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## Article

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## Article

# An Evolving Landscape of the Psychology of Judgment and Decision-Making: A Bibliometric Analysis

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**Abstract:** As a discipline with an expansive and intricate landscape, the field of judgment and decision-making (JDM) has evolved significantly since the beginning of the 2020s. The extensive and intricate nature of this field might pose challenges for scholars and researchers in designing course content and curricula as well as in defining research boundaries. Several techniques from a bibliometric study, such as co-word analysis and co-citation analysis, can provide insights into the scopes and directions of the field. Previous bibliometric studies on the psychology of JDM have primarily analyzed published documents restricted either by content areas or by journal outlets. The present study attempts to analyze a collection of published documents with broad search terms (i.e., “judgment\*” or “decision mak\*”) within the purview of the psychology subject area, separately by years of publication (from 2020 to 2022) using the bibliometrix package in the R environment. The most relevant journals and the most frequent keywords have suggested established areas of study, uncovering common themes, patterns, and trends. Beyond that, two science mapping techniques (i.e., keyword co-occurrence network and reference co-citation network) revealed 12 prominent themes that cut across the three-year period. These themes, alongside other intellectually stimulating issues, were discussed based on a comparison with outstanding book chapters and reviews. Implications for pedagogical purposes were also provided with a handful of notable resources.

**Keywords:** judgment and decision-making; JDM; psychology; applied psychology; bibliometrics



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## 1. Introduction

Judgment and decision-making (JDM) draws on a wide range of disciplines, from empirical philosophy to neuroscience, to better understand social phenomena. This diversity of disciplines has attracted a broad range of scholars and experts, leading to a rich and varied body of work that has driven the field forward. However, this diversity can present challenges, especially when trying to consolidate this broad knowledge base for certain academic activities. For example, designing a course or curriculum, or outlining a book or chapter, can be difficult because it requires a comprehensive understanding of many different areas. This complexity often poses challenges in organizing and presenting information in a way that is accessible and meaningful to students or readers.

Given the critical role that psychology plays in deciphering the intricate mechanisms that drive human decision-making processes, it is unsurprising that the intersection between psychology and JDM has become a central aspect of education, research, and professional practice. Taking into account the diverse nature of the fields of psychology and JDM, this current study aims to use a bibliometric technique to map out interdisciplinary connections, helping to understand how varied disciplines contribute to and influence each other. Bibliometrics is a way to look at data from published scholarly documents (e.g., journal articles and book chapters), and it can be used for two main purposes: performance analysis and science mapping (Zupic and Čater 2015). Performance analysis involves looking at who is publishing what, where, and how often. The current study will identify

the most relevant journals and keywords and then conduct the science mapping by using techniques such as co-word analysis and co-citation analysis to identify trends and patterns in the field. This understanding is vital for educators, researchers, and practitioners, as it helps them appreciate the complexity of psychology and JDM, design curricula that provide a comprehensive view of the field, and formulate research questions that cut across disciplines.

## 2. Landscape of JDM: Insights from Past Bibliometric Analyses, Book Chapters, and Reviews

### 2.1. Past Bibliometric Analyses

A bibliometric approach has been employed to document and conceptualize the knowledge base in diverse domains of JDM. For instance, [Barcellos-Paula et al. \(2022\)](#) conducted a bibliometric review of published articles investigating 17 decision models under uncertainty. Among these models were the Analytic Hierarchy Process, Markov Chain, and Fuzzy Delphi Method, which might be unfamiliar to JDM scholars in the field of psychology, unless they are well-versed in management science. [Cai et al. \(2023\)](#) presented bibliometric results analyzing published articles that included “collaborative decision making” in their titles, abstracts, or keywords, while [Laengle et al. \(2018\)](#) presented bibliometric results analyzing articles published in *Group Decision and Negotiation* from 1992–2016 (to honor and summarize the journal’s 25-year contribution to the field). Cai and colleagues’ work yielded six distinct keyword clusters in the area of collaborative decision-making, encompassing shared decision-making, supply chain management, collaborative governance, collaborative filtering, collaborative/cooperative learning, and quality assurance. In the realm of group decision-making and negotiation, Laengle and colleagues discovered that group decision-making, negotiation, and group support systems were the most frequently nominated keywords, with the network of co-occurrence keywords highlighting research areas such as conflict resolution, facilitation, negotiation support systems, collaboration, and consensus and electronic negotiations.

