COGNITIVE BIAS IN SAFETY DECISION-MAKING

The Influence of Regulatory Frameworks

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COGNITIVE BIASES are unconscious systematic deviations that are present in every aspect of life. They can significantly shape how people interpret and interact with their environment (Wilke & Mata, 2012). Even decisions made by subject matter experts in workplace safety are susceptible to cognitive biases (Berthet, 2022). These biases originate from cultural norms and values, internal and external influences, and emotional states.

How cognitive biases impact decision-making has been thoroughly researched in professional fields such as healthcare, management, law and finance (Berthet, 2022). For occupational EHS, research has found that cognitive biases are present in incident investigation and safety auditing (Hollnagel & Macleod, 2019; Thallapureddy et al., 2023). However, an opportunity exists for empirical studies in the EHS profession about decision-making in workplace safety. This article explores whether and how frameworks, such as those from OSHA, may contribute to cognitive biases. Specifically, this article explores how their emphasis on certain types of information, such as injury and illness rates, incident investigations and cited violations, might influence decision-making (Erkal & Hallowell, 2023; OSHA, 2023). The extent to which these frameworks contribute to such biases requires further investigation.

This article explores how cognitive biases originate and shape the decision-making of safety professionals in the environment of workplace safety. To accomplish this, the authors examine the safety professional's perspectives and experiences related to decision-making. Through this work, the article seeks to determine the most commonly occurring cognitive biases related to workplace safety as well as the contributing causes for their manifestation (Van Wassenhove et al., 2022). To achieve this, a survey incorporating specific scenarios was designed and implemented to assess the decision-making process within the context of workplace safety. A thematic analysis of the responses revealed consistent themes and patterns that subsequently helped the authors identify the most commonly occurring cognitive biases specific to each scenario.

By recognizing how cognitive biases shape workplace safety decisions, safety professionals may develop strategies to gain awareness of the influences of cognitive biases. These strategies can help to mitigate their impact, strengthen their decision-making processes and foster a deeper understanding of all the factors that contribute to workplace safety.

KEY TAKEAWAYS

- **Cognitive biases are present in workplace safety decision-making. This study examines several biases that can shape how safety professionals interpret information and make choices, including authority bias, focusing illusion, anchoring bias, availability bias and status quo bias.**
- **Regulations, such as those set by OSHA, can unintentionally contribute to cognitive biases in decision-making.**
- **This article explores how regulatory emphasis on certain types of information such as injury and illness rates, incident investigations and cited violations might influence safety professionals' decision-making.**

Literature Review

Decision-Making

In the occupational EHS industry, decision-making is crucial and continuous (Dekker, 2019). It forms the foundation for creating policies and procedures, as well as guiding every aspect of day-to-day workplace safety tasks. Research in this area is abundant and often focuses on whether the decisions made are ethical, sound and evidence-based and have the potential to contribute to adverse events (Murata et al., 2015). An opportunity exists to further explore what factors and processes help shape decision-making in the context of workplace safety.

Bias

Cognitive biases are unconscious ways of thinking that shape every aspect of our daily lives, including those in the workplace (Dekker, 2019). Kahneman et al. (1982) established the foundation for understanding heuristics and cognitive biases. Further research has demonstrated how biases influence decision-making processes across professional domains (Illankoon & Tretten, 2020; Korteling et al., 2023; O'Sullivan & Schofield, 2018).

In occupational areas such as executive leadership, the judicial system, healthcare and finance, cognitive biases have been found to significantly influence decision-making processes. From a workplace safety perspective, Hollnagel and Macleod (2019) found that the process of incident analysis is inherently biased, and Thallapureddy et al. (2023) demonstrated that biases are present as early as the information collection stage of an incident investigation. Maclean and Dror (2021) highlighted that in the case of regulatory inspectors, contextual information can lead to bias in professional judgment.

Dror (2020) identified eight primary sources contributing to cognitive biases in expert decision-making. These sources include data, reference material, contextual information, base rate, organizational factors, education and training, personal factors, and human and cognitive factors.

Methodology

Approach

The purpose of this study is to explore safety professionals' experiences, perspectives and motivations about key decision-making aspects of workplace safety (Brauer, 2022). This study examines their understanding and application of regulatory frameworks and how these interactions may shape their workplace safety decision-making. It also recognizes the dynamic and evolving nature of these interactions as they occur within complex systems and are shaped by individuals' perspectives at a specific point in time. Thus, the data generated by this study is a representation of the participants' knowledge and perception at the time of the survey (Bougie & Sekaran, 2020).

