

ORIGINAL ARTICLE

Psychological biases and heuristics in the context of foresight and scenario processes

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Abstract

This article studies the relevance of psychological biases and heuristics in the context of foresight and scenario processes. Though there is extensive literature studying cognitive mechanisms from the psychological side, discussions on the application of these findings in the foresight context, and more specifically with regard to specific steps of the scenario method, are rare. Some studies focus on a potential debiasing effect of scenario processes and do not examine the role biases and heuristics play during the process. We address this gap drawing from empirical research and practical experience. First, we examine the relevant cognitive mechanisms using a twofold perspective: Can the respective mechanism be an impediment or can it be an enabler within the scenario process? We specify the circumstances under which the respective mechanism occurs and establish its assumed effects. Second, we outline recommendations on how to modify the method to reduce the bias or to take advantage of it, respectively. In summary, we propose that the contextual debiasing effect of scenario processes can be significantly advanced by applying these modifications and a facilitation team that is aware of psychological biases and heuristics. Finally, implications for the scenario method and directions for future research are discussed.

KEYWORDS

cognitive biases, contextual debiasing, foresight, perception filters, psychological heuristics, scenarios

1 | INTRODUCTION

1.1 | Heuristics and biases in psychological research

The study of cognitive mechanisms involved in human decision-making has been a central research topic for psychologists for the better part of the last century and remains in the research focus to date. In the foresight community, these cognitive mechanisms have also started to receive some attention (Bradfield, 2008; Burrows & Gnad, 2017; Chermack, 2004; Hodgkinson, Brown, Maule, Glaister, & Pearman,

1999; Kahneman, Lovallo, & Sibony, 2011; Schoemaker, 1993; Wack, 1985). The term most often associated with this field of study is “biases and heuristics.” Cognitive biases in general describe systematic errors or deviations from norms or rationality in perception, memory, cognition, and judgment (Haselton, Nettle, & Andrews, 2005). Biases are in substantial parts unconscious and often result from the use of heuristics. The term heuristics describes mental shortcuts or simple rules that enable an individual to engage with its surroundings in an efficient way (Zimmer & Fahrenberg, 2014). But they can also lead to the construction of highly subjective images of those surroundings/reality.

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In psychology, very prominent contributions in the field have come from Daniel Kahneman and Amos Tversky, on the one hand, and from the research team around Gerd Gigerenzer on the other hand. Both research collaborations studied the biases and heuristics that come into play when individuals make judgments under uncertainty. Kahneman and Tversky (1979) and Tversky and Kahneman (1981) set out to demonstrate the systematic deviations of decision-making under authentic real-world conditions from hypothetical decision-making according to economic rational-agent models. Those models posit that rational decision-makers strive to optimize their decisions by maximizing the utility of the outcome according to their individual expectations and constraints. Kahneman and Tversky criticized those models and the concept of a completely rational actor ("homo oeconomicus") because their predictions corresponded poorly to the actual behavior of humans they observed in experiments. The group around Gigerenzer aimed at overcoming the conceptual vagueness of the mechanisms proposed by Tversky and Kahneman by formalizing heuristics in a very structured way. They focused on researching under which circumstances these heuristics are actually highly adaptive and functional (Gigerenzer, Hertwig, & Pachur, 2011). They rejected the idea that human cognitive processes are fundamentally flawed, and instead emphasized the ways in which heuristics serve us well in our everyday lives (Gigerenzer & Gaissmaier, 2011; Gigerenzer, Hertwig, & Pachur, 2011; Kahneman & Tversky, 1996). Both research strands, Kahneman and Tversky as well as Gigerenzer and his colleagues, reject the conventional (economic) understanding of rationality and rather correspond to Herbert Simon's concept of "bounded rationality" (Simon, 1978, 1979, 1991). Simon posits that human decision-makers strive to obtain a subjectively satisfying outcome instead of an objectively optimal outcome by taking into account the given internal and external restraints. Whereas, as a whole, the heuristics individuals use can certainly serve as an "Adaptive Toolbox," a term introduced by Gigerenzer and his team, in many contexts they can also become real pitfalls and introduce systematic biases. One of the contexts, that can be critical, we propose, is thinking about the future.

1.2 | Relevance of heuristics and biases when thinking about the future

When moving through the world, individuals constantly draw conclusions, make decisions or infer judgments. Some of these judgments seem insignificant and unintentional, like which parts of the environment to pay attention to, for example which road to choose on a stroll through the city. Others appear to be more deliberate and consciously derived like deciding on a career or buying an apartment. The amount of information an individual is confronted with is infinite. All of this information could be processed, evaluated, integrated, and used in decision-making.

Still, it is impossible to consider all potentially available information because people's mental capacities are limited and they do not have endless resources (such as time, available and accessible

information), especially regarding routine judgments (Newell & Simon, 1972; Simon terms these constraints "search costs," Simon, 1991). Therefore, they use heuristics as strategies for reducing complexity, saving resources, and at the same time achieving robust results that are satisfyingly accurate, although not perfectly accurate. Heuristics are efficient because they are cognitive simplification mechanisms or mental shortcuts that represent abstractions of patterns and rules, which an individual can apply to a given set of stimuli in reality to make their interpretation easier. These rules and patterns (heuristics) are based on evolved (meaning originating from the history of the species) and learned capacities (meaning originating from the history of the individual like socio-cultural context, personal learning experiences, etc.). They make use of prior (often tacit) knowledge and regularities (Brunswik, 1956; Hertwig, Hoffrage, & Martingnon, 1999; Kahneman & Klein, 2009). Therefore, they have an inherent tendency to reproduce known solutions and judgments by, for example, relying only on past events to anticipate future events. However, this is problematic, since for thinking about complex open futures, linear extrapolation and analogous reasoning are not sufficient. For engaging with futures in a meaningful, open way, it is crucial to abandon the familiar patterns of past experiences or anticipatory assumptions, according to Miller. "There is the familiar risk of adopting forecasting methods and models that depend too heavily on what happened in the past" (Miller, 2007, p. 342).

1.3 | Discussion of biases and heuristics in the foresight scenario literature

Nestik (2018) has published a comprehensive discussion on the psychological mechanisms of collective foresight activities. He outlines a variety of cognitive biases and socio-psychological effects that occur during foresight sessions and hinder group reflection in the context of corporate foresight. The heuristics identified by Nestik overlap to some extent with the heuristics we identify as relevant in the context of a more specific process, the scenario approach.

The scenario approach is one of the best-established foresight methods (Bradfield, Wright, Burt, Cairns, & van der Heijden, 2005; Ralston & Wilson, 2006; Schwartz, 1996; Sharpe & van der Heijden, 2007; Spaniol & Rowland, 2018; van der Heijden, 1996), even though there is no shared theoretical background and a huge diversity of approaches exists in parallel. The common understanding is that the scenario approach "provides a systematic process of creating alternative pictures of the future" (Dönitz & Schirrmeister, 2013, p. 15). The basic idea is to provide a method for handling uncertainty, which is always part of futures thinking. Though it is inherent to the approach to try to avoid a simple extrapolation from the past into the future, it traditionally does not explicitly refer to cognitive biases and heuristics. Scenarios are descriptions or images of possible futures. In some cases, these descriptions include full pathways toward these future states other scenarios merely sketch the final state of the system. There are a number of different approaches to scenario development (Bishop, Hines, & Collins, 2007). In the foresight community,

it is an ongoing discussion whether this multitude of approaches mirrors “methodological chaos” and insufficient theory or constitutes the versatility of the method (Spaniol & Rowland, 2018, p. 33). One major point of methodological disagreement, for example, concerns the number of factors to consider, that is, whether to stick to a 2×2 matrix or to include more factors (Ramirez & Wilkinson, 2014; Spaniol & Rowland, 2018). Still, most approaches start by “deconstructing” a system into a set of individual factors of change, then tackle these factors individually by sketching different possible long-term developments (“projections”) and finally reassemble these “factor projections” into different possible future configurations. For this paper, we stick to this minimalistic portrayal of scenario building to make our propositions relevant to as many practitioners and researchers as possible and offer recommendations that are not exclusive to one specific approach. We will refer to the different stages by.

