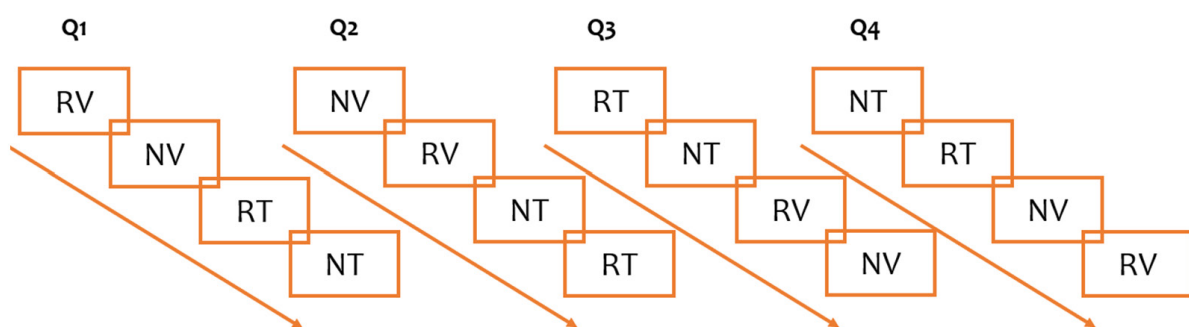


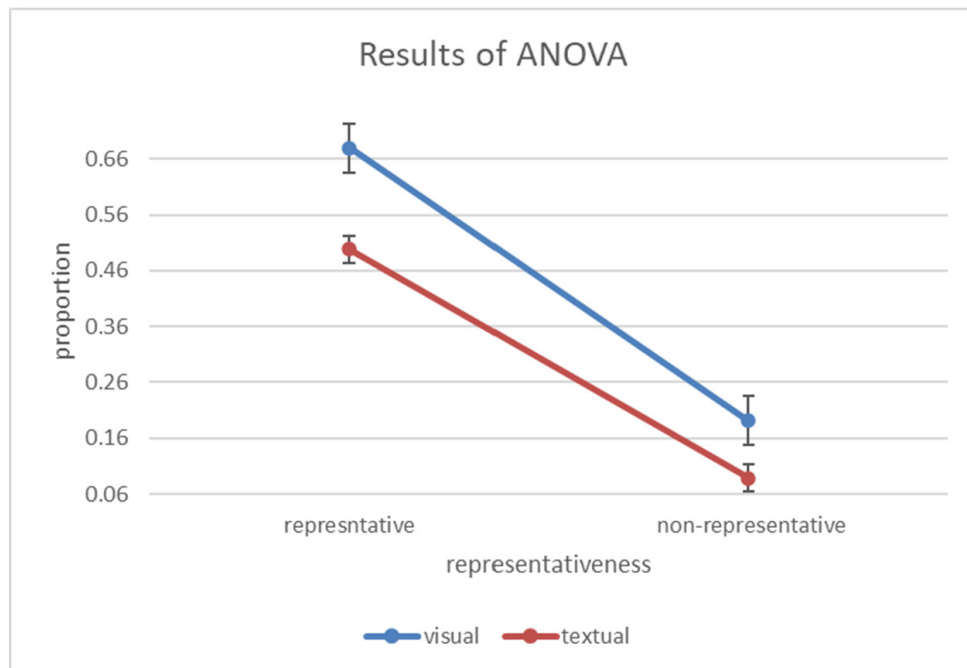
Figure 2. The four questionnaires randomly assigned to participants, representing the counterbalanced series of base rate neglect task variations

## Results

The data were analyzed using JASP and R statistical softwares. The highest proportion of the base rate neglect was registered in the representative visual form of the task ( $M = .680$ ,  $SE = .044$ ), while the proportion of such answers in the representative textual form was  $M = .498$  ( $SE = .050$ ). The insight in the results shows that the proportion of the biased answers registered in the visual non-representative form equals  $M = .191$ , with  $SE = .037$ , whilst the non-representative tasks in textual form elucidated the lowest

proportion of such answers ( $M = .089$ ,  $SE = .024$ ).