Population Criteria

The study population included members of a professional safety organization's online community and one of its separate in-person local chapters ($n = 60$). This purposive sampling sought participation from individuals actively engaged in the occupational EHS field (Bougie & Sekaran, 2020). Professional experience varied widely,

from being new to the profession to having more than 50 years in the industry. Among the industries mentioned in the responses are general industry, mining, manufacturing and maritime.

Survey

Braun and Clarke (2021) highlight that qualitative surveys generate detailed and varied data as well as provide an experiential framework for in-depth exploration of underlying significance. To ensure rich and diverse data, the survey employed a varied set of questions across multiple formats: open-ended responses for in-depth insights, closed-ended choices for specific feedback, multiple-selection options for nuanced preferences, and Likert scale ratings for quantifiable opinions. The questions were designed and selected to reflect specific scenarios safety professionals may encounter in day-to-day tasks (Brauer, 2022). For example, a common scenario is determining the appropriate metrics to use for measuring workplace safety performance.

The question order was randomized for each participant to mitigate the potential influence of response patterns (Mligo, 2016). Additionally, specific questions about job title, industry, experience and tenure were omitted to prevent leading and priming the survey takers in these subjects (Bougie & Sekaran, 2020).

The survey was made available through several mediums to gather a wide range of opinions. A link was posted at the organization's online communities, an email invitation was sent out to the local chapter's email distribution list, and physical copies were available upon request during chapter meetings. This type of approach favors accessibility and reach, and encourages more open participation (Braun et al., 2017).

To allow equal opportunity to respond and sufficient data to be gathered for in-depth analysis, the survey was open for 14 weeks. To ensure anonymity, participants were not required to provide any form of personal information. Participation in the survey was completely voluntary with no compensation offered. A total of 60 safety professionals participated in the survey.

Data Extraction

Initial Screening

To ensure accurate and useful information, a data quality screening process was conducted before any analysis (Braun & Clarke, 2021). This involved a comprehensive review of the data, identifying and removing incomplete or inapplicable responses from the open-ended questions. For the closed-ended questions, the initial screening consisted of a total count of answers per question. The results of this review were put into a spreadsheet to serve as the main source for subsequent data analysis.

Main Data Analysis

For data analysis, the survey questions and answers were grouped in a spreadsheet according to their format: open-ended, closed-ended, multiple-choice and Likert scale. The open-ended questions were analyzed through inductive thematic analysis, following the phased approached introduced by Braun and Clarke (2021). This method involves systematic exploration of the data to construct themes that adequately reflect the data's content. Each phase in this approach builds on the previous one in an iterative manner, resulting in a deeper understanding of the data.

The initial phase consisted of performing a deep dive to gain familiarity with the data. In the second phase, initial keywords and phrases were identified to create coding based on the data. Recurring themes and patterns in the responses were identified in the third phrase. These themes were then systematically organized into a comprehensive coding framework and compared against definitions for commonly occurring cognitive biases. A list of potential biases was generated that were systematically weighted and organized.

The closed-ended questions are considered qualitative data (Braun et al., 2017). For these, a data analysis was performed to determine how many responses were in each category. This was achieved utilizing a frequency table and visualizing the results. For the multiple-choice questions—also considered qualitative data—the distribution of responses was analyzed by the number of options chosen. This was achieved by utilizing a frequency table and graphic visualization. For the Likert scale—considered ordinal data (numeric)—a frequency table was used to determine the percentage of respondents that chose each option for each question.

Findings & Discussion

Closed-Ended Questions

The closed-ended qualitative questions were designed to gauge respondents' familiarity with specific areas of EHS regulatory frameworks. Table 1 aggregates responses as simple frequency counts (i.e., how many participants selected each answer option). These are presented descriptively in the table with the purpose of illustrating the range of perspectives, and no statistical analysis was conducted.

Notably, the responses exhibited distinct patterns; they were highly consistent for well-known topics such as the OSHA top 10 most cited standards. In contrast, the variability in responses to questions addressing topics such as letters of interpretation (which provide additional context for regulatory intent) or meaning of performance standards points to differences in respondent familiarity with the nuanced aspects of regulatory frameworks.

This uneven familiarity aligns with patterns described in anchoring studies, where prominence of certain standards may disproportionately shape perceptions of relevance. In such cases, these subjects (OSHA's top 10) may dominate discourse, while other lesser-known guidance (letters of interpretation) may receive less attention (Kahneman et al., 1982).

