THE AWARENESS OF BIAS SUSCEPTIBILITY AND INDIVIDUAL BIAS BLIND SPOTS IN MANAGERIAL DECISIONS

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ABSTRACT

This article explores managerial decision styles as potential predictors of individual bias awareness and bias blind spots. A survey with 500 C-1 level managers from Forbes 2000 companies also provides a ranking of the most prevalent perceived cognitive biases in managerial decisions. The results show that the awareness of one's susceptibility and the bias blind spots are highly different depending on an individual's decision style and type of cognitive bias. Decision makers with a strong tendency towards a rational or spontaneous decision style see themselves as less vulnerable to cognitive biases, but also show a much stronger bias blind spot than those with the tendency towards other decision styles. On the other hand, decision makers with a strong tendency towards an intuitive decision style tend to recognize their own vulnerability to cognitive biases and show even a negative blind spot – thus seeing themselves more flawed by cognitive biases than others. As a result, the individual decision style may serve as a predictor for one's own susceptibility for cognitive biases and bias blind spots.

KEYWORDS

Cognitive Biases, Bias Blind Spot, Decision Styles, Bias Susceptibility

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INTRODUCTION

Since the seminal work of Kahneman and Tversky (1974) the influence of cognitive biases on decision making in general and managerial decision making specifically has been recognized by various scholars (Hodgkinson & Clarke, 2007; Kahneman, Lovallo, & Sibony, 2019; Kahneman, Slovic, & Tversky, 1982; Powell, Lovallo, & Fox, 2011; Schwenk, 1984). Cognitive biases are systematic and non-random deviations from rationality in decision making (Das & Teng, 1999). More than 180 documented cognitive biases have the potential to negatively impact managerial decision making (Eppler & Muntwiler, 2021). While the concept of cognitive biases is well established in judgement and decision-making studies, and the cognitive mechanisms that lead to biases are well described in the literature, a question remains wide open: How aware are managers of these flaws? Do they recognize biased decision-making behavior? Or do individual bias blind spots prevent the recognition of these thinking errors in actual decisions, making it harder to mitigate the influence of cognitive biases on managerial decision making?

Our research thus aims at exploring the awareness of susceptibility and bias blind spots of managers. In this study, we combine two perspectives, the individual awareness of biased decision-making behavior in managerial decisions, and the individual bias blind spot (i.e., seeing the risk of a bias in others, but not in oneself). In addition, we use the concept of decision styles to analyze whether specific ways of making decisions correlate with the bias awareness of managers (and their bias blind spots). The results provide research and practice with insights about potential gaps in the awareness of crucial cognitive biases and enable to

draw a “risk map”, helping individuals to identify their risks in bias awareness based on their individual decision style.

Existing research has focused mainly on two perspectives. The first one is a decision-process and result oriented perspective recognizing the role that cognitive biases play in managerial decision making (Barnes, 1984; Bazerman & Moore, 2009; Das & Teng, 1999; Kahneman et al., 2019; Montibeller & Winterfeldt, 2015; Schwenk, 1984). The second perspective highlights the psychological foundations of cognitive biases in decision making helping to understand why cognitive biases flaw the decision process of individuals and groups (Arkes, 1991; Oreg & Bayazit, 2009; Stanovich & West, 1998; Stanovich et al., 2016; Tversky & Kahneman, 1974). To support the growing need for academic research on cognitive biases with an impact for practice (Brooks, Curnin, Owen, & Bearman, 2020) these two perspectives need to be integrated: “Although knowledge of such biases may help to understand specific behavior, it provides only limited help to overcome such biases” (Hutzschenreuter & Kleindienst, 2006: 707). Integrating both research perspectives may provide a basis for practitioners to identify specific bias-risky situations, personality profiles or configurations, as well as settings that are conductive to decision biases (Bruine de Bruin, Parker, & Fischhoff, 2020). The recognition of one’s susceptibility (or the recognition of a blind spot for one’s susceptibility) to cognitive biases serves as a foundation for corrective debiasing precautions.

As Kreilkamp, Schmidt, and Wöhrmann (2020) show, the application of debiasing techniques in companies helps to reduce the prevalence of cognitive biases. But to applicate specific debiasing techniques in managerial practice managers first must understand their own susceptibility to cognitive biases in their management decisions. The understanding of individual differences in the awareness and susceptibility to cognitive biases is considered as crucial for the mitigation of these biases in a professional environment (Berthet, 2022), especially as “individual differences have been largely neglected in this endeavor” (Berthet,

2021: 3). Thus, “the exploration of individual differences in cognitive biases can also help us understand how susceptible people are to the individual decision biases” (Aczel, Bago, Szollosi, Foldes, & Lukacs, 2015: 1), and – as a result – enabling the elicitation (Gertner, Zaromb, Schneider, Roberts, & Matthews, 2016) and the evaluation of the individual susceptibility (Sklad & Diekstra, 2014) to cognitive biases. .

Existing research showed the influence of cognitive ability and thinking dispositions on individual decision making (Bruine de Bruin et al., 2007; Stanovich & West, 1998; Stanovich et al., 2016; Toet et al., 2016) and the role of personality traits to explain the susceptibility to specific cognitive biases (Ahmad, 2020; Bergers, 2021; Caputo, 2014; Dewberry, Juanchich, & Narendran, 2013; Durand, Fung, & Limkriangkrai, 2019; Fujino et al., 2016; Gertner et al., 2016; Toet et al., 2016; Zelenski & Larsen, 2002).

In this article we focus on managerial *decision styles* as potential predictors of individual bias awareness and bias blind spots with the potential to raise the susceptibility to certain cognitive biases. Decision styles are the individual, habitual, and characteristic patterns and modes people use to take decisions (Scott & Bruce, 1995). These patterns can be evaluated by specific tests to measure the decision-making preferences (Spicer & Sadler-Smith, 2005).

Our results show a surprising outcome: The awareness of one’s susceptibility and the bias blind spots vary greatly depending on the individual decision style and type of cognitive bias. The self-reported awareness of cognitive biases (described in a specific flawed behavior) shows significant discrepancies by comparing different decision styles; as does the analysis of bias blind spots: The participants did not only show a significant bias blind spot overall, but also significant differences in the blind spot per each analyzed cognitive bias and per individual decision style. Before we present these results in more detail, we will briefly review the theoretical background of our study as well as its design and scope.

THEORETICAL BACKGROUND

The Awareness of Susceptibility to Cognitive Biases

Toet et al. (2016) provide an overview of research on individual characteristics that may predict cognitive biases in decision making. Their literature review identifies four major characteristics with an influence on bias susceptibility: *cognitive abilities, expertise, personality, and cultural background*.

The results in the context of forecasting cognitive biases are mixed. In general, *intelligence* does not predict a specific proneness to biases, but "highly intelligent people will display fewer reasoning biases when you tell them what the bias is and what they need to do to avoid it" (Stanovich & West, 2008: 690). The individual thinking style (deliberate processing vs. heuristic processing) seems to have an influence on certain biases like framing, or base rate neglect but not with others (such as conjunction fallacy).

The *expertise* of decision makers determines the deployment of a specific thinking style based on the context and thus the susceptibility to cognitive biases (e.g. experts are "more likely to select the thinking style appropriate for the context" (Toet et al., 2016: 7)). A high emotional intelligence helps to reduce emotionally induced cognitive biases (Fallon et al., 2014). Toet et al. summarize these results as "in general it can be concluded that cognitive ability does not safeguard an individual against bias, but it may in some cases help in deploying countering mechanisms that reduce, or prevent subsequent behavioral effects" (Toet et al., 2016: 6).

The relation between cognitive biases and *personality* traits has been researched by several studies. Individuals with high openness and agreeableness are more susceptible to anchoring (Caputo, 2014) and the sunk cost effect (Fujino et al., 2016), a high extraversion leads to a higher proneness for bandwagon bias, overconfidence (Ahmad, 2020), and mood-affected biases (Zelenski & Larsen, 2002) but also reduces the impact of loss aversion biases (Durand

et al., 2019). Conscientiousness is positively related to decision-making competence (Weller, Ceschi, Hirsch, Sartori, & Costantini, 2018) and "specifically extraversion and neuroticism were negatively associated with decision-making competence (Dewberry et al., 2013: 787). Toet et al. (2016) recapitulates these results as "it is not easy to determine the mechanisms underlying the relationships between personality traits and susceptibility to cognitive bias. Summarizing, personality appears to relate to bias susceptibility because it determines how people weigh and process information" (Toet et al., 2016: 8). The influence of the *cultural background* on the susceptibility of cognitive biases can – again following the words of Toet et al. – be summarized as follows: "While it is possible that culture affects sensitivity to bias (e.g., as a result of different preferred thinking styles or levels of self-efficacy), only a few studies on this topic have been conducted and their results are mixed" (Toet et al., 2016: 8).

These results show the difficulty to link single individual characteristics to one's proneness to cognitive biases in decision-making situations. This difficulty may be the result of two aspects: a) the cross-sectionality of cognitive biases in the context of personalities and cognitive abilities (Erceg, Galic, & Bubic, 2020), and b) the focus of cognitive bias research on their existence and robustness vs. the empirical closure on their underlying causes (Gertner et al., 2016). Considering the difficulties with cognitive abilities, expertise, personality, and cultural background as predictors for individual bias susceptibility, we introduce a different lens to explore and analyze the individual susceptibility for cognitive biases and bias blind spots: decision styles.