The 2 way totally repeated ANOVA revealed that there was no effect of interaction between representativeness and format ( $F(1,64) = 2.950$ ,  $p = .091$ ,  $\eta^2 = .004$ ). However, main effects of both representativeness and format were registered, suggesting that representativeness has moderate effect, explaining 47% of total variance ( $F(1,64) = 117.870$ ,  $p < .001$ ,  $\eta^2 = .470$ ), which implies that participants answer generally more biased in representative than in non-representative iterations of the scenario. On the other hand, the weak effect of the format of base rate information presented, explains 4.7% of total variance ( $F(1,64) = 20.742$ ,  $p < .001$ ,  $\eta^2 = .047$ ), but in reverse to our prior expectations – generally, when base rate information presented visually, participants answered significantly more biased than when information presented textually. Given that the dependent variable in this study is a proportion and that the assumption of homogeneity of variance is not satisfied, the results were validated using beta regression analysis in the statistical software R (“betareg” package). Initially, the measures of the dependent variable were subjected to a sigmoidal transformation. Subsequently, the following model was applied, where the proportion of biased participant responses served as the dependent variable. The effects of representativeness and format variables were tested, along with the examination of their interaction effect. Considering that the results of the beta regression revealed main effects of representativeness ( $z = -2.662$ ,  $p < .01$ ) and format ( $z = 2.070$ ,  $p < .05$ ), but not their interaction ( $z = -1.099$ ,  $p = .31$ ), it can be concluded that the ANOVA results were confirmed by a more robust analysis. Hence, Graph 1 displays the results of the ANOVA.



Graph 1. The results of the two-way totally repeated ANOVA

## Discussion and Conclusions

Although in cognitive psychology biases are common research topic and studies often cover different fields of decision-making heuristics and biases applications, biases in human resource decision-making are still underresearched. Studies implying work-related issues focus on common biases concerning first impression (Swider, Harris and Gong, 2022; Wayne and Kacmar 1991), anchoring (Belle, Cantarelli and Belardinelli, 2017), halo effect (Dagger et al. 2013; Karunarathna et al. 2010; Palmer and Loveland 2008) and decisions relied on stereotypes (Auster and Prasad 2016; Guillén, Mayo and Karelaia, 2018). Occasionally, studies tackle the problem of rate base neglect (Argote, Devadas and Melone, 1990, 1986; Whyte and Sue-Chan 2002) resulting in establishing outperformed importance of subjective information over statistical data concerning the group membership. These studies also imply the enchainment of the effect in situations when contextual information is more in concordance with typical categories

characteristics. Moreover, the aforementioned procedures for registering base rate neglect exhibited certain deficiencies. Hence, we found this topic important and valid for understanding potential pitfalls in managerial decisions, especially when employees are involved. Recruitment, selection, employee appraisal procedures are social contexts where judgment and decision-making processes are essential (Storm et al. 2023). Additionally, these procedures are often led in scarcity of time and information, which make them typical environment for heuristics and biases to occur (Marsh 2002). Finally, potential decision errors in domain are costly and consequences might be serious.

In the examined sample, in accordance with our expectations, a robust representativeness heuristic effect was observed, explaining 47% of the total variance. This finding aligns with expectations derived from the dual-process theory approach and is consistent with prior literature (e.g., Bar-Hillel, 1980; De Neys and Pennycook, 2019; Neys, 2006; Pennycook et al., 2014; Tversky and Kahneman, 1974). The results obtained can be explained by the assumption that descriptions of employees saturated with vivid details elicit the representativeness heuristic (Tversky and Kahneman, 1974), which subsequently generates inaccurate responses in Base Rate Neglect Tasks in HRM. Furthermore, our findings indicate another domain in which this phenomenon manifests – the HRM domain. However, it is important to note that this interpretation of base rate neglect relies on the assumption that the ergodic hypothesis is sustainable. This hypothesis suggests that individuals are representative of groups and vice versa. However, it turns out that in social sciences, in particular, this hypothesis does not hold (Molenaar 2004). Along with the interpretation implicated by the lack of ergodic hypothesis in social sciences, the behavior of our participants which is here considered as irrational, would be considered as rational, given that they apply supplemental data when reasoning about particular persons. This explanation would be in agreement with the interpretation proposed by Gigerenzer and Hoffrage (1995), that highlights the usefulness and adaptiveness of such heuristical reasoning. However, taking into account that our study originates from the classical heuristics and biases approach, we decided to keep interpretation according to which participants' biased answers are considered to be irrational. Yet, although the phenomenon of base rate neglect does not aim to establish relationships between probabilities related to an individual and the group to which they belong, incorporating the implications of ergodic hypothesis into future experimental research, and guiding conceptualization can be areas of potential benefits.