1. “creating the option space” (includes factor selection and generation of future projections),
2. “building scenarios” (includes assessing consistency and reassembling assumptions to scenarios), and
3. “using scenarios” (includes presentation and interpretation of scenarios).

Although some research at the intersection of cognitive biases and heuristics and foresight, and more specifically the scenario method, already exists, discussions on the issue are still scarce and selective. A decade ago, Bradfield (2008, p. 199) pointed out that “there is a notable absence of discussion in the literature on the individual cognitive and group behavioral factors that [...] influence the scenario construction process.” Similarly, Chermack (2004, pp. 303–304) wished for “a series of case studies, or research regarding the specific impact of scenario planning on individual habits of information gathering, synthesis, and decision-making.” These two quotations indicate the two aspects of the relationship between the scenario method and the mechanisms of human cognition that can be examined in more detail:

1. With Bradfield (2008), one could look at the influence of biases and heuristics during the process of constructing scenarios.
2. Taking Chermack’s (2004) perspective, one could consider the effects of the scenario method on the cognitive mechanisms and expect (to some extent) a debiasing effect.

Whereas psychological research achieved immense insights into a large number of biases, their conditions and consequences, it offers no clear guidance on how to overcome or handle these biases (Lilienfeld, Ammirati, & Landfield, 2009). The scenario literature seems to have gone the opposite way: most of the existing studies on the subject propose a debiasing effect of conducting scenario processes regarding the respective bias under discussion; most of them address cognitive mechanisms in very general terms or focus on one specific bias only (Lovallo & Sibony, 2010; see Bradfield, 2008 for a more encompassing consideration of cognitive mechanism). The

ways in which biases can function as barriers during a scenario process, on the other hand, have not yet been addressed in adequate detail. We now summarize the literature on both aspects.

Bryson, Grime, Murthy, and Wright (2016), as a recent example, discuss how scenario processes can help companies to overcome what they call “Business-as-Usual Thinking,” namely, the tendency to concentrate their attention on already familiar parts of their business environment (relating to customers, products, competitors, technologies, and stakeholders; Bryson, Grime, Murthy, & Wright, 2016, p. 195). This can be problematic because it increases the risk of missing important other signs for risks or opportunities from outside the familiar contexts (Schoemaker, Day, & Snyder, 2013). Bryson, Grime, Murthy, and Wright (2016) emphasize the role of the facilitator, who moderates and guides the scenario process, for detecting the participants’ biases and helping to overcome them. We are very much in accordance with Bryson, Grime, Murthy, and Wright (2016) when they argue that overcoming bias is an important aspect of preparing for the future and that the scenario method has the potential to be a powerful instrument for debiasing. Still, the conceptualization of cognitive bias reflected by Bryson, Grime, Murthy, and Wright (2016) is unspecific and it remains unclear which bias is relevant for which step of the scenario process and which consequences it entails. Moreover, the emphasis on the facilitator does not seem convincing. Given that it is the nature of biases to operate unconsciously in substantial parts and to be omnipresent (including the facilitator him/herself), it is insufficient to appoint the task of detecting and addressing the biases of the participants exclusively to the facilitator. Still, an ideal facilitator should have received bias literacy training and, therefore, is aware of relevant biases, their implications and effects, and knows how to counteract or exploit them for the benefit of the process.

Learning from those (in our minds) shortcomings, we propose to tackle the issue by restructuring the scenario process itself according to these two effects: first, to maximize the potential for softening bias. Second, to make use of heuristics and biases as enablers for the scenario process. This, of course, is only possible if specific assumptions about the types of biases involved at every step of the scenario method and their effects are put forward. If the process can be optimized to these effects and conducted in a standardized way, the role of the facilitator should not be as central as Bryson, Grime, Murthy, and Wright (2016) argue. Apart from that, the focus on managers as participants in scenario processes and their respective biases, that one often encounters in the literature (also: Kuhn & Sniezek, 1996; Meissner & Wulf, 2013), might carry misleading notions: for example, that only managers have biases and use heuristics, that they are especially prone to bias or that managers are the most important target group for the scenario method. In fact, these psychological mechanisms are universal, that means they affect every individual person, also laypeople or experts from the fields of research, politics or from socio-cultural contexts who often provide orientation information for decision-makers. Again, addressing these issues in the form of optimizing and standardizing the process improves the method in general and applies to all target groups.

There is more research from the scenario literature discussing how scenarios can soften diverse biases: Meissner and Wulf (2013), for example, showed in an empirical investigation that scenario planning reduces the framing bias. When framing occurs, certain aspects of an issue are selected and highlighted, whereas other aspects are systematically disregarded (Entman, 1993). Frames put an issue into a very specific cognitive context that selectively strengthens one perspective or emphasizes certain aspects of the issue. Framing bias refers to a reversal of preferences depending on the frame that is used: this manifests, for example, in choosing risky alternatives under a frame that emphasizes possible losses and avoiding risk under a frame that emphasizes possible gains. During a scenario process, participants engage with multiple perspectives and therefore multiple frames on a complex issue.

The reduction of the framing bias using multiple frames in a scenario process is also pointed out by Schoemaker (1993). He additionally outlines how scenario planning can counteract other heuristics and biases, such as overconfidence bias and the availability heuristic. Overconfidence bias describes the tendency to overestimate the certainty of predictions. In psychological research (Griffin, Dunning, & Ross, 1990), it has been demonstrated empirically that imagining alternative possible developments reduces subjective confidence in one's predictions. In his paper, Schoemaker (1993) replicates this effect using the scenario method (another replication is available from Kuhn & Sniezek, 1996). Schoemaker (1993) also argues that the scenario method potentially counteracts the availability heuristic, a tendency to overestimate the probability and relevance of information that is easily retrieved from memory. Yet, much like Bryson, Grime, Murthy, and Wright (2016), he discusses the proposed reduction of the effects of the availability heuristic via a scenario process in general terms and the distinctions between different cognitive mechanisms are not always clearly stated. Apart from reducing framing bias, overconfidence bias, and the availability heuristic, scenarios were also discussed as possible remedies against the existence bias (McKelvie, 2013), according to which the status quo is positively evaluated just because it exists. Furthermore, Goodwin and Wright (2001) propose a process to enhance the evaluation of strategies across different scenarios taking cognitive biases and heuristics into account. Rhisiart, Miller, and Brooks (2015) proposed a questionnaire that captures subjective learning experiences related to cognitive biases from participating in a scenario process. As they did not apply pre-post comparisons or control groups though, the evidence is merely descriptive.

Because of their large number, it is nearly impossible to consider every bias that has been identified by psychological research. Additionally, the identified biases and heuristics differ in abstractness, so some of them overlap or can be subsumed under more universal tendencies (for a useful taxonomy of human cognitive tendencies; see Stanovich, 2003). Still, there are more biases that are relevant in the scenario method than the ones that have been looked into by the scenario literature, so far. Though individual mechanisms can be identified, the human mind is not made up of

isolated modules but rather functions in a systemic manner. Many cognitive mechanisms are interrelated and interact with or reinforce each other (Bradfield, 2008). Therefore and intending practical application, it is necessary to consider associated phenomena in context and not just individually.

1.4 | Scope and objective of this paper

The objective of this paper is to make a conceptual contribution by outlining the relevance of selected heuristics and biases in scenario processes. We go beyond the existing research by implementing a more comprehensive overview and by looking at the cognitive mechanisms with a twofold perspective: (a) Can the bias or heuristic act as a barrier in the scenario process? If so, how can it be overcome or how can its effects be reduced? (b) Can the bias or heuristic be advantageous in the scenario process? If so, for which steps is it relevant and how can it best be made use of?

Using this structure, we intend to promote the reframing of the scenario process as a debiasing intervention and emphasize the procedural benefits over the resulting scenarios. Accordingly, we propose improvements of the process design, making our recommendations applicable to any group of participants. In that, our paper also aims to make a methodological contribution that expands the existing literature. It is, though, at the current moment in substantial parts, an exploratory paper presenting tentative findings.