Decision Styles and Cognitive Biases

As individual decision styles reflect "a combination of intellectual, motivational, emotional, and experience based skills" (Bruine de Bruin et al., 2020: 188), they address this cross-sectionality of cognitive biases. Decision styles are "learned, habitual response patterns

exhibited by an individual when confronted with a decision situation" (Scott & Bruce, 1995: 820), "a surface manifestation of more deep seated personality constructs" (Spicer & Sadler-Smith, 2005: 146). Thus, decision styles could act as potential predictors for one's individual susceptibility to cognitive biases in managerial decision making and thus influence the individual awareness of flawed decision-making behavior.

The General Decision Style Inventory (GDSMI) (Scott & Bruce, 1995) has been recognized as the "most encompassing, validated, and widely used conceptual approach" (Fischer, Soyez, & Gurtner, 2015: 525). The five decision styles are characterized as (Spicer & Sadler-Smith, 2005: 137–138)

- Rational: logical and structured approaches to decision making;
- Intuitive: reliance upon hunches, feelings and impressions;
- Dependent: reliance upon the direction and support of others;
- Avoidant: postponing or avoiding making decisions;
- Spontaneous: impulsive and prone to making "snap" or "spur of the moment" decisions

Existing research connects decision styles with the level of collaboration (Tsai, Melia, & Hinsz, 2019), problematic decision making (Bruine de Bruin et al., 2007; Parker, Bruine De Bruin, & Fischhoff, 2007), and the level of rationality in decisions (Curşeu & Schruijer, 2012). The results of these studies indicate a tendency for rational decision makers to be more decisive and make more deliberate decisions (Curşeu & Schruijer, 2012), and to have a higher Adult Decision-Making Competence (A-DMC) (Parker et al., 2007).

Based on these results we ask the following research question (RQ1):

Do decision styles influence the awareness one's own susceptibility to specific cognitive biases in managerial decisions?

Another way of asking this question is this one: If managers are made aware of their decision style, can they then identify the biases that they are most likely to fall into when making a decision? If this is the case, then research can help managers immunize themselves against relevant cognitive biases.

The Bias Blind Spot

We tend to see others more affected by biases than ourselves. This phenomenon is called the bias blind spot (Pronin, Lin, & Ross, 2002) and is grounded on two phenomena: the introspect illusion (Ehrlinger, Gilovich, & Ross, 2005; Pronin, 2009; Pronin & Kugler, 2007) and naïve realism (Pronin, Gilovich, & Ross, 2004). The awareness of a bias blind spot is a prerequisite for the application of debiasing techniques: "When people are unaware of their bias, they are unlikely to adopt corrective strategies to avoid the sources of bias that influence their judgment. Consequently, people who are more susceptible to bias blind spot are less prone to improve their decision making by engaging in bias reduction strategies, responding to training, and taking advice" (Scopelliti et al., 2015: 2483). A bias blind spot even leads to a higher susceptibility for specific biases like the omission bias: "Ironically, consumers who believe that they are less vulnerable to omission neglect may be more susceptible to omission neglect" (Han, 2011: ii).

The bias blind spot seems to be independent from a general decision-making competence (Scopelliti et al., 2015). Research on individual differences of bias blind spots is still scarce, even if this gap is acknowledged (Kukucka, Kassin, Zapf, & Dror, 2017; Zappala, Reed, Beltrani, Zapf, & Otto, 2018). West, Meserve, and Stanovich (2012) show that bias blind spots do not correlate negatively with measures of cognitive ability like SAT or CRT or thinking dispositions like need for cognition or the actively open-minded thinking test. On the contrary, they showed that *bias blind spots are even more apparent among individuals with a*

higher cognitive sophistication. This finding is confirmed by the suggestions that people with a high need-for-cognition and a higher self-esteem believe they are less susceptible to cognitive biases (Scopelliti et al., 2015).

To support the awareness of one's own susceptibility to bias blind spots and not only the susceptibility to specific cognitive biases we ask a second research question (RQ2): *Do decision styles help to identify individual differences in the susceptibility of bias blind spots?*

RESEARCH DESIGN

For the exploration of both research questions, we conducted a survey which included 15 of the most important cognitive biases in managerial decisions.

Choosing the Top 15 Biases

For feasibility reasons (enabling the participants to assess the cognitive biases properly and in a reasonable amount of time as for managers time is money) we have followed a stringent selection process for the most prevalent and important cognitive biases we confronted the participants with. To evaluate them, we applied a two-step procedure:

a) Step 1: We conducted a pilot survey to assess the managerial decision-making relevance of thirty (highly cited) cognitive biases, based on an existing compilation and classification of 187 documented cognitive biases (Eppler & Muntwiler, 2021). In this survey we asked 45 experienced managers (with a mean age of 32.9 years and an average of 10.3 years leadership experience) how often they recognized the corresponding behavioral patterns of these 30 cognitive biases in others. This provided us with a ranking of bias perception regarding their occurrence in managerial practice.
b) Step 2: The ranking of these 30 biases was then compared to other surveys providing a ranking of prevalence for cognitive biases. Kreilkamp et al. (2020) analyzed 9 cognitive biases and their occurrence. Brooks et al. (2020) analyzed 5 biases

associated with information overload and 8 biases associated with creating meaning/understanding. Zalewski et al. (2017) identified the most 11 relevant cognitive biases in architecture decision making by letting participants poll out of a list of 105 biases. The analysis of Saposnik et al. (2016) resulted in 19 cognitive biases that affect the decision making of physicians. Wattanacharoensil and La-ornual (2019) identified the most prevalent cognitive biases in tourist decision making based on a literature review and provided 24 different biases. For the final choice of the top 15 biases for our own survey we thus applied the following criteria: the resulting ranking in our pilot survey, the rankings in the other surveys, feasibility (including explainability) for the survey, plausibility for managerial decisions, debiasing potential (i.e., is there something that managers can do to prevent the bias from occurring).

As the knowledge of managers on theoretical definitions and explanation of cognitive biases as provided in the literature is scarce and biases occur unconsciously, managers are often not familiar with bias labels or descriptions. As a consequence, cognitive biases and their perceptions are difficult to measure directly (Kreilkamp et al., 2021). We hence followed the approach of Kreilkamp et al. (2020) to describe each bias as a specific "decision-making behavior" (of others or oneself) and asked the participants of the survey about specific decision behaviors that they have observed in others and themselves. The decision behaviors are based on the description of the 15 cognitive biases in the typology of cognitive biases by Eppler and Muntwiler (2021) and were pretested for comprehensibility. This led to the following list of cognitive biases and the corresponding behavior descriptions as basis for the survey (Table 1):

Cognitive bias	Decision-making behavior
Stereotyping	I (they) assigned characteristics to business partners or collaborators based on their membership to a certain group (gender, nationality, profession, age etc.).
Availability	I (they) used only the information I (they) could recall quickly and easily for a decision.
Problem-solving set	I (they) favored a familiar solution over a non-familiar solution, even if I (they) do not know the potential success rate of both.
Imaginability	I (they perceived events as more likely to happen when I (they) could imagine them vividly.
Curse of knowledge	In a business discussion, I (they) falsely assumed that my (their) colleagues have the same level of knowledge as I (they) do.
Confirmation bias	I (they) favored information that confirmed my (their) existing opinions instead of looking for contradicting evidence.
Illusion of explanatory depth	I (they) believed to understand a complex phenomenon better than I (they) actually did.
In-group bias	I (they) preferred people from my (their) own department over people from other departments, just because they are from my (their) own department.
Anchoring effect	I (they) was (were) influenced by a starting offer (like the starting price of a negotiation) and could not break away from this reference point later.
Planning fallacy	I (they) planned too optimistically, even if I (they) should have had enough experience from past planning failures.
Framing	I (they) perceived positively framed information different than the same information if it was negatively framed (example: “40 out 100 people buy from us” vs. “60 out of 100 do not buy from us”).
Bandwagon effect	I (they) did things just because other people did them too.
Sunk cost fallacy	I (they) continued a (hopeless) project since I (they) had already invested time and money in it.
Functional fixedness	I (they) used tools, resources, or data only in the traditional way and did not envision other ways of how they could be used more effectively.
Illusory Superiority (Overestimation)	I (they) assessed my (their) own capabilities as better than those of others and as above average.