Regarding attempts to mitigate the base rate neglect effect, our hypothesis did not find support in the data. What is more, we observed the inversed format effect, suggesting that participants provided more biased responses in the case of visual presentation of base rate information. Even though the variance explained by this factor is small (4.7%), this finding contradicts previous research reporting positive effects of visual presentation of the numerical data as the debiasing strategy (e.g. Ludolph and Schulz, 2018; Nagtegaal et al., 2020; Ohlert and Weissenberger, 2015; Singh, 2013). Our finding, in the context of the ecological rationality approach (Gigerenzer, 2008; Gigerenzer and Hoffrage, 1995), may be interpreted as a failure to adapt the form of environmental cues to our cognitive preferences. We believe that the ineffectiveness of our intervention lies precisely in its form. Specifically, during visual presentation of base rate information on the same page, participants could see task text and person description, as well as the visual representation of base rate. Given the numerous iterations of the task, it is possible that participants simply skipped or further neglected the visual representation of base rate information, leading to its ineffectiveness in this task variant. Additionally, another possible explanation for the unexpected, reversed effect may be found in the appearance of the visual representation. More precisely, the visual form of the task presentation shown in Figure 1 reveals that the intervention involved a pie chart displaying percentages relevant to each specific task. Such a display is not in line with the recommendations of Gigerenzer and Hoffrage (1995), who argue that absolute numbers are much more intuitive for reasoning than relative ones, considering that we exposed participants to percentages falling into the realm of relative numbers. Furthermore, the finding of Ohlert and Weissenberger (2015) supports this interpretation of the ineffectiveness of our intervention, as they achieved a significantly lower percentage of biased responses using a visualization based on absolute numbers. Additionally, it is noteworthy to mention that the difference between the research conducted by Ohlert and Weissenberger (2015) and ours lies in the presentation format. In their study, absolute values and their distribution across categories were displayed, which is additive. On the other hand, in our research, a pie chart was utilized to represent independent probabilities. More precisely, even though we acknowledge that when an employee achieves a specific numerical result predicting the exact probability (base rate) of a certain behavior, it does not

necessarily imply that the probability of the mentioned behavior not occurring is additive. Therefore, a significant critique of the debiasing strategy we employed can be attributed to the inadequacy of the visual tool type used in relation to the type of information that needed to be conveyed. Therefore, as a step for future debiasing interventions, we suggest attempting exposure of visualizations on a separate screen, as well as using visualizations based on absolute numbers. In addition to the limitations regarding our intervention, it is worth noting that our experiment is constrained by the sample size, and some relevant participant data, such as previous education, specific work experience, and additional personal characteristics, are not included. Finally, as an additional limitation of our study, the sample size could be mentioned. Sensitivity analysis in G\*Power v3.1.9.2 program with alpha error equals .05, statistical power equals .95 and our sample size of 65 participants revealed that the maximum interaction effect size we were able to detect was  $\eta^2 = .17$ .

Experience is relevant in the context of the differences in approaches to the decision-making problem of experts and those who lack sufficient experience. Scholars found that novices are prone toward integrating and actively searching for additional information to elaborate them, while experts use "Pareto principle" (Hafenbrädl et al. 2016). That makes experts fast, but beginners could learn more from the process, even when motor activities are in question (Dundon et al. 2023). Additionally, Ceschi and colleagues (Ceschi et al. 2019) claim that cognitive ability helps avoid conjunction fallacy and base rate fallacy, but rather than cognitive ability, certain debiasing strategies bare more potential benefits in beating these phenomena.

It was found that there are differences in biasing tendencies and reactions based on personal variables. For example anchoring is more frequent among raters with higher openness to experience, while neuroticism is linked with risk aversion framing. Also, high agreeableness, low conscientiousness, less assertive traits in managers' result in their lenience bias on subordinate's appraisal task (John Bernardin et al. 2016). Even current states of evaluator might incline them toward some specific bias. For example, stress that he or she is experiencing might influence the process (Vanderpal and Brazie 2022). Also, group dynamics might intensify some biases, when discussing about the decision halo effect or polarization (based on the contrast effect) might increase previous position and lead toward less accurate judgment (Palmer and Loveland 2008). In the context of base rate neglect some of these personal predictors, as well as some other rationality measures, might be relevant too and future researches might focus on them.

Secondly, decision making in this experiment, although simulate the real life situations given in narratives and visualized, is artificial situation by default, and might not be the perfect representative of the authentic participants' behaviour. The genuine process of judging other people include reciprocal contact, when the object of observation is not passive and rather adjust behaviour based on feedback, with success that depends of self-monitoring ability.

In conclusion, it is possible to ascertain that the phenomenon of base rate neglect is present in the domain of human resource management. However, our attempt to mitigate it through visual intervention proved unsuccessful. Such a result could stem from the inadequate choice of a pie chart as a visual intervention tool. This, along with the small sample size, can be identified as the primary limitations of the presented study. Future research directions may involve refining visual interventions and exploring additional, diverse strategies for debiasing base rate neglect in the realm of human resource management.

### **Conflict of interests**

The authors declare no conflicts of interest.

### **Author Contributions**

Conceptualization: I. K; Data curation: I. K, M. M; Formal analysis: M. M, I. K; Funding acquisition: I. K; Investigation: I. K, M. M; Methodology: I. K; Project administration: I. K; Resources: I. K; Software: M. M; Supervision: I. K; Validation: I. K; Visualization: M. M; Writing/original draft: I. K; M. M; Writing/review and editing: I. K. All authors have read and agreed to the published version of the manuscript.

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