From the vast range of methods used in foresight, we selected the scenario method because of its relevance and popularity within the foresight context and because it is very well suited to demonstrate our considerations and observations. We decided to focus only on biases and heuristics that pertain to individual participants but also discuss some selected phenomena that relate to behavior within groups with specific relevance in the context of scenario development. Nevertheless, the study of social dynamics and interactions is qualitatively different from the study of individual cognitive tendencies and, therefore, deserves further investigation (for techniques improving group decision-making see, for example, Phillips & Phillips, 1993; Schweiger, Sandberg, & Ragan, 1986). In line with our reasoning to focus on features of the scenario process itself, we also do not discuss aspects of the scenario method like the selection of participants or the role of the facilitator or moderator unless they are directly linked to the biases we discuss. In summary, we offer the following propositions:

1. Scenario processes can be used as tools for debiasing (as already shown in some studies, albeit selectively).
2. This debiasing effect results from certain features of the scenario process. It, therefore, can be influenced by manipulating features of the process design.
3. The number of cognitive biases and heuristics involved in the scenario process (and its proposed debiasing effect) exceeds the phenomena that have been discussed in the scenario literature so far. We propose a more encompassing view, considering multiple phenomena in context.

4. To optimize the process in view of biases and heuristics, it must be known which phenomena are relevant at which stages of the process and what effects the respective phenomenon has. In this regard, we make assumptions based on the available research and on practical experience, which can be tested empirically in future research.

2 | OVERVIEW BIASES AND HEURISTICS IN FORESIGHT

The heuristics and biases that are included in this overview are presented in Figure 1. It also illustrates possible interrelations. Positioned at the center is the so-called end-of-history illusion, a tendency to assume that a development is complete at the present moment (Quoidbach, Gilbert, & Wilson, 2013); it results in perceiving the current state as stable and the future as fixed. This, of course, is incompatible with the scenario method, which is based on exploring alternative developments. The end of history illusion, therefore, is a prime example of the relevance of the consideration of cognitive mechanisms and their consequences for judgments in the scenario approach. Still, other mechanisms feed into that illusion. In his article on the subject, Schoemaker (1993, p. 209) points out an interesting observation when he suggests that the scenario method “exploit[s] one set of biases [...] to overcome another set.” In line with this observation, we identified groups of phenomena in relation to the scenario method. One group is already addressed or even taken advantage of by the scenario approach to some extent. It encompasses the general tendencies to avoid uncertainty and favor a single perspective on an issue (ambiguity aversion,

framing bias), heuristics that favor easily recalled information over new or less well-known information (availability and fluency heuristics) and tendencies relating to a heightened sense of subjective certainty (hindsight bias, overconfidence, confirmation bias). Other phenomena, in our opinion, need to be addressed in more elaborate ways than is usually done in the standard scenario process. To avoid potential pitfalls of these biases and heuristics, we point out the critical elements in the scenario process and propose changes accordingly. Within this group of phenomena, we consider the overestimation of relevance and probability (recognition heuristic, neglecting distributional information), distortions relating to individual beliefs and desirability (belief bias, unrealistic optimism), and overgeneralization (halo-/horns-effect, representativeness). Please note that we do not regard this classification as a generalizable model, but rather use it as a tool to structure the discussion of these cognitive mechanisms in the context of the scenario method.

2.1 | The scenario process as a debiasing measure

Of course, the most salient result of a scenario process are the alternative future scenarios that are developed and can be used as a basis for further discussions or strategic decisions. Apart from that we would like to emphasize the more subtle benefits that arise from taking part in a scenario process, referred to as “an instrument of organizational learning by widening individual perspectives, promoting new cognitive models or systemic thinking” (Gabriel, Warnke, Schirrmester, & Dönitz, 2016). We propose that these process benefits of the scenario method are, if applied accordingly, a form of debiasing.

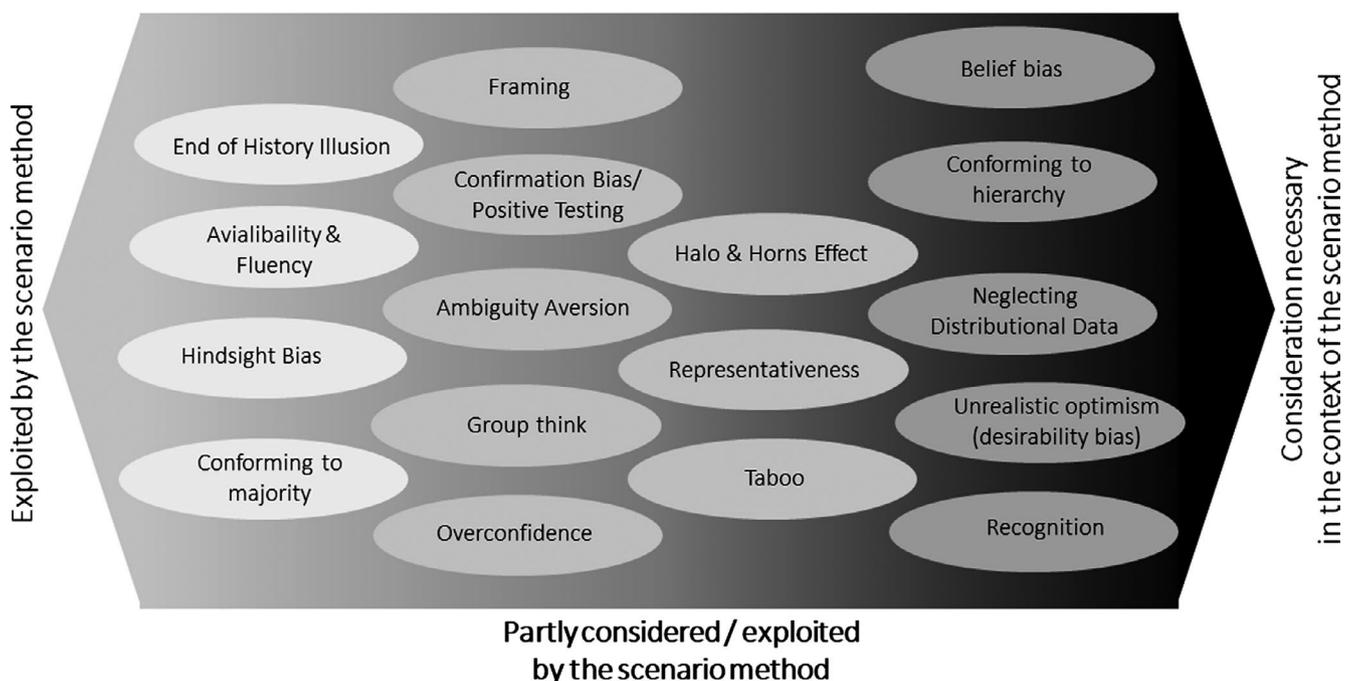


FIGURE 1 Overview of identified relevant biases and heuristics for the scenario method

Table 1 shows all cognitive phenomena we regarded as relevant in the context of the scenario method. The table and the following discussion of selected examples are structured in this way: initially, the respective cognitive phenomenon is described, followed by an example of its effect; then, the relevance of the phenomenon in the scenario method is outlined. Finally, we draw conclusions and give recommendations to optimize the design of the scenario process according to the different steps.

2.2 | Analyzed effects of the most important biases in scenario building

For the detailed discussion, we selected biases that cover different areas of information processing, relating to smoothness of processing, the influence of beliefs on processing, the selection and integration of data, and the interactions within groups.

2.2.1 | Availability/fluency

One very basic human tendency is to judge the probabilities and frequencies using the ease with which adequate instances or examples can be retrieved from memory. This tendency is called the availability heuristic and results in judgments that depend on the content of our memories rather than on objective data (Gigerenzer, 2015; Gigerenzer & Gaissmaier, 2006; Kahneman, Slovic, & Tversky, 1982). Individuals may, for example, remember incidents of plane crashes with many fatalities from media coverage and overestimate the probability to die in a plane crash compared to less available (less spectacular and therefore less often reported on) causes of death (Pachur, Hertwig, & Steinmann, 2012). Regarding expectations about the future, there are also varying levels of availability depending on the individual deliberate confrontation with future perspectives.