Table 1: List of top 15 cognitive biases for the survey

Design of the Survey

The survey consists of a questionnaire in mix-mode design: Computer-aided-telephone interviews with screen sharing for questions with longer lists of items (call to screen). A mix-mode design reduces “coverage and nonresponse error at reasonable survey costs and with improved timeliness” (De Leeuw & Berzelak, 2016: 149). We used the following survey procedure and elements:

1. Basic questions on participants data (age, gender, occupation, industry, experience etc.)

2. The participants first name up to 5 behaviors from the list above (Table I) that they believe are most common among decision makers in their organization (randomized list).
3. Based on the same list, the participants choose up to 5 behaviors they believe to have the greatest *negative* impact on decisions in their organizations.
4. For those 5 behaviors with the greatest negative impact they are asked, if they remember the occurrence of any of such decision-making behaviors and can briefly describe the situation and its impact.
5. Based on the list of the 15 cognitive biases they are asked to select all behaviors that they have observed on themselves at least once in the last 6 months.
6. Decision style inventory: The participants rate the 25 statements of the GDSMI (Scott & Bruce, 1995) regarding their decision style.
7. The participants evaluate 13 debiasing techniques according to how helpful they see them for their decision practice and how often they actually use them.

Sample Characteristics

The survey included 500 participants working for companies listed in the Forbes Global 2000 (https://www.forbes.com/lists/global2000/#1737558d5ac0) list of the world's biggest public companies with headquarters in the USA (72% of the participants), EU (15%, Germany, Spain, Italy, France, Netherlands), the UK and Switzerland (13%). The distribution of countries (assessed through location of headquarter) in the sample follows the distribution of countries in the 2021 edition of the Forbes 2000 list. Participants work in one of two broadly formulated business functions: Business Strategy/Market Development and Growth/Marketing/ Communications/Advertising. They are all C-suite direct reports, meaning they are reporting directly to a member of the executive board in their company. Thus, we

ensured that respondents have the responsibility for business decisions and are accountable in terms of success or failure of those decisions.

186 respondents were females, while 314 were males, with an average age of 49.3 years. 53.4% of the participants had more than 15 years of management experience, 30.8% 10 – to 15 years, and 15.8% less than 10 years of experience. Participants' job titles included different types of Directors (63.8%) and Vice President roles (36.0%) plus other high-level roles (0.2%).

RESULTS

The Prevalence of Cognitive Biases

The participants reported the in-group bias, the confirmation bias, and the illusory superiority as the top three biases in the decision making of others (see Figure 1). The top 5 of the observed cognitive biases in their own decision making were availability bias, imaginability, problem-solving set, illusion of explanatory depth, and illusory superiority (see Figure 2).

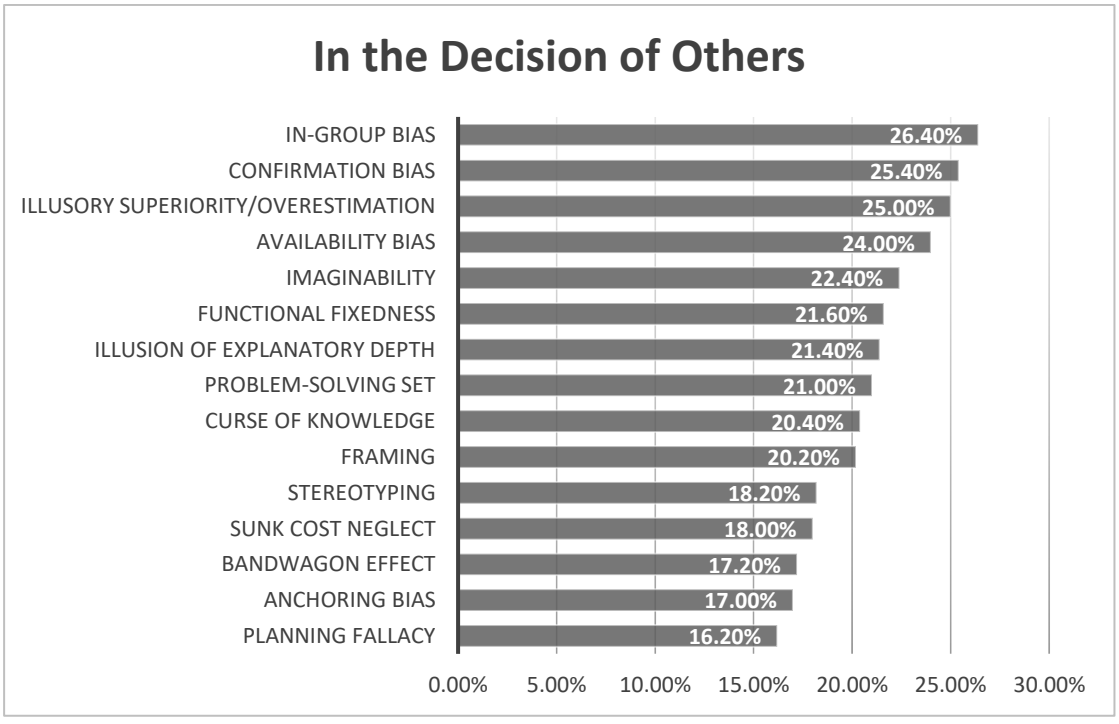

Figure 1: Prevalence of cognitive biases in the decision of others

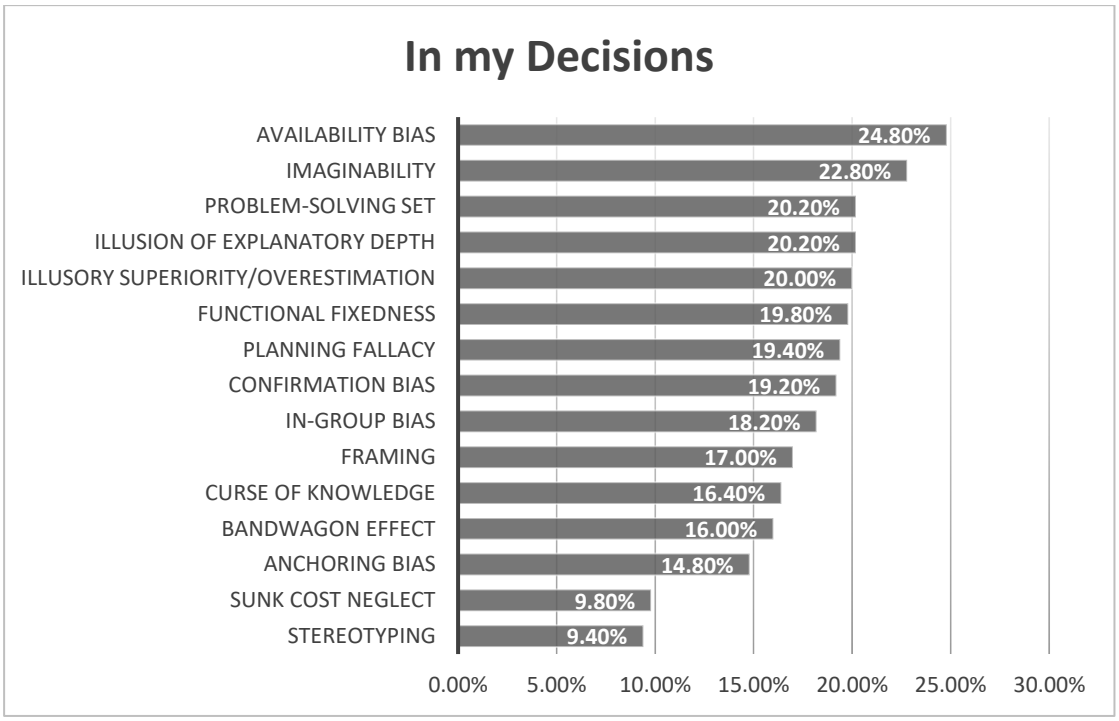

Figure 2: Self-reported prevalence of cognitive biases in one's own decision

The rating of the highest negative impact on decision making resulted in the following influential biases: functional fixedness, in-group bias, and planning fallacy (see Figure 3).