[Srivastava et al. \(2021\)](#) conducted an updated study where they analyzed bibliometric data extracted from 145 articles. These articles were published in *Decision*, a journal that covers a broad range of JDM aspects, from neuropsychological to sociocultural and economic perspectives. Employing article coupling analysis, the authors identified six distinct research domains that attracted scholarly attention: rationality, uncertainty and risky choices, information search and individual differences, transitivity and intertemporal preferences, quantum decision-making models and emotions, and reinforcement learning models. Furthermore, a keyword co-occurrence network unveiled five thematic clusters of interest: decision-making and mathematical modeling, prospect theory, context effects, choice making, and learning. Although these bibliometric studies had merit within their respective areas, in order to fully utilize the bibliometric techniques in crafting pedagogy courses and book outlines in the psychology of JDM, and to provide directions for psychology scholars engaged in basic and applied research on JDM, a study that delves into the expansive landscape of the psychology of JDM is warranted.

### 2.2. Book Chapters and Review

In addition to previous bibliometric works, certain book chapters can provide a retrospective view of the historical confluence between the domains of psychology and JDM. In the introductory chapter of the book *Judgment and Decision Making at Work*, [Highhouse et al. \(2014\)](#) presented a historical perspective and summarized key milestones in the field of JDM from the 1950s to 2000s, as well as providing information about popular books authored by prominent scholars in the field. According to the milestones, during the 1950s, several academics including Ward Edwards, Paul Meehl, and Herbert Simon, among others, expanded the scope of JDM by offering psychological explanations for anomalies in human JDM that deviated from prevailing economic theorems. For example, [Edwards \(1954\)](#) attempted to integrate psychological mechanisms and explanations into the framework

of expected utility theory. Moreover, Augier (2001) introduced the concept of bounded rationality by sharing excerpts from an interview with Herbert Simon. From the dialogue, Simon encapsulated the gist of bounded rationality by highlighting that “the bounds are the bounds on knowledge, bounds on calculation, multiple objectives, or competing objectives if you have a group of people competing to make the decision” (p. 272, original text italicized). Towards the 2000s, a variety of psychological and social mechanisms were proposed to explain how people proceed with information, form judgments, and make decisions in everyday life. Some renowned examples were subjective probability and subjective utility in prospect theory (Kahneman 1979), the intricate interplay of interpersonal dynamics and group decision-making (Stoner 1968), and the taxonomy of dispositional decision-making styles (Scott and Bruce 1995). Recognizing that JDM’s technical terms (e.g., endowment effect and hindsight bias) have been widely used in the popular press and common conversations, Highhouse and colleagues were able to gauge the importance of the psychology of JDM in applied settings.

The landscape of JDM can also be illuminated by examining its prominent handbook. In the introductory chapter of the Wiley Blackwell Handbook of Judgment and Decision Making, Keren and Wu (2015a) sketched a brief history of JDM by organizing the salient materials chronologically. According to two hypothetical handbooks (conceived by Keren and Wu) and two actual handbooks (Keren and Wu 2015b; Koehler and Harvey 2004), the brief history of JDM can be divided into four periods: the initial period (1954–1972), the second period (1972–1986), the third period (1986–2002), and the fourth period (2002–2014). In their opinions, three themes emerged during the initial period, which have continued to influence, more or less, the trajectories of research and practice in the field: uncertainty and probability theory, risk and utility theory, and strategic decision-making and game theory. The second period introduced concepts like expected utility theory and prospect theory, heuristics and biases, and their applications in diverse areas including economics, marketing, medicine, and social psychology. In the actual handbook of JDM, taken from Koehler and Harvey (2004, p. iv), the interdisciplinary development of the field of JDM became even more evident: “the 1980s and 1990s also saw the field spread from its origin in psychology to other disciplines, a trend that had already begun in the 1970s.” This was exemplified by chapters presenting the contributions from areas such as accounting and finance, governance and public policy, and healthcare, as well as the contributions from sub-areas within psychology such as social, cognitive, developmental, performance, and cultural psychology. For the fourth period (represented by the handbook edited by Keren and Wu), it was evident that the field of JDM has captured the attention of numerous scholars and researchers from diverse fields (the handbook comprises two volumes with a total of 35 chapters, exploring new themes such as decision from experience, neuroscience, and moral judgment and decision-making). Looking ahead, Keren and Wu concluded their chapter by highlighting two future trends in JDM: neuroscience and real-world applications, manifesting in the forms of decision support systems and decision aids.