Another tendency that goes hand to hand with the availability heuristic is the fluency heuristic. It also concerns using the recall from memory as an indicator of relevance in the given context; unlike the availability heuristic that is concerned with the recall content, fluency relates to the recall process. Information that is easily and smoothly retrieved from memory has an advantage in processing. We discuss these two tendencies together because the concepts are closely linked.

In the scenario method, the focus is explicitly on developing and discussing alternative assumptions and so alternative information should become more available and more easily retrievable. Thereby, scenarios can contribute to leveling out differences in perceived probability or relevance that stem from individual or societally shared mental availability and fluency. A potential hazard relates to judging the consistency of future assumptions in scenario building: combinations of assumptions that subjectively “go well together” or already exist might be more fluent and available. In that way, present-day consistencies might strongly influence the judgment of future consistencies.

Considering multiple alternatives in itself has been discussed as a tool for leveling out differences in availability (Chermack, 2004) and has also been empirically shown to be effective (Hirt & Markman, 1995). Accordingly, there are two ways in which debiasing can help to improve the scenario process: first, leveling out differences in availability and fluency and, second, limiting the influence of subjective present-day consistencies on judging future consistencies. In practice, this translates to widening the content considered in the scenarios to promote the availability and fluency of a-priori less prominent information. At the same time, one should not put further emphasis on the probability and relevance of already highly available and fluent information, but rather argue against it. Concrete steps include avoiding prime examples and clichés, offering data that qualifies or disproves implications of highly available and fluent information, spending equal time and rhetorical effort in presenting and interpreting different scenarios. Second, to limit the influence of perceived present-day consistencies, they should be actively questioned, for instance, by asking for justifications when rating consistencies, reexamining their origins and stability over time or using creativity methods that mix up assumptions randomly that at first sight are attached to each other.

2.2.2 | Representativeness

Psychological research suggests that judgments about probability do not only depend on availability and fluency but among others also on the correspondence of the information to a prototype. Actually, people tend to judge the probability that a case belongs to a certain class as high if the case is very typical of that class, although being representative is not the same as being likely¹. This heuristic is called the representativeness heuristic and is relevant in the context of estimating relationships between objects and categories (Tversky & Kahneman, 1974). It is important to underline that this correspondence or fit stems from a subjective impression and is not determined by statistical truths. In contrast, representativeness as an indicator of probability leads to inadequate consideration of base rates, sample sizes, randomness, or regression toward the mean. The representativeness heuristic in general favors outcomes that merge as expected according to a prototype derived from scripts, schemas, or stereotypes. The subjective representativeness, and thereby the tendency to overestimate probability, is higher for combined events or instances than for single ones, although statistically a conjunction cannot be more probable than the single elements that constitute it (a phenomenon called “conjunction fallacy”: Stanovich, 2003; Tversky & Kahneman, 1983).

In the scenario process, this could be relevant when it comes to judging the consistency of future assumptions: if future plausibilities are evaluated using the intuitions about present-day plausibilities (based on the prototypes). In using and interpreting the scenarios, the representativeness heuristic could result in scenarios (combinations of future projections) that correspond well to a prototype

TABLE 1 Overview of relevant biases and heuristics and associated implications for the scenario process

Description	Effect (example)	Relevance for scenario processes	Implications for scenario process specified according to process phase
<p>Availability (recall content)</p> <ul style="list-style-type: none"> Ease of recall of suitable examples/ instances affects estimations of the probability/frequency of an event Ease of recall serves as a cue for estimating probability and frequency (quantity of recalled examples, concerns memory content) 	<p>Events for which examples are available (in memory; can also be mediated via the media) are judged as more likely</p>	<ul style="list-style-type: none"> Scenario processes can change subjective probabilities by <ul style="list-style-type: none"> Increasing the mental availability of options (with a low a-priori availability) <ul style="list-style-type: none"> Relativizing the judgment of highly available future assumptions Assessment of consistency between future assumptions may be influenced by present-day consistency of combinations 	<p>Creating the option space: factor selection & generation of future assumptions</p> <ul style="list-style-type: none"> Widening considered content: Reflection of dominant future assumptions may reveal limitations of future assumptions and facilitate consideration of a broader range of available futures Prime (textbook) examples should not be overly emphasized Making quantitative data available (may help to reveal overestimations) <p>Building scenarios: evaluation of consistency</p> <p>Structural widening: • Reflection of present-day dominant structural relationships and make alternative combinations of future assumptions more fluid and available</p> <p>Using scenarios:</p> <ul style="list-style-type: none"> Equal presentation of alternative future assumptions; avoid overly complex presentations; use clear and concise language, use metaphors and images to create narratives
<p>Fluency (recall process)</p> <ul style="list-style-type: none"> Processing fluency of an information increases the subjective relevance of that information in a given context Ease of retrieval of suitable examples/ instances from memory (concerns recall process) 	<p>Information that is processed smoothly (high fluidity) is favored in processing</p>		
<p>Representativeness</p> <ul style="list-style-type: none"> Judgments about the likelihood that an instance belongs to a certain class are influenced by the correspondence between instance and class (similarity of an individual instance to the prototypical class) Relevant in the context of estimating the relationship between object and category (e.g., event and process) 	<ul style="list-style-type: none"> Generally favors outcomes that merge as expected (according to prototypes derived from scripts, schemas, stereotypes) Subjective fit between both instances overrides statistical truths No adequate consideration of base rates, sample sizes, random events, regression toward the mean 	<ul style="list-style-type: none"> Consistency analysis: future plausibilities are judged using present-day plausibilities (based on the prototypes) Scenarios (combinations of future assumptions) that correspond well to a prototype are judged as more likely than other scenarios (that do not match the prototype as closely) or single assumptions (plausibility derived from prototypes and enrichment because of combination, see also conjunction fallacy (Tversky & Kahneman, 1983) 	<p>Creating the option space: generation of future assumptions</p> <ul style="list-style-type: none"> Reflect and widen prototypes Make less representative events plausible Contrast multiple (diverging) prototypes <p>Building scenarios: evaluation of consistency</p> <ul style="list-style-type: none"> Minimize impact of prototypes in the process Isolation of individual assessments of plausible combinations, as far as possible (e.g., use software for the merge) Provide data on the past and on the current situation, and take it into account in factor selection as well as in the development of future assumptions (make less representative combinations plausible)

(Continues)

TABLE 1 (Continued)