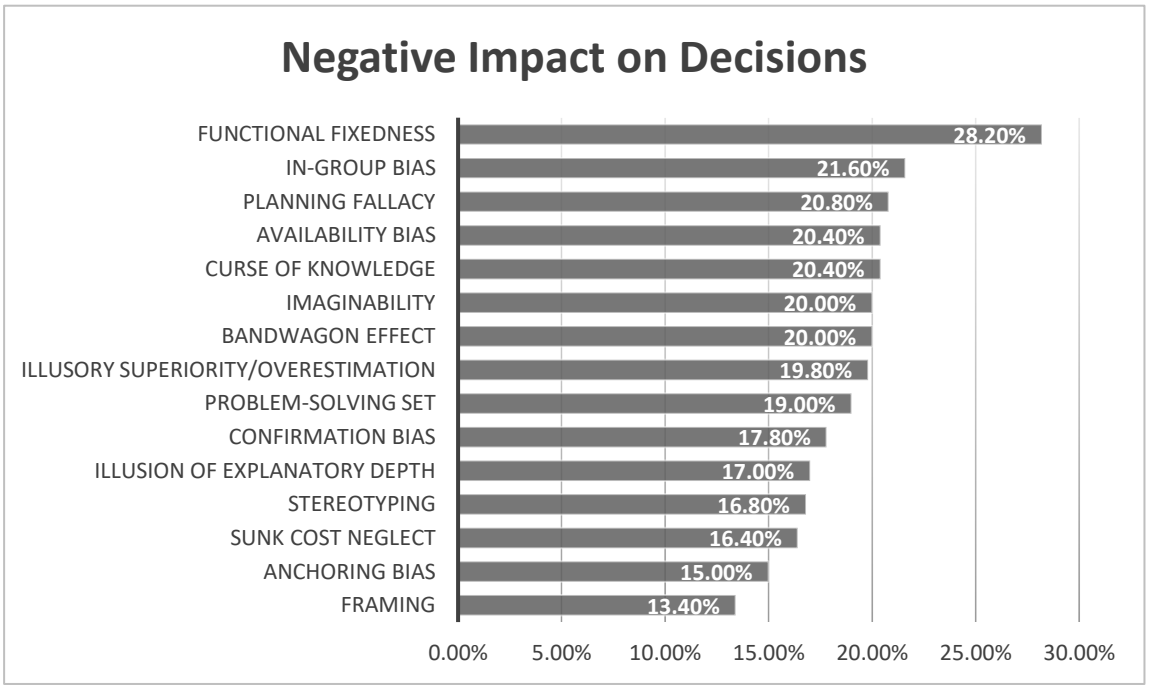

Figure 3: Ranking of negative impact on decisions

The Susceptibility of Biases Based on Individual Decision Styles

The susceptibility for cognitive biases was measured based on the number of decision-making behaviors (out of the list of 15) the participants have observed in their own behavior over the last 6 months (overall: n=500, m=2.678, SD=.6443, range 1.0 – 5.0). The decision styles were measured according to the GDSMI inventory (resulting means (n=500); rational: m=4.3116, SD=.4542; intuitive: m=3.1648, SD=.5825; dependent: m=2.9416, SD=.7775; avoidant: m=2.2052, SD=.5852; spontaneous: m=2.1952, SD=.6039).

Table 2 shows the inter-correlation matrix of the 15 cognitive biases, the five decision styles, age, and gender. The composite of susceptibility for all biases shows a highly significant negative correlation with the rational and the spontaneous decision style, and a positive one with the intuitive decision style. This indicates that rational and spontaneous decision makers identify less biases in their own behavior, and intuitive decision makers have a high awareness for their own cognitive biases.

The inter-correlations between the individual cognitive biases and the decision styles show strong negative correlations between the *rational* decision style and the biases stereotyping, in-group bias, anchoring, and the sunk cost neglect. This means, that managers who perceive themselves as more rational in their decision making, rarely indicate to be victims of those biases. The intuitive decision style on the other hand is positively correlated with stereotyping, problem-solving set, in-group bias, and sunk cost neglect and negatively with the bandwagon effect. The only correlation for the dependent decision style is the in-group bias (negative). For the spontaneous decision style, we found negative correlations with stereotyping, the illusion of explanatory depth, and illusory superiority. The avoidant decision style shows no correlation with a single cognitive bias. As a result, avoidant decision makers

cannot predict a specific susceptibility to certain cognitive biases from their own decision style.

The inter-correlations between the cognitive biases show 33 significant correlations, but all negative. Interesting side results show the significant negative correlation of age and the sunk cost neglect (the older you get, the more you are willing to cut your losses), the positive correlation of age and the decision styles dependent and avoidant (the older you get, the more you rely on others or delay decisions), and the negative correlation of gender (male) with the intuitive decision style (indicating that women generally tend to be more intuitive decision makers).

The significant correlations provide us with an answer to the first research question: There are differences in perceived bias susceptibility depending on the individual decision style.

Variable	Susceptibility (SUS)															Susceptibility composite, decision style measures (DS), and control variables (CV)							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1. SUS: Stereotyping	__																						
2. SUS: Availability	-.026	__																					
3. SUS: Problem-solving Set	-.008	-.047	__																				
4. SUS: Imaginability	-.028	-.091*	-.012	__																			
5. SUS: Curse of Knowledge	-.069	-.042	-.048	-.151***	__																		
6. SUS: Confirmation Bias	-.105*	-.104*	-.106*	-.120**	-.038	__																	
7. SUS: Illusion of Explanatory Depth	-.077	-.116**	-.055	-.120**	-.021	-.005	__																
8. SUS: In-Group Bias	-.010	-.091*	-.095*	-.009	-.097*	-.046	-.057	__															
9. SUS: Anchoring Bias	.039	-.044	-.083	-.052	-.109*	-.089*	-.013	-.094*	__														
10. SUS: Planning Fallacy	-.035	-.139**	-.106*	-.071	-.010	-.096*	-.005	-.059	-.060	__													
11. SUS: Framing Bias	-.018	-.087	-.095*	-.068	-.071	-.058	-.095*	.021	-.054	-.031	__												
12. SUS: Bandwagon Effect	-.085	-.049	.066	-.068	-.134**	-.019	-.084	-.121**	-.059	-.088*	-.038	__											
13. SUS: Sunk Cost Neglect	-.083	.056	-.049	-.067	-.092*	-.058	-.032	-.016	-.024	-.092*	-.096*	.003	__										
14. SUS: Functional Fixedness	.012	-.041	-.025	-.091*	-.030	-.038	-.088	-.026	-.094*	-.038	-.118**	.016	-.012	__									
15. SUS: Illusory Superiority	-.007	-.056	-.040	.050	-.073	-.104*	-.052	-.042	-.025	-.091*	-.093*	-.123**	-.047	-.123**	__								
16. SUS Composite	.161***	.136**	.205***	.124**	.003	.031	.136**	.155***	.086	.062	.044	.108*	.117*	.194***	.134**	__							
17. DS Rational	-.122**	-.049	.032	-.031	.048	.037	-.034	-.095*	-.093*	.066	.018	.003	-.129**	-.071	-.050	-.250***	__						
18. DS Intuitive	.110*	.001	.094*	.043	-.005	.014	.063	.103*	.151***	-.033	-.029	-.090*	.112*	.078	.056	.373***	-.245***	__					
19. DS Dependent	-.053	-.015	.014	.018	-.040	-.026	-.029	.090*	.073	.005	.016	-.074	-.041	-.005	.043	-.002	-.312***	.178***	__				
20. DS Avoidant	.028	.027	.033	.016	-.054	.001	-.042	.030	.073	-.032	-.019	-.006	.071	.001	-.004	.060	-.351***	.278***	.473***	__			
21. DS Spontaneous	-.135**	-.013	-.039	-.054	-.009	.012	-.100*	-.067	-.002	.044	.048	.020	-.007	-.044	-.132**	-.279***	.110*	-.080	.225***	.371***	__		
22. CV: Age	-.059	.038	-.024	.057	-.080	.025	.036	.043	.026	.029	-.014	-.010	-.175***	-.026	-.059	-.079	-.081	-.002	.218***	.124**	.073	__	
23. CV: Gender	-.007	.075	-.027	-.004	-.017	-.026	-.006	.023	-.030	.003	-.029	.003	.011	-.071	-.012	-.065	-.029	-.111*	-.026	.026	.048	-.163***	__

* = p < 0.05, ** = p < 0.01, *** = p < 0.001

Table 2: Inter-Correlations Among the Key Variables - Self-reported Bias Susceptibility

Susceptibility Comparison of Top 25 vs. Bottom 25 per Decision Style

We also conducted a detailed analysis from the perspective of the five decision styles to identify not only correlations of decision style and cognitive biases as above, but to see whether the most typical decision style participants are specifically aware of and prone to certain biases. For this reason, we grouped the results of the GDSMI into quartiles for each decision style and compared the results of the top 25 (participants in the quartile with the highest scores per decision style) with the bottom 25 group (participants in the quartile with the lowest scores per decision style).

Decision Style	**Rational**	**Intuitive**	**Dependent**	**Avoidant**	**Spontaneous**
Cognitive Biases	m(top25)=2.5 SD(top25)=.040 m(bottom25)=2.976 SD(bottom25)=.053 F(1/331)=50.9501 p<0.0001*	m(top25)=2.93798 SD(top25)=.057 m(bottom25)=2.344 SD(bottom25)=.509 F(1/252)=53.3941 p<0.0001**	m(top25)=2.82424 SD(top25)=.046 m(bottom25)=2.88136 SD(bottom25)=.054 F(1/281)=0.6419 p=0.4237	m(top25)=2.83562 SD(top25)=.053 m(bottom25)=2.79091 SD(bottom25)=.061 F(1/254)=0.33055 p=0.5809	m(top25)=2.43243 SD(top25)=.044 m(bottom25)=2.98374 SD(botom25)=.049 F(1/269)=70.1489 p<0.0001*

*Table 3; Self-reported general bias susceptibility per decision style (Top25 per decision style: * = significant lower self-reported susceptibility, ** = significant higher self-reported susceptibility)*

The overview of the general self-reported susceptibility to cognitive biases in their decision behavior (Table 3) shows that more rational and/or spontaneous decision makers (top 25 quartile) tend to report a significant *lower* susceptibility to biased decision behavior. Intuitive decision makers recognize a significant *higher* susceptibility and for the decision styles of dependent and avoidant decision maker there was no significant difference between the top 25 and the bottom 25 per decision style which is according to the inter-correlation matrix.