Keren and Wu (2015b) utilized a method of reviewing literature on JDM published in *Annual Review of Psychology* for the development and design of their editorial handbook. Over the last decade (2014–2023), *Annual Review of Psychology* has published 34 articles with titles, abstracts, or keywords containing “judgment\*” or “decision mak\*”. These publications have shed light on ongoing and emerging trends within the essence of JDM, delineating three loosely interconnected conceptual groupings.

The first group reviewed ongoing trends in the psychology of JDM. Within this group, topics such as normative and descriptive models of JDM (Summerfield and Parpart 2022), the information processing paradigm (Oppenheimer and Kelso 2015), the role of emotion (Lerner et al. 2015), moral judgment and decision-making (Treviño et al. 2014; Malle 2021), and group decision-making (Stasser and Abele 2020) have been examined. The second group focused on upcoming trends, exploring topics that have intermittently captured scholarly interest from unique perspectives within the psychology of JDM. These topics included neuroscientific and neuropsychological foundations that interconnect cognition,

emotion, motivation, and action (Floresco 2015; Botvinick and Braver 2015), the evolutionary roots of human decision-making (Santos and Rosati 2015), choice solutions (Shaddy et al. 2021), and human learning (Gershman and Daw 2017; O'Doherty et al. 2017). The third group reviewed applications of the psychology of JDM in various contexts, as well as integrations of esteemed and widely adopted techniques into the psychology of JDM. These publications covered a range of contexts, including vocation and career (Brown and Lent 2016; Wang and Shi 2014), work and organization (Ryan and Ployhart 2014), mating (Buss and Schmitt 2019), truth judgments (Brashier and Marsh 2020), law and judicial decision-making (Clatch et al. 2020), and game-based applications (Van Dijk and de Dreu 2021). Notice that besides publications that explicitly emphasized neuroscience and neuropsychology as central to their synthesized information (Floresco 2015; Botvinick and Braver 2015), certain publications touched upon how the phenomenon of interest can be explained from neuroscientific and neuropsychological vantage points, thereby signaling the importance of consolidating psychological and social explanations with underlying neuropsychological factors. For example, Summerfield and Parpart (2022) incorporated neurocognitive mechanisms when discussing several phenomena based on normative and descriptive models of JDM, and Van Dijk and de Dreu (2021) mentioned neurocomputational mechanisms in the context of future directions and emerging trends in designing and implementing games for studying social decision-making dynamics.

In the most recent review titled “Judgment and Decision Making” in Annual Review of Psychology, Fischhoff and Broomell (2020) emphasized the analysis of personal and task characteristics when individuals form their judgments, state their preferences, and pick their choices. The authors also reviewed research studies that demonstrated inter-individual differences and intra-individual differences (across the lifespan) in personal characteristics and competencies related to JDM, and those that assimilated the theories and concepts of JDM to enhance JDM processes and outcomes across various domains such as expert judgment, healthcare, policy analysis, and risk communication.

### 2.3. The Current Study

As the outcome of this bibliometric study can serve as a guiding framework for developing and/or updating course content that draws upon the knowledge base of the psychology of JDM, we initiated an informal survey to gather course syllabi and course contents pertaining to JDM via the World Wide Web. A total of 21 course syllabi and/or associated materials were sourced, primarily originating from psychology departments, even though some emanated from different departments such as management and business, public policy and government, and health. By tallying the topics posed in the course contents and course schedules, our observations unveiled heuristics and biases as focal points, explicitly integrated into 14 out of 21 courses (while we cautiously speculated that these topics might be included in all the courses, they might not have been prominently displayed in the course outlines), with the two runners-up being prospect theory and the two systems of reasoning. On the applied front, the concept of nudges was explicitly included in seven courses. Moreover, several intriguing topics featured in more than one course included de-biasing, risk perception and risk communication, behavioral game theory, moral decision-making, group decision-making, strategic decision-making, decision trees, and applied Bayes theorem. Nevertheless, it is vital to acknowledge that this list merely provided a rough overview of the educational landscape in the psychology of JDM, as our approach did not involve systematic retrieval of course syllabi or rigorous analysis of course contents. Yet, we will keep this impression in mind as we proceed to compare and contrast it against the results of the subsequent bibliometric analysis.