Description	Effect (example)	Relevance for scenario processes	Implications for scenario process specified according to process phase
<p>Recognition</p> <ul style="list-style-type: none"> Assessing information as relevant in a given context solely on the basis of it being already known (compared to unknown alternatives) Formalized (for alternate pairs): if one of two objects is recognized, but the other is not, then conclude that the recognized object has the higher value on the criterion (Gigerenzer, 2015) 	<p>If there is a lack of correlation between recognition and criterion, the recognition heuristic is not an efficient strategy</p>	<ul style="list-style-type: none"> Systematically lower assessment of the relevance of less well-known aspects due to: <ul style="list-style-type: none"> Media attention, public funding Temporal distance, still far in the future <ul style="list-style-type: none"> Individual professional context "Expert-over-optimism" (high expertise together with availability/fluency and little psychological distance to one's own area (Tichy, 2004): overestimation of the importance of developments in one's own area of expertise (see also "Unrealistic optimism") 	<p>Creating the option space: factor selection</p> <p>Reflection and consideration of the correlation between subjective awareness and relevance in the given context</p> <ul style="list-style-type: none"> Provide a wide range of diverse information to reflect awareness Ensure and use diverse expertise of the participants (covering competing fields) Avoid diversity being lost through consensus Consideration of the correlation between time horizon and awareness
<p>End-of-history-illusion</p> <p>Assuming that a development is completed at the given moment, future without surprise (Quoidbach, Gilbert, & Wilson, 2013)</p>	<ul style="list-style-type: none"> The present is seen as stable and the future is expected to be a linear continuation Selectively remembering aspects of the past that are consistent with the subjective present, for example, autobiographical: memory advantage of aspects of one's own biography, which are compatible with the current self-image 	<p>Developments that deviate greatly from a linear continuation of the current state are systematically neglected</p> <ul style="list-style-type: none"> Strong influence of the assessment of the current situation Option space (variance of the scenarios) is limited Selectivity in recall may enhance this effect 	<p>Creating the option space: generation of future assumptions</p> <ul style="list-style-type: none"> Create distance to the current situation Show subjectivity of the assessment of the current state Demonstrate the plurality of the current assessment and the future expectations Suggest triggers for alternative developments (rationalization of opposites as mode of thinking) Explain about selective recall in human memory Looking back, emphasizing the dynamics of change; reflection of surprising events in the past
<p>Hindsight-bias and unavoidable (Fessel, Epstude, & Roese, 2009)</p> <p>Tendency to see past events as predictable and unavoidable (Fessel, Epstude, & Roese, 2009)</p>	<ul style="list-style-type: none"> The past appears predictable and unavoidable in retrospect (past without surprises) "I-knew-it-all-along" effect (see above for information on selective remembering of pertinent aspects of the past; (Fessel, Epstude, & Roese, 2009) 	<p>Awareness for the hindsight-bias is crucial for openness to consider diverse scenarios</p>	<p>Creating the option space: generation of future assumptions</p> <ul style="list-style-type: none"> Reduction of bias through explicit presentation of diversity and openness of future expectations and their change over time. (e.g., using "old" scenarios) Ask participants to generate reasons for different outcomes (making different alternatives plausible can reduce hindsight bias, Arkes, 1991; Arkes, Faust, Guilmette, & Hart, 1988)

(Continues)

TABLE 1 (Continued)

Description	Effect (example)	Relevance for scenario processes	Implications for scenario process specified according to process phase
<p>Halo-/Horns-effect</p> <p>A known positive (negative) property is used to infer other positive (negative) properties (Asch, 1946; Thorndike, 1920)</p>	<p>Over-generalization of a single feature to an entire feature complex (e.g., a person is judged to be attractive, might also be considered competent, intelligent, honest, etc.)</p>	<p>Process of scenario development:</p> <ul style="list-style-type: none"> ◦ Misinterpretation of a match in valence as consistency ◦ Preferring combinations of factor values with the same valence (with all positive or all negative connotations) ◦ Drafting of pure utopias/dystopias (or “positive” & “negative” scenarios) ◦ Enrichment of the scenarios with distinctive negative/positive features by assumptions with the same valence ◦ “Positive scenarios” attract more attention, for example, in strategy formation (see also unrealistic optimism; Newby-Clark, Ross, Buehler, Koehler, & Griffin, 2000) 	<p>Building scenarios: evaluation of consistency and integrating assumptions</p> <ul style="list-style-type: none"> • Counteract misinterpretation of equal valence as consistency • Isolated consideration of individual combinations promotes differentiated assessment of consistency (asking for explanations in addition to the rating) • Merge individual ratings using software <p>Using scenarios:</p> <ul style="list-style-type: none"> • Breaking overgeneralization in the interpretation of scenarios: • Instruct to think only positive/negative separately regarding a question • Present all scenarios equally well (spend equal time, find adequate narratives and examples)
<p>Belief bias</p> <p>Belief in the truth or falseness of a conclusion influences the evaluation of an argument (Stanovich, 2003)</p>	<p>Important arguments are not sufficiently examined or prematurely rejected (Wack, 1985)</p>	<ul style="list-style-type: none"> • Dismiss pathways for development if conclusion (future situation) is considered outside the scope of possibility • Advantage for pathways where conclusion is considered given (true) 	<p>Creating the option space: factor selection and generation of future assumptions</p> <ul style="list-style-type: none"> • Draw attention to the difference between argument and conclusion • Encourage playful explorative mode of thinking • Enable discursive exchange between participants with diverging future expectations (beliefs in truth or falseness of different conclusions)

(Continues)

TABLE 1 (Continued)

Description	Effect (example)	Relevance for scenario processes	Implications for scenario process specified according to process phase
<p>Unrealistic optimism/optimistic bias</p> <p>Overestimation of the probability of pleasant (subjectively desirable according to individual interests) and/or underestimation of the probability of unpleasant events (in relation to objective indicators and/or concerning the in-group vs. an out-group, e.g. Armor & Sackett, 2006; Carroll, Sweeny, & Shepperd, 2006; Krizan & Windschitl, 2007; Newby-Clark, Ross, Buehler, Koehler, & Griffin, 2000)</p>	<p>Risks of another (comparable) person or out-group for negative events (e.g., be identified with a virus) is rated higher than own or in-group risk</p>	<ul style="list-style-type: none"> Scenario process: <ul style="list-style-type: none"> Future assumptions that are undesirable from a personal perspective are less likely to be included in the scenarios Using scenarios <ul style="list-style-type: none"> Scenarios that are desirable for a person are overvalued in terms of their relevance "Negative" scenarios are hard to accept; strategies are built upon scenarios with desirable implications Systematic underestimation of risks; risks are not taken into account adequately in strategy building Experts exhibit unrealistic optimism (Tichy, 2004), the tendency correlates with subjective level of expertise (Kruger & Dunning, 1999) 	<p>Creating the option space: factor selection and generation of future assumptions</p> <ul style="list-style-type: none"> Discuss as "thought experiment" to avoid rejection Diversity of participants with different ideas about desirable futures Reflection of undesirable events in the past <p>Building scenarios: evaluation of consistency and integrating assumptions</p> <ul style="list-style-type: none"> Integration of all assumptions (also less desirable ones) when constructing the scenarios if possible Develop scenarios that involve both desirable and undesirable developments <p>Using scenarios:</p> <ul style="list-style-type: none"> Strengthen motivation to engage with potentially threatening events Promote the development of resilient strategies (applying to multiple scenarios) rather than assessing probabilities and focusing on one or two scenarios Question seemingly unambiguous valences, think through consequences Think only positive or only negative regarding a question; change perspectives (e.g., Thinking Hats method)
<p>Overconfidence</p> <ul style="list-style-type: none"> Overestimation: tendency to overestimate one's ability, performance, level of control Over-precision: tendency to overestimate the accuracy of a prediction (e.g., actual accuracy of 78% at 100% subjective certainty, Moore & Healy, 2008) 	<ul style="list-style-type: none"> Objective marginal utility of additional information decreases, whereas subjective certainty continuously increases In judgment tasks usually new information is only substantially helpful up to a certain amount; from that point on, the accuracy of a prediction barely increases with additional information, while confidence in the correctness of one's own prediction continues to grow 	<ul style="list-style-type: none"> Overconfidence regarding subjectively expected developments/scenarios counteracts openness to alternative developments/scenarios. In a scenario process, the objective is not to achieve accurate predictions but to capture the space of possibilities; this corresponds to an "expansion of confidence intervals" (Griffin, Dunning, & Ross, 1990) 	<p>Scenario process overall</p> <ul style="list-style-type: none"> The notion of correct predictions (accuracy of a scenario) must be counteracted Emphasize the objective of capturing the space of possibilities, mode of thinking in alternatives Show the variance of developments in the past and reflect on surprising events from the past

(Continues)

TABLE 1 (Continued)