The analysis for each of the 15 different cognitive biases (see Table 4) showed no significant difference in the self-reported susceptibility for several of those biases: curse of knowledge, confirmation bias, and framing bias. For *stereotyping*, the top 25 rational and spontaneous

decision makers show a lower self-reported susceptibility than the bottom 25 and the top 25 of intuitive decision makers a higher one. On the other hand, the *availability* bias is the only bias where the top 25 rational decision makers report a significant higher susceptibility. The biases problem-solving set, imaginability, and functional fixedness show significantly stronger reported susceptibility for the top 25 intuitive decision makers, in contrast to the other four decision styles. For the illusion of explanatory depth and the illusory superiority, only the top 25 spontaneous decision makers show a (in the first case weak) significance in lower reported susceptibility than the others. The most avoidant and dependent decision makers report a higher susceptibility to the in-group bias (which means for the dependent decision makers that the top 25 show a significant higher susceptibility to this bias than the bottom 25 but still having a negative correlation with this specific bias over all (see results from Table 2)).

Rational decision makers report a lower susceptibility for the anchoring bias and the sunk cost bias – in contrast to intuitive decision makers, they report a higher susceptibility for both biases. The planning fallacy shows a lower self-reported susceptibility for the top 25 avoidant decision makers, and the bandwagon effect a lower one for the top 25 intuitive decision makers. We can thus report that certain decision-making styles struggle more with certain biases than others (in the self-awareness of the decision makers).

Decision Style	Cognitive Bias	Top 25		Bottom 25	Statistic
Rational	Stereotyping	n=208		n=125	F(1/331)=8.3828
		m=.058	<	m=.152	p=.004
		SD=.020		SD=.026	
	Availability	n=208		n=125	F(1/331)=3.404
		m=.221	<	m=.312	p=.0659
		SD=.030		SD=.024	One tailed p-test p=.033
	In-Group	n=208		n=125	F(1/331)=3.4693
		m=.144	<	m=.224	p=.0634
		SD =.026		SD=.034	One tailed p-test p=.0317
	Anchoring	n=208		n=125	F(1/331)=6.9004
		m=.111	<	m=.216	p=.009
		SD=.025		SD=.032	
	Sunk Cost Neglect	n=208		n=125	F(1/331)=6.2206
		m=.063	<	m=.144	p=.0131
		SD=.020		SD=.026	
Intuitive	Stereotyping	n=129		n=125	F(1/252)=7.575
		m=.124	>	m=.032	p=.0063
		SD=.023		SD=.024	
	Problem-solving set	n=129		n=125	F(1/252)=6.3010
		m=.240	>	m=.120	p=.0127
		SD=.034		SD=.034	
	Imaginability	n=129		n=125	F(1/252)=3.0362
		m=.248	>	m=.160	p=.0826
		SD=.035		SD=.036	One tailed p-test p=.0413
	Anchoring	n=129		n=125	F(1/252)=6.8411
		m=.220	>	m=.104	p=.0094
		SD=.032		SD=.033	
	Bandwagon Effect	n=129		n=125	F(1/252)=5.3064
		m=.116	<	m=.224	p=.0221
		SD=.033		SD=.033	
	Sunk Cost Neglect	n=129		n=125	F(1/252)=4.0945
		m=.163	>	m=.080	p=.0441
		SD=.029		SD=.029	
	Functional Fixedness	n=129		n=125	F(1/252)=4.4838
		m=.209	>	m=.112	p=.0352
		SD=.032		SD=.033	

Dependent	In-Group Bias	n=165		n=118	F(1/281)=4.7312
		m=.218	>	m=.119	p=.0305
		SD=.030		SD=.035	
Avoidant	In-Group Bias	n=146		n=110	F(1/254)=3.6176
		m=.220	>	m=.127	p=.0583
		SD=.032		SD=.036	One tailed p-test p=.0292
	Planning Fallacy	n=146		n=110	F(1/252)=3.6641
		m=.151	<	m=.245	p=.0567
		SD=.033		SD=.037	One tailed p-test p=.0284
Spontaneous	Stereotyping	n=148		n=123	F(1/269)=11.9627
		m=.041	<	m=.163	p=.0006
		SD=.024		SD=.026	
	Illusion of explanatory	n=148		n=123	F(1/269)=2.8063
	depth	m=.155	<	m=.236	p=.0951
		SD=.032		SD=.036	One tailed p-test p=.0475
	Illusory Superiority	n=148		n=123	F(1/269)=8.6090
		m=.135	<	m=.276	p=.0036
		SD=.032		SD=.036	

Table 4: Significant self-reported susceptibilities per decision style for the cognitive biases (Top25 vs. bottom25 per decision style)

The Bias Blind Spot(s)

The size of the blind spot was measured with the difference of the number of behavioral patterns recognized on oneself and on others, and this overall and per cognitive bias (overall n= 500, m=.466, SD=.885, range -2.00 to 4.00).

The comparison between the number of cognitive biases attributed to others and to oneself showed a significant difference and revealed a general bias blind spot among managers (mean others=3.144, mean oneself=2.678, ANOVA F(1/998)=135.8620, p<.0001). By considering that, for the first question, the participants could name up to 5 biases that they observed on others and up to 15 biases that they observed on themselves, the general bias blind spot is even more apparent.

The analysis per bias revealed that the top three biases with a strong blind spot for managers are *stereotyping, in-group bias, and sunk cost neglect* (see Figure 4), meaning that the managers see them generally much more in others than themselves. The three biases imaginability, availability, and planning fallacy showed a reversed blind spot. They are more observed on oneself than on others (which in the case of the planning fallacy confirms earlier research: people claim to be more biased by this fallacy than their peers (Pronin et al., 2002)).

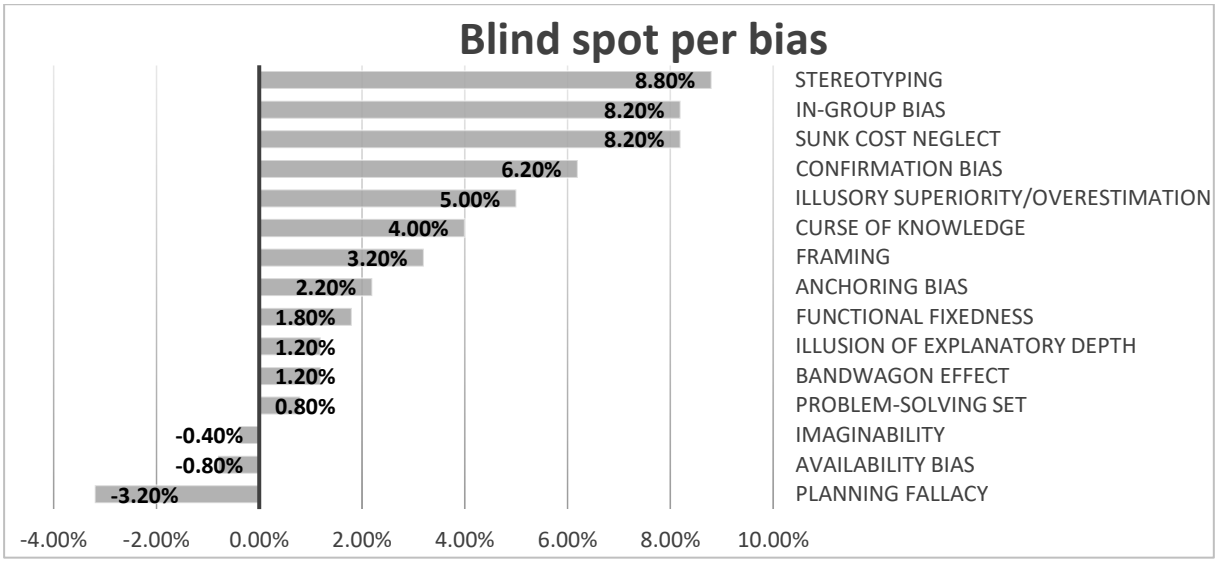

Figure 4: Self-other assessment (difference in percentage) per bias (top 4 with significant blind spot: stereotyping, p=.002; in-group bias, p<.001; sunk cost neglect, p<0.001; confirmation bias, p=.017)

Table 5 shows the inter-correlation matrix of the 15 cognitive biases, the five decision styles, age, and gender. The composite blind spot result shows a significant positive correlation with the rational, dependent, and spontaneous decision style. Thus, indicating an overall stronger blind spot for biases for these three decision styles. The intuitive decision style correlates negatively with the blind spot composite, showing that intuitive decision makers tend to have a significant negative blind spot for cognitive biases in their decision behavior (i.e., they see themselves as more affected by biases than others).