Furthermore, as this list is based on citations issued after an OSHA investigation, any focus on this is ultimately and inherently reactive and skewed toward the standards mentioned in the list (Lundberg et al., 2010). Additionally, the availability of this information and focus is widespread. A search for peer-reviewed articles on "OSHA's top 10 most cited standards" on Google Scholar yields more than 100 results. Conversely, a search for "letters of interpretation" yields fewer than 10. While important, an emphasis on the most cited safety standards could lead to a reactive safety approach that may not address

the unique hazards of each workplace (Dekker & Tooma, 2022). Additionally, it creates a focus point (anchor) toward specific standards, limiting perspectives on workplace safety (Kahneman et al., 1982).

Open-Ended Questions

For the open-ended responses, the authors conducted a thematic analysis to establish emerging patterns in the data. This involved systematically analyzing and coding responses to identify recurring themes, which were subsequently categorized using established definitions of cognitive biases (Braun & Clarke, 2021). For example, responses emphasizing enforcement and compliance were grouped under the theme "OSHA oversight." This theme highlights the potential influence of authority bias (Milgram, 1963), where respondents over rely on information from authority figures, as evidenced by their frequent reference to OSHA's actions.

Authority Bias

One of the most frequent cognitive biases present in the responses was authority bias. This is seeking and accepting knowledge from an authority figure without evaluating it first (Milgram, 1963). This was evidenced by respondents using OSHA standards and interventions as the sole source for organizational safety learning, further understanding safety standards, and determining when training is due. For example, one response was, "previous OSHA investigations helped us better understand the requirements for a safety program." This statement indicates that understanding specific safety requirements was potentially shaped in part due to OSHA investigations (Lundberg et al., 2010).

As Lundberg et al. (2010) note, when investigations are conducted, the subject has already been predetermined by a specific event. This implies that the potential interpretation provided by an OSHA investigation is inherently limited to the investigation's scope and investigator's approach. Consequently, the resulting guidance has that same limitation and may not be ideal for comprehensive learning.

While regulatory interventions can provide the means to address issues, they are limited in scope and reactive, and they may not anticipate the unique and emerging challenges specific to each workplace (Haviland et al., 2012; MacLean & Dror, 2021). Moreover, these standards often require specific letters of interpretation and may not align with current workplace safety practices (Brauer, 2022; U.S. Government Accountability Office, 2012).

Another respondent shared the belief that regulatory interventions are necessary for work to be performed safely: "Years ago, we did not have OSHA oversight on our jobs. We did not know what regulations were available to keep us safe." Several sources have noted the positive impact of OSHA (Michaels & Barab, 2020). However, this exclusive deference to authority may lead to counterproductive safety initiatives based on compliance and control that stifle learning and progress (Dekker & Pitzer, 2016).

TABLE 1
SURVEY RESPONSES (CLOSED-ENDED QUESTIONS)

Survey question	Answer choices	Count
Have you heard of OSHA's "Top 10 Most Frequently Cited Standards"?	1. Yes 2. No	1. 59 2. 1
Some OSHA standards are performance-based; this means the following.	1. OSHA will require performance metrics for compliance. 2. These standards establish the end-result, but not how to achieve it. 3. These are meant as recommendation, not a requirement.	1. 12 2. 47 3. 1
How familiar are you with OSHA's letters of interpretation?	1. Very familiar 2. Somewhat familiar 3. Not at all familiar	1. 42 2. 16 3. 2
Adhering to OSHA standards on the job means the following. Select all that apply.	1. We ensure compliance to the OSHA standards. 2. The task being performed will be completed safely. 3. Is only one aspect of completing the job safely 4. Will give the worker unnecessary paperwork	1. 48 2. 22 3. 45 4. 0

Note. Descriptive summary of responses to the closed-ended questions. No statistical tests were performed.

Focusing Illusion

Placing too much focus on one aspect while ignoring others was common among the respondents (Schkade & Kahneman, 1998). For example, while some considered multiple avenues to get new and emergent concepts for workplace safety updates, their responses underscore the perception that only regulatory sources play a pivotal role when learning about new developments in the field of workplace safety. Frequent responses included, "I am constantly reading updates and such on new rules or regulations" and "just screening the different agency websites weekly or monthly to stay on top of it." This singular focus on a particular method for updating safety knowledge can be attributed in part to the focusing illusion.