Description	Effect (example)	Relevance for scenario processes	Implications for scenario process specified according to process phase
<p>Confirmation bias/ Positive testing</p> <ul style="list-style-type: none"> Confirmation bias Information is selectively perceived/remembered and interpreted according to one's expectations Sources of potentially disproving information are avoided Positive testing Strategy of information search mainly within the a-cell of a contingency table (focal event and assumed condition present) Salient events have an advantage in consideration of information (occurrence of an event is more noticeable than its absence) Also, tendency to "test" existing hypotheses in such a manner that a "yes" response confirms the hypotheses 	<ul style="list-style-type: none"> Confirmation tendency instead of searching for refuting evidence (falsification) Polarization of opinions, for example, in-group discussions with initially known differences of opinion, even when evaluating arguments contradictory to own opinion Illusory correlations (Stanovich, 2003) 	<ul style="list-style-type: none"> Falsification does not play a major role in scenario processes. Exception: apparent consistencies might falsely appear as mandatory combinations and limit the space of possible options Positive testing for alternative developments can be exploited in generating the scenarios (alternative hypotheses) By allowing for alternative hypotheses (scenarios) different aspects can be considered "confirming evidence" for different scenarios; thereby, overall more information can be integrated using alternative scenarios than when sticking to one hypothesis (one expectation for the future) 	<p>Building scenarios: evaluation of consistency</p> <ul style="list-style-type: none"> In the case of apparent consistency asking for counterarguments might be beneficial to avoid <p>Using scenarios</p> <ul style="list-style-type: none"> Confirmation bias/positive testing is already taken up by the scenario approach (scenarios serve as "hypotheses" that participants or users "confirm") Scenarios counteract the consolidation of a single vision of the future or polarization of differing expectations (conceptually the scenario method challenges to consider alternatives, Wack, 1985)
<p>Neglecting distributional data</p> <ul style="list-style-type: none"> Distributional data tend to be neglected Assessments are often based on information about one element of a class rather than knowledge about comparable cases of the general class 	<ul style="list-style-type: none"> Overestimating the significance of single opinions (based on isolated incidents) 	<ul style="list-style-type: none"> Information about individual cases can be used to generate future assumptions through an explicit overvaluation, generalization, or transmission Changes that happen distributed or slowly rather than as a single event are more difficult to capture and receive little attention in scenarios 	<p>Creating the option space: factor selection and generation of future assumptions</p> <ul style="list-style-type: none"> Search explicitly for "gradual changes in the width" Information about individual cases can be used as inspiration for generating future assumptions
<p>Ambiguity aversion/ Prospect Theory</p> <ul style="list-style-type: none"> Uncertainty is generally experienced as an aversive state (little available knowledge, missing, indistinct, or ambiguous information) Prospect Theory: tendency to avoid risks regarding potential gains; tendency to seek risks regarding potential losses (Kahneman & Tversky, 1979) 	<p>People seldom choose alternatives with uncertain outcomes, if alternatives with secure outcomes are also available</p>	<p>Possible risk: fundamental rejection of the scenario approach due to ambiguity aversion</p>	<p>Scenario process overall</p> <ul style="list-style-type: none"> The scenario process is fundamentally suitable for building ambiguity tolerance Tendency for risk aversion or risk seeking can be mitigated by scenarios (reframing using context scenarios) Select participants with high certainty regarding their field of expertise and thus can tolerate the ambiguity created by scenarios more easily Establish a clear distinction between context scenarios and strategies

(Continues)

TABLE 1 (Continued)

Description	Effect (example)	Relevance for scenario processes	Implications for scenario process specified according to process phase
<p>Framing</p> <ul style="list-style-type: none"> • Communication strategy, that selectively strengthens selected aspects of an issue, while disregarding others • Framing-bias refers to a distortion in line with the frame (Entman, 1993) 	<p>Selective strengthening of one perspective on an issue; often implication of causal attributions and moral judgments</p>	<p>Creating alternative visions of the future, can be interpreted as reframing an topic using multiple perspectives</p>	<p>Scenario process overall</p> <p>Take advantage of the scenario approach to foster multiple perspectives on an issue and to break up the dominance of single frames</p>
<p>Conforming to majority & Groupthink</p> <ul style="list-style-type: none"> • Self-censoring of opposing opinions within a group • Focus on supportive arguments leads to high confidence and extreme positions and decisions 	<p>Distorted evaluation because of one-sided arguments leads to risky decision. Decisions can be even more extreme than all individual group members would have supported</p>	<p>The scenarios are usually discussed within small working groups. Group think can occur within these groups, but since the groups are only established for a short time no extreme groupthink is expected</p> <p>Scenario processes require the conscious discussion of alternative developments and are therefore a countermeasure against groupthink within an organization</p>	<p>Building and Using Scenarios</p> <p>To foster immersion into a scenario and to overcome the end of history illusion groupthink can be useful</p> <p>Scenario process overall</p> <p>Being forced to think in alternatives is a measure against groupthink. The involvement of external participants and changing discussion groups support the breakup of groupthink</p>
<p>Conforming to authority</p> <ul style="list-style-type: none"> • Opposing opinions and alternative ideas to the one expressed by a person of higher hierarchy within an organization are suppressed 	<p>Diversity of ideas and opinions is reduced. Relevant arguments and ideas are not considered during a strategy or decision process</p>	<p>Group discussions and brainstorming sessions are a relevant element of scenario processes. The aim is the take up of diverse future perspectives of all participants regardless of hierarchy and implicit prohibition of specific topics</p>	<p>Creating the option space: generation of future assumptions</p> <ul style="list-style-type: none"> • Create distance to the current situation and hierarchy • Demonstrate the plurality of the current assessment and the future expectations • Suggest triggers for alternative developments (rationalization of opposites as mode of thinking) • Encourage playful explorative mode of thinking <p>Appreciate diverse and extreme perspectives</p>
<p>Taboo</p> <ul style="list-style-type: none"> • Implicit prohibition of specific topics by social custom or a protective measure 	<p>Something is not acceptable to say, mention or do. It is possible that the existence of taboos prevents important topics to be put on the agenda and be addressed adequately</p>		

being judged as more likely than other scenarios (that do not match the prototype as closely) or single assumptions (if plausibility is derived from prototypicality combined prototypical events appear enriched; this might lead to the conjunction fallacy like for example “a future with sustainability and wealth” as a prototypical utopian future scenario).

To reduce the impact of prototypes in the scenario process in general (often implicit), prototypes should be explicitly addressed, reflected upon, and questioned. It might be helpful to contrast diverging prototypes. For factor selection and development of future projections, data on the past and on the current situation that disconfirms assumed prototypes can be provided and taken into account. When judging consistency, the assessments of combinations of future assumptions should be done isolated in pairs. Also, it should be emphasized that the standard for judging consistencies should be plausibility instead of correspondence to a prototype. Besides adequate instructions, participants can be cued to engage in plausibility-oriented assessments by asking for explanations in addition to the mere ratings.

2.2.3 | Halo-/Horns-effect

Another bias that we identified as relevant is the halo- or horns-effect. It refers to the tendency to overgeneralize a known positive or negative property using this information to infer other positive or negative properties (Asch, 1946; Thorndike, 1920). Single known features can influence the evaluation of an entire feature complex (like, e.g., a person that is judged as attractive might also be considered competent, intelligent, honest, etc.).

In scenario development, this could result in misinterpretation of a match in normative orientation as a high consistency so only factor combinations with the same normative orientation would be judged as consistent and selected for scenario development. This might add up to entirely positive or entirely negative scenarios (utopia/dystopia scenarios), an outcome that is not expected in exploratory scenario building where scenarios should reflect plausible and consistent combinations with both positive and negative elements depending on actor perspectives. In interpretation, this tendency can be relevant when scenarios that encompass mainly positive or negative features are *ex post* enriched with details. In this step, the halo- or horns-effect would lead to a biased selection of details with a matching connotation so scenarios would tend to become even more dominated by either positive or negative elements.

In the process design, this tendency should be counteracted, for instance, by distinguishing between a match in normative orientation and a high consistency. To avoid “piling up” of all assumptions with a negative connotation in one scenario and all assumptions with a positive connotation in another, future assumptions should always be considered in pairs only. Isolating the individual combinations promotes a differentiated assessment of consistency concerning the respective pairs because it demands absolute instead of relative judgments. Giving a justification for each rating

should be mandatory. On the one hand, this instruction discourages entirely intuitive judgments, which are more prone to the influence of matching or mismatching value orientations compared to more deliberate ones. On the other hand, it allows for greater traceability and comprehensibility in retrospect when constructing the different scenarios. Furthermore, the merging of the individual judgments of consistency into scenarios should be supported by software or other rigorous structuring devices. When interpreting scenarios, for instance for strategy building, groups should be instructed to separately think positively and negatively regarding each scenario to identify opportunities or potential hazards in all scenarios and prevent overgeneralization of single assumptions within a scenario.