Variable	Bias Blind Spot (BBS)															BBS composite, decision style measures (DS), and control variables (CV)							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1. BBS: Stereotyping	__																						
2. BBS: Availability	-.018	__																					
3. BBS: Problem-solving Set	.025	-.035	__																				
4. BBS: Imaginability	-.129**	-.093*	-.056	__																			
5. BBS: Curse of Knowledge	.082	-.054	-.139**	-.077	__																		
6. BBS: Confirmation Bias	.048	-.148***	-.094*	-.103*	-.027	__																	
7. BBS: Illusion of Explanatory Depth	.070	-.035	-.083	-.107*	-.021	-.176***	__																
8. BBS: In-Group Bias	.046	-.085	-.132**	-.066	-.151***	-.003	-.028	__															
9. BBS: Anchoring Bias	.032	-.051	-.056	-.027	-.075	-.045	-.064	-.053	__														
10. BBS: Planning Fallacy	.044	-.130**	-.125	.006	-.051	-.058	-.012	-.089*	-.063	__													
11. BBS: Framing Bias	.040	-.041	-.091*	-.127**	-.045	-.088*	-.047	-.065	.005	-.071	__												
12. BBS: Bandwagon Effect	.052	-.032	.055	.034	-.095*	-.036	-.105*	-.064	-.137**	-.057	-.023	__											
13. BBS: Sunk Cost Neglect	.005	-.126**	-.056	-.067	-.053	-.034	.012	-.010	-.024	-.078	-.057	-.088*	__										
14. BBS: Functional Fixedness	.044	-.104*	-.027	-.059	.004	-.081	-.061	-.030	-.059	.030	-.043	-.059	-.070	__									
15. BBS: Illusory Superiority	.087	-.033	.005	.086	-.045	-.112*	-.002	-.079	-.125**	-.028	-.112*	-.110*	-.060	-.126**	__								
16. BBS Composite	.156***	.078	.101*	.162***	.053	-.006	.135**	.141**	.083	.130**	.093*	.116**	.073	.155*	.155***	__							
17. DS Rational	.035	.019	.047	.075	.006	-.008	-.015	.084	.121**	-.075	-.029	-.050	.095*	.049	.052	.246***	__						
18. DS Intuitive	.098*	-.026	-.087	.014	.070	.041	-.052	-.156***	-.156***	.068	-.051	.119**	.044	.014	-.038	-.234***	-.245***	__					
19. DS Dependent	.042	.049	-.045	.054	.068	.028	.013	-.027	-.089*	.044	.046	.048	.020	.025	-.065	.127**	-.312***	.178***	__				
20. DS Avoidant	.024	-.025	-.102*	.017	.065	-.046	.068	-.010	-.043	.050	.013	.008	-.008	.063	-.021	.028	-.351***	.278***	.473**	__			
21. DS Spontaneous	.094*	-.047	.074	.069	.081	-.021	.061	.069	-.017	-.064	.029	-.032	.098*	.057	.094	.327***	.110*	-.080	.225***	.371***	__		
22. CV: Age	.040	.028	-.017	-.039	.024	-.033	-.045	-.069	-.046	-.043	.082	.041	.114*	.056	.003	.043	-.081	-.002	.218***	.124**	.073	__	
23. CV: Gender	.005	-.031	.019	-.031	.012	.046	.006	.005	.104**	.005	.015	-.042	-.083	.074	.005	.072	-.029	-.111**	-.026	.022	.046	-.163	__

* = p < 0.05, ** = p < 0.01, *** = p < 0.001

Table 5: Inter-correlations among the key variables - bias blind spots

A closer look at the correlations between decision styles and the individual bias blind spots shows a positive correlation between the rational decision style and blind spots for the anchoring bias and the sunk cost neglect, as well as a positive correlation between the spontaneous decision style and blind spots for stereotyping and sunk cost neglect. The intuitive decision style correlated negatively with an in-group bias and the anchoring bias (smaller blind spot) and positively for stereotyping and the bandwagon effect. Dependent decision makers only correlate negatively with the anchoring bias, avoidant only with problem-solving set. These results indicate that individual differences in decision styles also lead to individual bias blind spots, but, interestingly, fewer differences between the styles than in the susceptibility to cognitive biases.

The inter-correlations between the bias blind spots showed 26 significant negative correlations, no significant positive correlations. Gender (female) correlates positive with a blind spot for the anchoring bias and age (older) positive with a blind spot for the sunk cost neglect.

Blind Spots per Decision Style (Top 25)

To further clarify the relationship between bias blind spots and individual decision styles, we analyzed the size and significance of the blind spots for the most pronounced participants (top 25) per decision style (see Table 6). We thus analyzed only the correlations of the top quartile with the bias blind spots.

The participants within the top 25 of the rational decision style show a significant blind spot for stereotyping, curse of knowledge, in-group bias, anchoring, sunk-cost fallacy, and illusory superiority and a negative blind spot (a higher self-reported susceptibility for oneself than for others) for the planning fallacy. The top 25 in the intuitive decision style show a significant blind spot for the confirmation bias and the curse of knowledge. The blind spots for

dependent decision makers are in stereotyping, curse of knowledge, confirmation bias, framing bias and a negative blind spot for the anchoring bias. Avoidant top 25 participants show a significant blind spot for the curse of knowledge and functional fixedness, and a negative blind spot for problem-solving set. For spontaneous decision makers, the significant blind spots are problem-solving set, curse of knowledge, in-group bias, sunk cost fallacy, stereotyping, and illusory superiority.

Decision Style	**Cognitive Bias**	**in others**		**in oneself**	**Statistic**
Rational top25	Stereotyping	m=.0163		m=.058	F(1/414)=12.1176
(n=208)		SD=.021	>	SD=.021	p=.0006
	Curse of knowledge	m=.260		m=.188	F(1/414)=3.1244
		SD=.029	>	SD=.029	p=.0779
					One tailed p-test p=.0389
	In-Group	m=.270		m=.144	F(1/414)=10.1019
		SD =.028	>	SD=.028	p=.0016
	Anchoring	m=.188		m=.111	F(1/414)=4.8859
		SD=.025	>	SD=.025	p=.0276
	Planning Fallacy	m=.115		m=.197	F(1/414)=5.3115
		SD=.025	<	SD=.025	p=.0217
	Sunk Cost Neglect	m=.202		m=.063	F(1/414)=18.3115
		SD=.023	>	SD=.023	p<.0001
	Illusory Superiority	m=.270		m=.168	F(1/414)=6.2667
		SD=.029	>	SD=.029	p=.0127
Intuitive top25	Curse of knowledge	m=.271		m=.171	F(1/256)=3.8327
(n=129)		SD=.036	>	SD=.036	p=.0513
					One tailed p-test p=.0257
	Confirmation bias	m=.310		m=.217	F(1/256)=2.8854
		SD=.039	>	SD=.039	p=.0906
					One tailed p-test p=.0453
Dependent top25	Stereotyping	m=.194		m=.010	F(1/328)=6.3229
(n=165)		SD=.027	>	SD=.027	p=.0124
	Curse of knowledge	m=.224		m=.140	F(1/328)=4.0170
		SD=.030	>	SD=.030	p=.0459

	Confirmation bias	m=.267 SD=.033	>	m=.188 SD=.033	F(1/328)=2.9242 p=.0882 One tailed p-test p=.0441
	Anchoring	m=.133 SD=.030	<	m=.224 SD=.030	F(1/328)=4.6816 p=.0312
	Framing	m=.236 SD=.031	>	m=.163 SD=.031	F(1/328)=2.7333 p=.0992 One tailed p-test p=.0496
Avoidant top25 (n=146)	Problem-solving set	m=.123 SD=.031	<	m=.226 SD=.031	F(1/290)=5.4078 p=.0207
	Curse of knowledge	m=.247 SD=.032	>	m=.130 SD=.032	F(1/290)=6.5754 p=.0108
	Functional Fixedness	m=.267 SD=.035	>	m=.185 SD=.035	F(1/290)=2.8270 p=.0938 One tailed p-test p=.0469
Spontaneous top25 (n=148)	Stereotyping	m=.209 SD=.026	>	m=.041 SD=.026	F(1/294)=20.5124 p<.0001
	Problem-solving set	m=.264 SD=.034	>	m=.182 SD=.034	F(1/294)=2.8156 p=.0944 One tailed p-test p=.0472
	Curse of knowledge	m=.243 SD=.033	>	m=.149 SD=.033	F(1/294)=4.2346 p=.0405
	In-group bias	m=.257 SD=.033	>	m=.149 SD=.033	F(1/294)=5.4131 p=.0207
	Sunk cost neglect	m=.209 SD=.029	>	m=.081 SD=.029	F(1/294)=10.0907 p=.0016
	Illusory Superiority	m=.257 SD=.033	>	m=.135 SD=.033	F(1/294)=7.0665 p=.0083

Table 6: Significant self-reported bias blind spots for the top25 per decision style for the cognitive biases

These results show individual differences in the susceptibility of bias blind spots and thus answer the second research question. The understanding of one's own decision style can be used to identify individual bias blind spots.

DISCUSSION

For the discussion we summarize the results following the structure of the General Decision Style Inventory (GDSMI) (Scott & Bruce, 1995) to show the vulnerability to specific cognitive biases for each decision style.

Rational Decision Style

The rational decision style is defined as "comprehensive search for information, inventory of alternatives and logical evaluation of alternatives" (Thunholm, 2004: 933), behaviors which are associated with "good decision making" (Parker, Bruine, Fischhoff, 2007). Rational decision makers show a positive correlation to attributing the control over one's destiny to factors within rather than outside oneself (Thunholm, 2004). Therefore, the results showing an overall lower self-reported susceptibility to cognitive biases are in line with research on rational decision styles.