Regulatory updates are fundamental in establishing universal worker protection. However, these regulations are crafted generically to encompass as many industries as possible, and lack the granularity to address the internal complexities of workplace safety. For instance, sources such as Dekker and Conklin (2022) argue that effective

workplace safety relies equally on internal organizational learning, and unlike external regulations, this learning emerges through frontline workers' firsthand experience handling complex and emergent scenarios.

Maintaining current knowledge of workplace safety regulations is a fundamental responsibility for EHS professionals. Beyond this essential foundation, however, an opportunity exists for exploration of modern safety theories such as human and organizational performance (Conklin, 2019), Safety-II (Hollnagel, 2017), resilience engineering (Hollnagel et al., 2006), and high-energy control assessments (Erkal & Hallowell, 2023). These theories offer valuable perspectives on understanding and managing risk that may not yet be reflected in codified regulations, especially given the potential lag between new developments and regulatory updates (U.S. Government Accountability Office, 2012).

While practical EHS roles often focus primarily on regulatory requirements, integrating awareness of these broader theories can complement and enrich safety professionals' decision-making processes.

Anchoring Bias

People tend to rely too much on the first piece of information that is encountered (Kahneman et al., 1982). This overreliance leads to what are known as anchors, and once they have been established it can be difficult to see otherwise regardless of the context (MacLean & Dror, 2016). When asked when refresher training should occur, respondents demonstrated a focus on regulatory compliance—both from a specific standard requirement as well as the frequency at which it should be conducted. For example, one response stated, "In my maritime industry, we conduct every 3 years for equipment training." In this case, the specific industry (maritime) requirement becomes the anchor. In other words, the respondent is only considering very specific regulatory requirements for training. While a training schedule to maintain compliance is essential and should be a priority, this narrow focus may lead to overlooking broader opportunities of the rule or others related to learning and expanding knowledge and skills (Casey et al., 2021; Reiman & Rollenhagen, 2010).

Similarly, many responses such as "annual training as mandated by OSHA" or "refresher training every 3 years for equipment training" emphasize regulatory timelines. For instance, the 3-year interval directly aligns with OSHA's 29 CFR 1910.178 (2025) powered industrial trucks standard, as do other cited examples such as "after an incident or injury" and "following accidents where the procedure was not followed, when workers demonstrate inadequate understanding of the risks imposed by their behavior." These recurring themes in responses highlight an anchoring effect with compliance schedules treated as the sole driver of training programs instead of strategies grounded in organizational needs.

Availability Bias

Mental shortcuts that rely on easily recalled ideas that come to mind when evaluating a specific topic are known as availability bias (Kahneman et al., 1982). Survey participants were asked what type of data their organizations use to learn about workplace safety. According to respondents, the primary data analyzed were injury rates and information required for regulatory recordability and reportability such as total recordable injury rate, lost time injury, days away from work, days of restricted work activity or job transfer, experience modification rate, and OSHA forms 300 and 301.

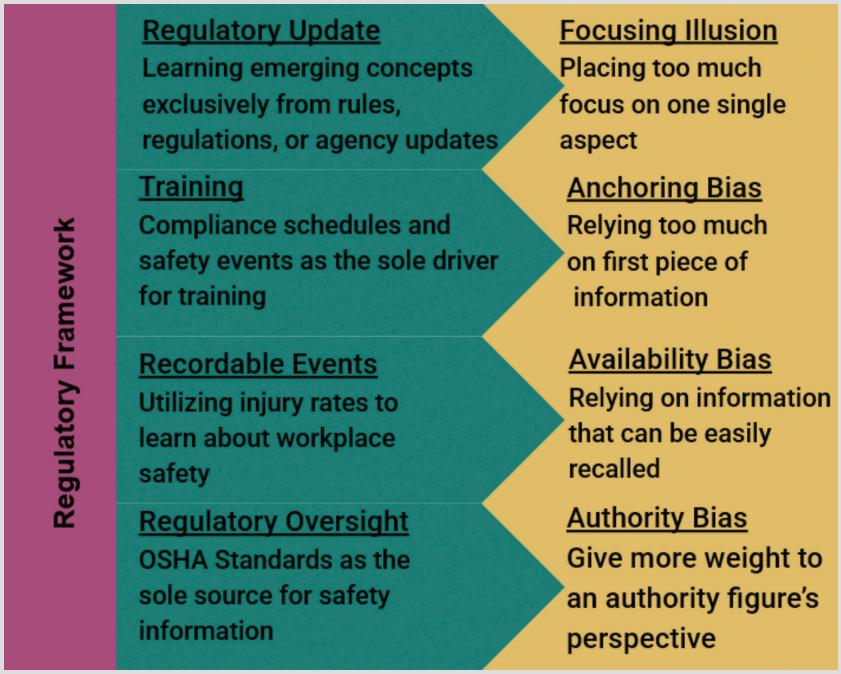
The prominence of these responses can be attributed in part to these indicators being readily available because of regulatory requirements (Dekker & Tooma, 2022; Erkal & Hallowell, 2023). Furthermore, some responses mentioned utilizing these data for benchmarking purposes. One respondent pointed out that they use injury rates for national averages in the specific industry. While learning about how, where and why injuries take place in the workplace is important, this information should not be utilized as the sole learning measure for workplace safety as hazards and injuries are unique to each workplace (Hallowell et al., 2021).