2.2.4 | End of history illusion

People also have a tendency to underestimate future changes, a phenomenon called the end-of-history-illusion. Usually, this phenomenon describes a personal “future without surprises,” that means that individuals underestimate how much they will personally change in the future in terms of traits, interests, taste, etc. (Quoidbach, Gilbert, & Wilson, 2013). Generalized from the area of personal development and preferences it can be interpreted as the assumption that a development is complete at the given moment. On that basis, the present seems stable and the expected future resembles its linear continuation. The end of history illusion is also strengthened by the way the human memory functions, by selectively remembering aspects of the past that are consistent with the subjective judgment of the present state.

If the current state is perceived as stable, assumptions about the future are very much determined by the assessment of the current state. This limits the potential space for future developments that are imaginable and biases it toward the subjective status quo. Developments that deviate greatly from a linear continuation of the perceived current state might be neglected systematically and only scenarios on the basis of different growth rates (low, medium, and high) are developed, also called baby-bear, momma-bear, and papa-bear scenarios (Miller, 2007).

One possibility to confront this tendency is to create some psychological distance to the evaluation of the current situation by questioning the subjective certainty. Concrete measures can be emphasizing the multitude of different perspectives and opinions represented by the participants (if indeed there is a multitude of opinions present) or suggesting possible triggers for diverging developments and provoke participants to reconsider (e.g., use of ambiguous or contradicting quantitative information, discussion of wildcards). Educating about the phenomenon and explaining about the selective nature of human memory might also be helpful. Psychological research suggests that regarding individual development it is easier to acknowledge changes of the past self, compared to expect changes of the future self (Quoidbach, Gilbert, & Wilson, 2013). It might therefore also be a good strategy to look back on surprising developments in the past and illustrate the dynamics of change in

that way. Then, this mindset can be translated onto the present and future. By demonstrating the variety and uncertainty regarding the past and present, the option space for future developments and therefore the future assumptions created by the participants might also increase in variety (Warnke & Schirrmester, 2016).

2.2.5 | Neglecting distributional data

Whereas the biases and heuristics discussed so far influence which information is typically preferred in processing, it is also important to consider the properties of human information search. When looking at which information sources people use, one can observe a tendency to over-weigh the significance of single cases and to under-weigh the information provided by distributional data². Assessments are often based on information about single elements of a class instead of on knowledge about the class in general (Gigerenzer, 2015).

In the scenario process, on the one hand, this tendency can be taken advantage of using single cases as inspiration for generating future assumptions and explicitly overvalue, generalize, or translate them to other areas. On the other hand, it can skew the process to one extreme or polarize discussions if experts overgeneralize and rely on few, extreme examples (e.g., isolated incidents of car sharing interpreted as a "sharing economy") and possibly disregard their status as exceptions rather than rules. By mainly considering information from prominent cases, changes that are more subtle, because they happen distributed and slowly instead of concentrated and quickly, might go undetected or be disregarded in the scenarios. For the design of the scenario method, it should be emphasized that both sources of information can complement each other. First, the use of information about significant singular cases as inspirations and creativity boosters for generating bold future assumptions should be maintained. Second, the search for more gradual changes that happen in a distributive way should be fostered, like by illustrating their significance over longer terms or quantities (e.g., using the metaphor of "steering the ocean liner one degree").

2.2.6 | Group biases

Linked to the well functioning of teams are several phenomena that favor the members of one's own group (the in-group) over non-group members (the out-group) and support social conformity within the group. Germar, Albrecht, Voss, and Mojzisch (2016, p. 10) have shown that "others' decisions can cause individuals to selectively process stimulus information supporting these decisions, thereby inducing social conformity. This effect is present even when individuals do not blindly follow the majority but rather increase their attentional resources and carefully process stimulus information." When generating scenarios, it is particularly important to express and take up diverse assumptions about the future and this should therefore be supported by the process, for example, by inviting experts with

diverse backgrounds and by asking participants to write down ideas individually before the group discussion starts.

Groupthink describes a phenomenon of self-censoring diverging opinions when a group is focusing on getting consensus no matter how it was formed (Montibeller & von Winterfeldt, 2018). This can lead to group discussions that focus exclusively on supporting arguments during the scenario process. This phenomenon can be used to enable groups to immerse into a scenario and to overcome phenomena that impede to imagining change and transformation. Groupthink and conforming to majority can result in people with initially opposing ideas about the future discussing possible scenarios in a constructive and harmonious way. At the same time, it is necessary to avoid extreme distortion during the evaluation of possible developments.

On the other hand, conforming to authority or hierarchy is a group phenomenon that should be avoided or reduced as much as possible at any stage of the process. Facilitation can successfully counteract this phenomenon. In addition, splitting groups up into multiple small working teams with changing members can be an effective counter measure. In general, debiasing interventions for group biases require experienced facilitation and the inclusion of multiple experts with diverse disciplinary and organizational backgrounds as well as a structured process that supports individual consideration and expression of opinions before group discussions take place (Montibeller & von Winterfeldt, 2018).

Another phenomenon that appears within social groups is the emergence of taboo topics, meaning an implicit prohibition of even mentioning certain topics. By enabling a discussion about hypothetical developments in a distant future, participants often feel more comfortable to bring up and discuss taboo-topics. The facilitators should be trained to recognize possible taboos. They can encourage the participants to discuss extreme events and assumptions. In addition, external participants and playful elements within the process are useful in this respect.

Summarizing the results of the table, it is striking that most measures for debiasing are linked to the phase of creating the option space and several of these measures have to be considered already upfront, when preparing a scenario process. One of the most powerful measures to counteract several biases seems to be the interaction of experts with diverse expertise and contrary beliefs. Only if throughout the scenario process consensus building is avoided, while a playful explorative mode of thinking is created, the process benefits are maximized. The balance between looking for contrast and opposites while ensuring a constructive process might be supported by creating a distance to today and instead creating a link to diverse futures. Specific measures assigned to the different steps of the scenario process are summarized in (Figure 2).

To ensure that the interaction of the participants can develop in this way, it requires facilitation by at least two people, extensive experience in moderating group discussions and facilitation of scenario processes, and furthermore knowledge and awareness of cognitive heuristics and biases. This is a prerequisite for being able to support the exploitation of cognitive heuristics and the detection

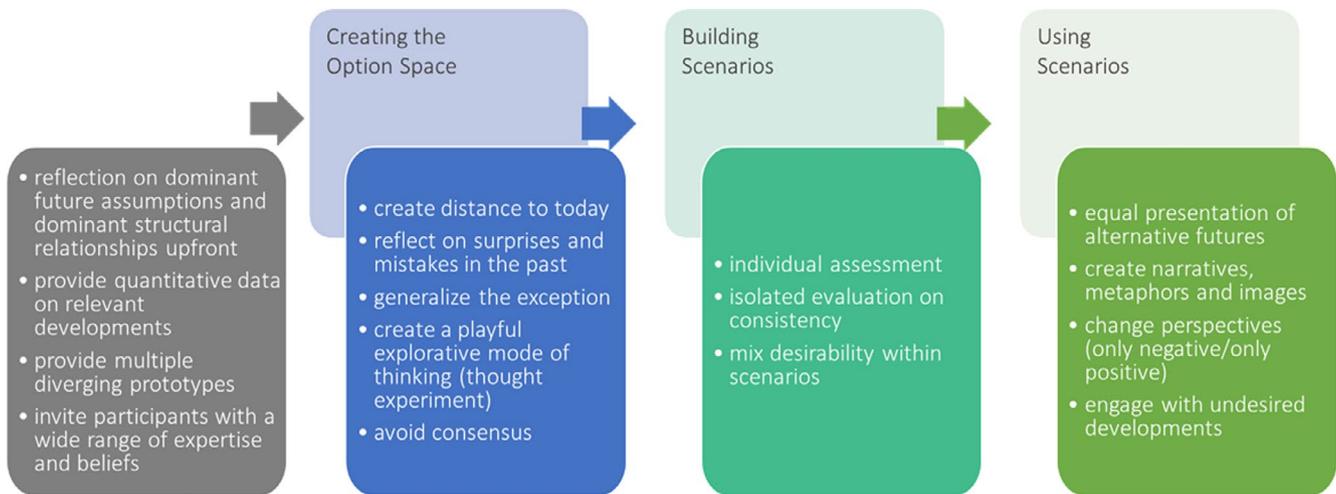


FIGURE 2 Selected measures during the scenario process

of hindering biases. A facilitator can intervene, for example, by explaining certain biases and heuristics, by dissolving working groups and by introducing appropriate additional steps during the scenario process. Scenarios that have been developed in such an interactive, participatory way may suffer from rejection by people who have not been involved in the scenario process. To avoid the instant rejection of the scenarios by external people, the scenarios might comprise mixed values and beliefs within each scenario.