The analysis of the blind spots for the rational decision styles on the other hand, lead to a surprising result: Participants with a strong rational decision style show more bias blind spots than the other decision styles. Research provides us with three potential explanations for this phenomenon:

A) Rational decision makers do have larger bias blind spots, as they understand themselves as more rational and having better decision-making skills and thus expect themselves to perform fewer of the presented (negative) decision behaviors. They are simply more confident in their decision-making capabilities (Hamilton, Shih, & Mohammed, 2016). West et al. (2012) reported that indeed subjects that are more cognitively sophisticated showed larger bias blind spots.
B) The blind spots can be explained by the type of cognitive biases and the degree of social desirability. Thunholm (2004) shows a significant correlation of the rational

decision style with a self-perception of being hard working and independent. Consequently, rational decision makers see themselves unaffected by biases like stereotyping, in-group bias, curse of knowledge, illusory superiority and the sunk cost neglect (the blind spot in anchoring may be a different case).

C) Subjects with a strong rational decision style report to have a lower susceptibility to cognitive biases. Perhaps their perception is not a blind spot at all, but an accurate self-assessment, as they really are less prone to fall into cognitive traps. Thus, "it is possible that if people high in openness to experience have both superior cognitive ability and some awareness of that ability, they might accurately report that they are less susceptible to bias than their peers" (Scopelliti et al., 2015: 2477). This would contradict the finding that individuals with larger blind spots do *not* show smaller cognitive biases (West et al., 2012; West, Toplak, & Stanovich, 2008). But an interesting finding of our study may support the explanation with an accurate self-assessment: our question on the use debiasing techniques resulted in a positive correlation between a rational decision style and the number of debiasing techniques used ($r=.3185$, $p<.0001$). Rational decision makers in fact use more debiasing techniques than the other decision styles (m(rat)=4.11, m(int)=3.93, m(dep)=3.81, m(avo)=3.86, m(spo)=3.84).

There is no clear picture yet on the quality of self-assessments of the rational decision makers group, as the mere indication of using more debiasing techniques is not a proof thereof. More research is thus needed to understand the individual susceptibility of rational decision makers to cognitive biases and the reason behind their individual bias blind spots (and if they can be even called such for this group). The perspectives of individual motivational backgrounds of cognitive biases (Oreg & Bayazit, 2009) or inter-causalities of cognitive biases (social desirability as potential moderator or amplifier for other cognitive biases or bias blind spots)

may help find more insights about this phenomenon. Still, the combination of self-reported susceptibility and blind spots for cognitive biases for the rational decision styles leads to an overview of potential "bias risks" for self-assessed rational managers in their decisions (Table 7).

Top25 Rational	**Significant Blind Spot**	**Without Blind Spot**
Significant Higher Susceptibility (top vs. bottom)		Availability
No Significantly Different Susceptibility (top vs. bottom)	Curse of Knowledge Planning Fallacy (negative blind spot) Illusory Superiority	Problem-solving set Imaginability Confirmation Bias Illusion of Explanatory Depth Framing Bias Bandwagon Effect Functional Fixedness
Significant Lower Susceptibility (top vs. bottom)	Stereotyping In-Group Bias Anchoring Bias Sunk Cost Neglect	

Table 7: Individual "bias risks" for biased decision behavior and blind spots – rational decision style

Intuitive Decision Style

Thunholm (2004) describes the intuitive decision style as characterized by a less systematic search for information and a tendency to premonitions, feelings and attention to (at times irrelevant) details in the flow of information. Intuitive decisions are a combination of one's experience and the feelings and emotions in a decision-making situation (Burke & Miller, 1999). Our results (see Table 2 and Table 8) show a high bias awareness of subjects with a strong intuitive decision style and surprisingly small bias blind spots. This points, one can stipulate, to a smaller introspect illusion for these subjects. There was no correlation with the number of debiasing techniques used compared to the intensity of an intuitive decision style ($r=-.0389$, $p=.3852$). These results indicate that intuitive decision makers seem to be more

(accurately) aware of their decision flaws but do *not* follow through on that insight by using more debiasing techniques than others (in fact they use slightly less m(int)=3.93 compared to rational decision makers (m(rat)=4.11)).

Top25 Intuitive	**Significant Blind Spot**	**Without Blind Spot**
Significant Higher Susceptibility (top vs. bottom)		Stereotyping Problem-solving set Imaginability Anchoring Bias Sunk Cost Neglect Functional Fixedness
No Significantly Different Susceptibility (top vs. bottom)	Curse of Knowledge Confirmation Bias	Availability Illusion of Explanatory Depth In-Group Bias Planning Fallacy Framing Bias Illusory Superiority
Significant Lower Susceptibility (top vs. bottom)		Bandwagon Effect

Table 8: Individual "bias risks" for biased decision behavior and blind spots – intuitive decision style

Dependent Decision Style

Subjects with a strong dependent decision style tend to search for advice and direction from others in their decisions (Scott & Bruce, 1995; Thunholm, 2004). The measures of this decision style do not show any correlations with the overall susceptibility to cognitive biases or bias blind spots. A closer look to the top 25 subjects for the dependent decision style shows an average to high self-reported susceptibility and some bias blind spots (Table 9). Interestingly, this decision style correlates significantly and negatively with the number of debiasing techniques used ($r=-.5340$, $p<.0001$). So, this decision style does depend on others, but unfortunately not on debiasing techniques.

Top25 Dependent	Significant Blind Spot	Without Blind Spot
Significant Higher Susceptibility (top vs. bottom)		In-Group Bias
No Significantly Different Susceptibility (top vs. bottom)	Stereotyping Curse of Knowledge Confirmation Bias Framing Bias	Availability Problem-solving set Imaginability Illusion of Explanatory Depth Planning Fallacy Bandwagon Effect Sunk Cost Neglect Functional Fixedness Illusory Superiority
Significant Lower Susceptibility (top vs. bottom)	Anchoring Bias (negative blind spot)	

Table 9: Individual "bias risks" for biased decision behavior and blind spots – dependent decision style

Avoidant Decision Style

The avoidant decision style is characterized by "attempts to avoid decision making whenever possible" (Thunholm, 2004: 933). The tendency to avoid decisions did not show a significant correlation with the self-reported susceptibility of cognitive biases in general. This is confirmed by the top 25 analysis, where most biases show an average susceptibility with only few bias blind spots (see Table 10). Like the dependent decision style top 25, the top quartile of the avoidant decision style correlates significantly and negatively with number of debiasing techniques used ($r=-.4026$, $p<.0001$). There is thus ample potential for this kind of managers to nudge themselves to timely and sound decisions by starting to use debiasing techniques.

Top25 Avoidant	Significant Blind Spot	Without Blind Spot
Significant Higher Susceptibility (top vs. bottom)		In-Group Bias
No Significantly Different Susceptibility (top vs. bottom)	Problem-solving set (negative blind spot) Curse of Knowledge Functional Fixedness	Stereotyping Availability Imaginability Confirmation Bias Illusion of Explanatory Depth Anchoring Bias Framing Bias Bandwagon Effect Sunk Cost Neglect Illusory Superiority
Significant Lower Susceptibility (top vs. bottom)		Planning Fallacy

Table 10: Individual "bias risks" for biased decision behavior and blind spots – avoidant decision style

Spontaneous Decision Style

Spontaneous decision makers have “a sense of immediacy and a desire to get through the decision-making process as soon as possible” (Scott & Bruce, 1995: 823). A high score on the spontaneous decision style items correlated negatively with the overall self-reported susceptibility to cognitive biases and strongly positively with bias blind spots. As the spontaneous decision style also correlated negatively with the number of debiasing techniques used ($r=-.2382$, $p<.0001$), one can assume that managers with this decision style are indeed prone to more bias blind spots than the other decision-making styles. This is also represented in the “bias risk map” of the top 25 (Table 11).

Top25 Spontaneous	Significant Blind Spot	Without Blind Spot
Significant Higher Susceptibility (top vs. bottom)		
No Significantly Different susceptibility (top vs. bottom)	Problem-solving set Curse of Knowledge In-Group Bias Sunk Cost Neglect	Availability Imaginability Confirmation Bias Anchoring Bias Planning Fallacy Framing Bias Bandwagon Effect Functional Fixedness
Significant Lower Susceptibility (top vs. bottom)	Stereotyping Illusory Superiority	Illusion of Explanatory Depth

Table 11: Individual "bias risks" for biased decision behavior and blind spots – spontaneous decision style

Explorative Factor Analysis GDMSI

A detailed analysis of the 25 items of the GDMSI inventory for face and content validity showed surprising inconsistencies. From a content perspective, we registered the indication that not all items in the dimensions are representative for the domain they aim to measure (rational, intuitive, and avoidant decision styles). For two decision styles (dependent, spontaneous), the items may even measure two different dimensions instead of one.

In our factor analysis, it was not possible to reproduce the dimensional structure of the GDMSI inventory. We, therefore, conducted an explorative factor analysis for each dimension to check whether the items measuring a certain dimension load high and if the items have substantively meaningful factor loadings. Table 12 shows the results of the five explorative factor analyses. Applying the two items with the highest factor loadings as representative items for the three decision styles rational (items DS01, DS05), intuitive (items DS06, DS07), and avoidant (items DS16, DS17), the analyses did not reveal a significant difference for the bias susceptibility and blind spots compared to the original five items.