Furthermore, the practical utility of lagging indicators is hampered by inherent underreporting, statistical unreliability and inability to proactively address risks (Committee on Education and Labor,

FIGURE 1

COGNITIVE BIASES ASSOCIATED WITH REGULATORY FRAMEWORKS

This figure demonstrates how specific approaches within a regulatory framework, as identified from participant responses, can be associated with certain cognitive biases.



2008; Hallowell et al., 2021). Additionally, this focus leads to overlooking context-specific leading indicators such as safety suggestions (or lack thereof), daily work risk assessments and worker engagement simply because they are not directly tied to regulatory requirements (Mannan et al., 2016).

Status Quo Bias

The status quo bias is known for favoring established methods and practices while having a reluctance to change (Zeckhauser & Samuelson, 1988). Respondents demonstrated a preference for maintaining the current state of affairs, which is indicative of status quo bias. This was evident when respondents indicated that workplace safety retraining is primarily used to fulfill regulatory requirements. For example, when discussing workplace safety training, phrases such as "as required by OSHA," "depends on if regulatory driven," "it depends on the code," and "after an incident" highlighted this connection. These responses suggest a tendency to maintain the current practices until a regulatory requirement or event necessitates a change.

This reactive approach contrasts with modern concepts of safety science such as Safety-II (Hollnagel, 2017), resilience engineering (Hollnagel et al., 2006), and high-reliability organizations (Weick & Sutcliffe, 2007). These frameworks emphasize proactive learning by understanding how systems succeed in day-to-day tasks. In other words, these frameworks encourage organizations to utilize frontline tasks and daily operational variability as valuable learning opportunities. This approach shifts the organizational focus from reactive training activities that are driven by regulatory requirements to ones that leverage daily operational variability to drive proactive learning and continuous improvement.

The same tendency was noted when participants were asked how they learn about emerging concepts related to workplace safety. The responses included maintaining subscriptions to regulatory body updates and screening agency websites while acknowledging that these methods are not ideal, as noted by one respondent: "Screening the different agency websites weekly or monthly to stay on top of it. Definitely is and should be a way better system." The workplace is a complex system that is always evolving, and relying solely on outdated safety models may fall short of addressing modern safety needs. This dynamic nature demands resilience and innovation in safety approaches (Dekker & Pitzer, 2016; Michaels & Barab, 2020).

Practical Strategies for Addressing Cognitive Biases

Strategies for addressing cognitive biases combine a structured multiphase framework that begins with early, iterative feedback on both the accuracy of judgments and the overall quality of the decision-making process (Fasolo et al., 2024). The next aspect is focusing on learning and education. This starts with bias awareness to help individuals recognize unconscious patterns and strategies to address them, such as utilizing structured counterarguments, in-depth case comparison, and actively generating and including diverse perspectives. A practical application of this strategy in EHS involves integrating real-time multidisciplinary feedback loops into hazard analysis. For instance, during a risk assessment, this means involving frontline workers, supervisors and EHS professionals, and actively incentivizing open communication (Dekker & Conklin, 2022). This approach not only aligns with the "learning from normal work" principle, which incorporates insights from daily operations, but also deliberately includes diverse perspectives to uncover potential blind spots (Fasolo et al., 2024).

A proactive approach to addressing cognitive biases in EHS involves integrating evidence-based bias management strategies into established EHS communication channels. For example, computer-based learning modules can incorporate tools such as the Implicit Association Test to help individuals recognize unconscious biases (Greenwald et al., 2009). Organizations can strengthen decision-making processes by embedding structured counterarguments (actively encourage opposing perspectives), such as challenging root-cause determinations. Similarly, toolbox talks can use scenario plans to simulate diverse outcomes of a job hazard analysis (Morewedge et al., 2015). Machine learning algorithms can also analyze hazard detection and risk assessment data to identify patterns in decision-making (El-Helaly, 2024).