3 | CONCLUSION AND OUTLOOK

Humans are not perfectly rational creatures. They rely on heuristics or intuition based on associative processes. This enables them to decide efficiently but also makes them prone to systematic errors (biases). In foresight, it is crucial to avoid mere extrapolation of current day associations based on experience of the present and past. Hence, tackling systematic errors or biases, that is, finding ways to debias judgments, is especially relevant for our field. Simultaneously, cognitive heuristics offer possibilities to inspire collective intelligence, creativity, and the immersion into diverse futures.

In this article, we aimed to demonstrate this, taking the highly pertinent example of the scenario method. The investigation revealed the high suitability of this choice, since on the one hand, the scenario method addresses many biases by its very nature (like framing bias, ambiguity aversion, bias resulting from availability/fluency, hindsight bias, overconfidence) or makes use of them (like confirmation bias, group think, conforming to majority). On the other hand, the method can be modified to better correspond to other potential biases (such as bias resulting from recognition heuristic, belief bias, desirability bias, halo-/horns-effect, bias resulting from representativeness heuristic). Other biases (e.g., heightened subjective significance of information about singular over distributional data) should be both, taken advantage of at certain points in the process (like as inspiration for generation of future assumptions) and reigned in at

others (e.g., in factor selection, to avoid subtle changes with important consequences to go unnoticed).

We laid out the biases we judged as highly relevant for the scenario method, described their effects and relevance for the approach, and suggested possible remedies. We demonstrated that addressing specific biases improves specific steps of the scenario method (Figure 2), and thereby leads to an overall optimization and offers practical guidance on how to improve the method. By applying the proposed modifications, a genuine additional value of scenario processes can be achieved that exceeds the unspecific debiasing effect that is inherent to scenario processes. On the basis of the transfer of the available empirical evidence as well as our experience, we recommend the proposed modifications, because they improve the process overall, while also being practicable. We also recommend that biases literacy of the facilitators of such processes is a precondition for the effective consideration of cognitive biases and heuristics. Yet, the exact contribution of each modification to the improvement of the debiasing effect of the scenario method remains to be demonstrated empirically.

A framework that takes into account biases and heuristics can also contribute to the discussion of methodological design choices. One can argue that regarding the debate over whether to stick to a 2×2 matrix or to include more factors (Spaniol & Rowland, 2018), from the perspective of biases and heuristics it might be beneficial to include more factors, to foster multidimensional thinking and to avoid very schematic scenario seeds, that might be prone to enrichments along prototypes or according to matches in subjective valence or normative orientation.

Using software for consistency checks can also contribute to debias the scenario method, though we propose one important condition: the software should be designed to not only uncover scenarios that focus on projections that reinforce each other and thereby reproducing biases themselves (which may be even less reflected than “human bias,” for it is formalized in software and reproduced with the authority of the machine as a seemingly objective judgment). Instead, a software for merging future projections should be

crafted in such a way that the resulting scenarios also allow for future projections that do not reinforce each other (Dönitz & Schirrmmeister, 2013). There are several software options in use, but many are either for own use only or commercial products with limited adjustment possibilities (e.g., *Parmenides Eidos* or *Inka 4*).

The prevalence of bias in human cognition is well studied and there is some insight into contextual debiasing strategies but less insight into cognitive debiasing strategies. While contextual debiasing strategies seek to affect the heuristics at use in a specific situation or context, the more general cognitive debiasing strategies seek to improve the way people reason directly. Even though developing scenarios is not always linked to a specific decision-making process, the existing research in the field of contextual debiasing in a decision-making process should be considered.

Contextual debiasing strategies that affect a specific decision-making situation have been implemented and tested. They typically include checklists, slowing down or pausing decision-making processes and consider-the-alternative-stimuli (Bolz, 2015; Correia, 2018; Hirt & Markman, 1995; Kahneman, Lovallo, & Sibony, 2011b; Kahneman, Rosenfield, Gandhi, & Blaser, 2016). We assume that the evidence for positive effects of debiasing strategies for specific decision-making process also apply to the spelled out scenario method. It remains unclear whether the debiasing effects of a specific scenario process can also be extended and transferred to other decision-making processes and can improve the way people reason apart from the specific scenario process when considering alternative futures.

One broad-spectrum intervention to tackle bias might be to foster metacognitive reflection. In the scenario process, participants can be educated about biases and heuristics and encouraged to engage in metacognition to interrupt automatic processes or reconsider intuitions. Yet, if biases occur unconsciously, to monitor one's own thoughts, to identify bias and then to counteract it, seems to be a very difficult endeavor. It requires immense metacognitive effort and high introspective skills. It is much easier to detect fallacies in other peoples' reasoning than it is to detect them in oneself. Because the scenario method is a group-based approach, this can be taken advantage of by encouraging "a culture in which people watch out for one another as they approach minefields" (Kahneman, 2012, p. 418). When people identify and compensate each other's blind spots, the multiplicity of biases can be exploited. In this respect, the facilitators play a particularly important role. Since they can not only observe and intervene when necessary, but in addition, they can empower and encourage the group to do so. The scenario method lends itself nicely to this mode of engaging because the objective is explicitly not to make accurate predictions or forecasts. Therefore, no real mistakes are possible and biases can become subject of discussion in a non-threatening context.

Still, even if it is possible to identify biases (by observing them in others instead of oneself in a non-threatening context), addressing each individual bias, for example, specific prior beliefs participants hold, is not feasible. It is much more practical to conceptualize the process in such a way, that all relevant biases are attenuated via updating "intuitions," for instance, by

adding available information or forming new associations that are suggesting different causal relationships. It might be a pathway for future research to investigate whether this update is permanent and has a lasting debiasing effect on participants' thinking. Further research is required to give insights to the debiasing effect of scenario processes, for example by conducting in-depth interviews with participants before and after a scenario process. In addition, research on the effects over a longer period of time would be of interest, aiming at the optimization of a continuous engagement with scenarios and foresight.

Striving for high diversity of perspectives represented in the workshop group might promote the different biases to partially level out each other. While using a group-based approach brings these benefits relating to bias, it is also associated with an array of group based biases that one should consider.

An interesting area for further investigation is the question, whether it is possible to determine the most dominant biases and heuristics within specific groups or organizations and extract specific biases- and heuristics-profiles for these groups. For innovation management, such an analysis would be helpful to develop customized debiasing measures that can counteract the most relevant distortions in decision-making processes during early phases of innovation management or under uncertainty in a more general way.

We hope this article can be a contribution to both, using the scenario approach as a specifically adjusted debiasing intervention to improve the capability to actively handle uncertainty, thereby promoting "Futures Literacy" (Miller, 2015) and also to deepen the exchange between psychology and foresight.

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NOTES

¹ For games of chance, for example, most people will intuitively judge a sequence of events that appears to have an inner structure (e.g., sorted events) as less likely than a sequence without an apparent structure. Both have the exact same likelihood of occurrence, but one option better corresponds the prototype of randomness—see Stanovich (2003).

² This bias arises if the integration of the information about the specific event and information about comparable events fails: for example, a teacher who relies on one extreme achievement to predict a student's success. The failure consist in matching prediction to impression without considering predictability. Under high uncertainty (low predictability), distributional data are much more reliable for predictions than data based on single events (Kahneman, Slovic, & Tversky, 1982).

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