Dimension in Decision Style Scale	Item	Factor loadings in Principal Axis Factor Analysis, Varimax Rotation with Kaiser Normalization, number of factors determined by Kaiser		Factor loadings in Principal Axis Factor Analysis, Varimax Rotation with Kaiser Normalization, number of factors set to 1	Comment
		Factor 1	Factor 2		
Rational	DS01	0.638		0.638	Two variables with highest factor loadings will be used for further analysis. Good comprehensibility because a clear behavior is described.
	DS02				
	DS03				
	DS04	0.344		0.344	
	DS05	0.601		0.601	
Intuitive	DS06	0.842		0.834	Two variables with highest factor loadings will be used for further analysis. Good comprehensibility.
	DS07	0.851		0.869	
	DS08		0.68		
	DS09	0.342		0.325	
	DS10	-0.359		-0.342	
Dependent	DS11		0.708	0.387	Formation of 2 index values: DS13 and DS15: Openness to support. DS11 and DS12: Dependence on others
	DS12		0.709	0.376	
	DS13	0.788		0.533	
	DS14	0.453	0.398	0.681	
	DS15	0.706		0.588	
Avoidant	DS16	0.701		0.501	Two variables with highest factor loadings will be used for further analysis. Best comprehensibility. No added value from DS18 (too concrete due to "because") and DS20 (procrastinate has too negative connotations and is a technical word that should be avoided)
	DS17	0.509		0.507	
	DS18		0.404		
	DS19		0.320	0.369	
	DS20		0.607	0.349	
Spontaneous	DS21		0.670		Formation of 2 index values: DS23 und DS25: Spontaneuous DS21 und DS24: Impulsiveness
	DS22		0.603		
	DS23	0.831		0.941	
	DS24		0.644		
	DS25	0.772		0.671	

Factor loadings below 0.3 are not displayed.

Table 12: Factor loading analysis of GDSMI factors

For the dependent decision style, the items loaded on two clearly distinct factors when we applied the Kaiser criterion: The openness for support (items DS13, DS15) and the dependence on others (items DS11, DS12). From our perspective, forcing the items into one factor, clearly leads to a loss of differentiation. We, therefore, decided to generate the two dimensions mentioned above for further analyses. The same applies to the spontaneous decision style: the items measure two distinct dimensions that we named spontaneous decision style (items DS23, DS25) and impulsive decision style (items DS21, DS24). The general pattern of bias susceptibility of the two split decision styles is significantly different than the one of the original decision styles for the top 25 of each of these styles:

Generally, the top 25 of dependent decision makers do not show a significant difference to the bottom 25 regarding bias susceptibility. When split up into “openness for support” and

“dependence on others”, however, they both show a significant difference. The top 25 of “openness for support” report a significant lower susceptibility to cognitive biases than the bottom 25 (m(top25)=2.30709, m(bottom25)=2.97895, F(1/220)=94.7156, p<.00001), and the top 25 of “dependence on others” a significant higher one (m(top25)=2.90431, m(bottom25)=2.42195, F(1/245)=17.4629, p<.0001).Thus, “openness for support” may reduce one’s susceptibility to cognitive biases.

Different patterns can also be recognized for specific biases: The analyses of stereotyping and in-group bias provide a lower reported susceptibility for “openness for support” and a higher reported susceptibility for “dependence on others”. For the curse of knowledge, the planning fallacy, and the bandwagon effect we observed a lower reported susceptibility for the top25 “dependence on others” (no difference for “openness for support”). And, for the sunk cost fallacy and functional fixedness we observed a lower reported susceptibility of the top 25 “openness for support” (no difference for “dependence on others”).

Comparing the two splits of the spontaneous decision style, the top 25 of the “spontaneous” style show – similar to the original spontaneous top 25 – a lower susceptibility than the bottom 25 to cognitive biases (m(top25)=2.224719, m(bottom25)=2.96154, F(1/280)=135.9949, p<.0001). The top 25 “impulsiveness” on the other hand report a significant higher susceptibility to cognitive biases than the bottom 25 of the same decision style (m(top25)=2.84848, m(bottom25)=2.51064, F(1/304)=24.7836, p>.0001).

A closer look at specific biases shows the following significant differences between the two “sub decision styles”: A lower susceptibility for the top 25 of “spontaneous” and a higher susceptibility of “impulsiveness” can be observed for stereotyping. For the availability bias, the framing bias, the sunk cost neglect, and functional fixedness a higher susceptibility for the top 25 “impulsiveness” is reported (with a lower reported susceptibility for the sunk cost

neglect and functional fixedness for “spontaneous”). The top 25 of “spontaneous” style also show a significant lower susceptibility for the in-group bias and illusory superiority (no difference for “impulsiveness”).

Regarding the bias blind spots, the general perspective does not change: The top 25 of all decision styles show a significant bias blind spot. Differences are again in between the sub decision styles. In contrast to the top 25 of “dependence on others”, the top 25 of “openness for support” show a significant bias blind spot for stereotyping, in-group bias, the framing bias, the sunk cost neglect, and functional fixedness and a negative bias blind spot for the planning fallacy. The top 25 of “spontaneous” show a significant bias blind spot for stereotyping, problem-solving set, in-group bias, anchoring bias, framing bias, and functional fixedness, and a negative bias blind spot for planning fallacy – where the top 25 “impulsiveness” do not show a significant bias blind spot for these biases. As a difference to the other sub decision style, the top 25 of “impulsiveness” only show a slightly significant bigger blind spot for confirmation bias.

These results show that the splitting of the two decision styles “dependent” and “spontaneous” can lead to a more differentiated picture about bias susceptibility and bias blind spot awareness than the original 5 decision styles. But for more reliable information the 7 vs. 5 item decision style index needs to be further validated in different settings.

CONCLUSION

In this article we explored the awareness of bias susceptibility and the bias blind spots of experienced international managers from the C-1 level. The results show that the individual awareness of bias susceptibility and the bias blind spots differ between the individual decision styles of managers. Decision makers with a strong tendency towards a rational or spontaneous decision style see themselves less vulnerable to cognitive biases, but also show a much

stronger bias blind spot than those with the tendency towards other decision styles. On the other hand, decision makers with a strong tendency towards an intuitive decision style tend to recognize their own vulnerability to cognitive biases and show even a negative blind spot – thus seeing themselves more flawed by cognitive biases than others.

As a result, the individual decision style may serve as a predictor for one's own susceptibility for cognitive biases and bias blind spots. By understanding one's own tendencies in decision style, managers can raise their own awareness for the danger of (specific) cognitive biases in their decision and take debiasing measures (a practice that is not yet very popular, as our study shows).

Implications for research

By exploring the two research questions (RQ1: the influence of decision styles on bias susceptibility; RQ2: the influence of decision styles on bias blind spots) this study provided insights for further approaches to analyze the phenomenon of cognitive biases in decision making from an individual perspective, as requested by various scholars (Aczel et al., 2015; Berthet, 2021; Bruine de Bruin et al., 2020; Hutzschenreuter & Kleindienst, 2006). The decision styles (GDSMI) proved as a valuable lens to explore individual differences in awareness for one's own susceptibility to cognitive biases and bias blind spots. Nevertheless, the results highlighted to important questions and issues for future research, namely: a) Are the 5 items of the original GDSMI sufficient to show and potentially explain individual differences in decision-making behavior? b) Are bias blind spots always bias blind spots or do rational decision makers have an accurate self-assessment concerning their vulnerability to cognitive biases? Or does this depend on the specific bias that is examined and on the cognitive background and motivation behind that bias (as the introspect illusion and naïve realism have different interactions with different cognitive biases)? To shed light on these

issues further studies are necessary which will need to be combined with follow-up interviews, focus groups, and ultimately experiments (to compare self-reported measures to actual behavior).

Implication for Practice

The ranking of bias prevalence and the five "bias risk maps" help decision makers to identify their individual vulnerability to certain biased decision behaviors and to signal the risk of underestimating these behaviors because of an individual bias blind spot. This can serve as a starting point for an executive's pro-active debiasing actions.

Considering the obtained results regarding rational decision styles, there is a word of warning to self-proclaimed rational managers: They should consider that they are overly confident and optimistic in their self-assessment and apply debiasing measures like a devil's advocate or "consider the opposite". For the other decision styles, a similar practical implication seems clear: Use more debiasing techniques, especially when you identify yourself as an intuitive decision maker.

Limitations

This study exhibits the typical weakness of any survey-based research. The results are based on a self-assessment and self-observations of individual decision-making behaviors. A complementary approach could be, as noted above, to compare the self-observations with actual decision-making behaviors in an observational or experimental study and contrast these findings with the data from this survey. This would provide deeper insights in the actual bias proneness, awareness, and bias blind spots of executives.

A second limitation (that resulted in a minor methodological contribution) regards the quality of the GDSMI score and its predictive value for decision-making behavior, as the five original decision style may not provide enough accuracy in grasping the differences in decision

making. Here the distinction introduced in our study (i.e., openness for support and dependence on others) should be further tested in different research settings to show its usefulness.

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