Broader Implications

This article explores how cognitive biases shape decision-making within workplace safety contexts, particularly under regulatory frameworks, as illustrated in Figure 1. While the current focus is on occupational environments, the insights gleaned may extend to other sectors reliant on compliance-driven governance such as environmental management (Goetsch, 2023). In this field, regulations provide the guiding principle for practices, risk assessments and decision-making.

For instance, status quo bias may hinder sustainability efforts such as the transition to renewable energy by framing shifts from established living patterns as a perceived loss rather than necessary progress (Marx et al., 2007). Similarly, availability bias can distort risk assessment related to climate change, as the assumption is that the future climate patterns will resemble familiar past experiences (Hao & Rose Clark, 2023).

Security—specifically, physical security or cybersecurity—is another industry closely related to workplace safety where compliance frameworks may shape decision-making. For example, anchoring bias could lead to focusing on highly publicized events such as a data breach, cyberattack, or ransomware attack, influencing future strategies and risk perceptions (Nobles & McAndrew, 2023).

Overemphasizing a single concern (focusing illusion) can lead to the neglect of other critical risks. For example, in a laboratory environment, prioritizing safety protocols such as preventing spills while overlooking physical security measures such as access controls might leave the facility vulnerable to theft of data, equipment or high-value chemicals (Jin et al., 2025). In both disciplines, acknowledging and understanding cognitive biases can lead to more effective risk assessment, decision-making and regulatory compliance. It can help professionals move beyond reactive measures and adopt proactive, holistic approaches.

Limitations

This study has inherent limitations due to its qualitative nature and thematic data analysis (Braun & Clarke, 2021).

The researcher's background, skills and perspective inevitably contribute to data interpretation. To mitigate this, a rigorous systematic review and iterative coding process was employed. However, it is important to acknowledge that cognitive biases similar to those explored in this study may still influence the findings and should be considered when interpreting the results.

The study relied on self-reported data; as such, participants may have felt the need to provide responses that align with socially acceptable norms (Bougie & Sekaran, 2020). To mitigate this pressure and encourage open answers, observers were not present during the survey. Additionally, the survey was delivered through electronic methods, allowing the participants to complete it privately and at their own pace. Furthermore, participants were informed about the anonymity and confidentiality measures before they began the survey.

Purposive sampling was utilized to select safety professionals as the specific group of interest for this study (Bougie & Sekaran, 2020). This approach prioritized understanding this specific group over claiming representativeness across all occupational roles. As a result, structured data on participant characteristics (e.g., job title, experience, industry) were not gathered, limiting the potential for subgroup analysis. This aligns with the study's goal of identifying decision-making patterns intrinsic to the safety profession. Voluntary participation, while introducing potential self-selection bias, enhances internal validity by ensuring participants were genuinely willing contributors.

Further research is needed to better understand cognitive biases in workplace safety decision-making. Additionally, given that safety roles often encompass responsibilities in environmental management and security, future studies could explore how these biases manifest and interact in these interconnected domains (Dror, 2025). Ecological validity could be further enhanced by conducting this study in a field setting or scenario-based exercises.

Conclusion

One facet of a safety professional's job is to comply with regulatory frameworks (Bougie & Sekaran, 2020). While these are intended to improve safety, they can inadvertently contribute to cognitive biases that shape their decision-making process. This study offers valuable insight on how biases influence workplace safety decision-making. Through a survey designed to reflect day-to-day scenarios and decisions in the context of workplace safety (such as using methods and resources to stay compliant, establishing measurable safety data, utilizing refresher training, and keeping current with emergent safety concepts), the following biases were identified in the responses: focusing effect, anchoring bias, availability bias and status quo bias. Bias shapes how safety professionals interact with the daily role requirements. Overall, the theme is that regulatory frameworks contribute to the manifestation of cognitive biases. These biases, in turn, significantly influence the safety professional's decision-making process. Although biases are inherent to human nature, understanding how and why they affect workplace safety decision-making will enable safety professionals to assess their impact on these decisions (Bougie & Sekaran, 2020).

To mitigate the impact of biases, safety professionals should actively engage in challenging their assumptions about workplace safety. By recognizing and mitigating these biases, safety professionals can make more objective and informed decisions.

Finally, it is important to acknowledge that biases are simply a part of the human experience. Instead of viewing them as inherently good or bad, we should strive to understand their influence on the thought process. **PSJ**

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