In light of the inherently exploratory nature of our work, the current study does not frame specific hypotheses for the forthcoming bibliometric analysis. Any preconceived hypothesis could limit the examination to certain outcomes and potentially overlook broader insights. However, this study can predict potential insights that could emerge from the bibliometric analysis, specifically from the co-word analysis grouping frequently



co-occurring keywords. These insights will essentially take the form of themes arising from keyword clusters across the three years (2020–2022), along with additional observations from various analyses conducted in the study. From a practical standpoint, such themes can inform scholars in their academic work, such as adopting research trends and outlining courses/books.

The predictions are grounded on three key premises. First, a surge is expected in research at the intersection of neuroscience and technology, including artificial intelligence and machine learning, with the goal of enhancing human decision-making through psychological processes. This projection aligns with [Keren and Wu's \(2015b\)](#) outlook and is further supported by recent articles in *Annual Review of Psychology* that integrate neuroscientific and neuropsychological frameworks into the psychology of JDM. Second, as the world still navigates the residual impacts of the pandemic, it seems reasonable that scholars from various fields, including the psychology of JDM, have steered their research towards tackling this global issue. For instance, the comprehensive review by [Vilhelmsson et al. \(2021\)](#) bolsters this argument. Consequently, a significant thematic emergence of the psychology of JDM applied to COVID-19 and health-related issues can be anticipated. Lastly, given the extensive applicability of the psychology of JDM across diverse domains of human life, the integration of novel psychological constructs and concepts into the field of JDM can be expected. Such integration can equip researchers and practitioners with a well-rounded understanding of phenomena, thereby assisting them in creating interventions and treatments specific to particular contexts. A striking example of this is the editorial book by [Fluke et al. \(2021\)](#), which exemplifies how various aspects of psychology, such as the theory of planned behavior ([Rodrigues et al. 2021](#)), can be employed to address challenges in child welfare and protection.

### 3. Methods

#### 3.1. Bibliometric Analysis

Bibliometric analysis is a big umbrella, encompassing a wide range of analytical approaches tailored to various objectives. As mentioned previously, bibliometric analysis has two main functions, i.e., performance analysis and science mapping ([Zupic and Čater 2015](#)). In line with our objectives, we focused on outcomes that help scholars make well-informed decisions in their academic pursuits. This includes selecting relevant topics for courses or books and determining the appropriate emphasis on specific content. For performance analysis, particular emphasis was placed on identifying significant journal outlets and keywords, as these elements can offer effective search parameters for scholars seeking to refine their work. The number of citations of the journal articles was de-emphasized due to the limited timeframe (i.e., we exclusively considered journal articles published in 2020–2022 so that the number of citations may provide incomplete information). For science mapping, we strived for co-word analysis and co-citation analysis, separately analyzed by publication years. A co-word analysis will yield a thematic network that illustrates recent themes within the realm of psychology and JDM, visualizing their spatial relationships. A co-citation analysis will also yield a thematic network, revealing recent themes inferred from the collective citations of a group of references across journal articles. Through these analyses, we sought to uncover insightful directions that can inform and update our understanding of these subject areas, thereby enriching our scholarly comprehension.

#### 3.2. The Details of the Analyses

The co-word analysis and co-citation analysis have specific details worth mentioning. To ensure meaningful conceptualization of the extracted themes, we imposed constraints on the keywords subjected to analysis, encompassing only those that appeared in a fair number of journal articles, and in the same vein, also imposed constraints on the references being analyzed to those that have been cited by a fair number of journal articles. Keywords with minimum appearances and references with minimum citations would insert too much noise into the resulting networks. In addition, bibliometric data retrieved from the

database may contain duplicate keywords conveying equivalent semantics (e.g., emotion, emotions, and affect) or references denoting the same scholarly work (e.g., author names featuring distinct initial variations). Therefore, we consolidated information from duplicate keywords and references before conducting co-word and co-citation network analyses. Notably, co-word networks were examined based on a similarity matrix containing the number of a pair of keywords that co-occurred in journal articles. Thus, keywords presented more frequently in journal articles were more likely to exhibit co-occurrence with other keywords compared to those presented less frequently. We planned to analyze co-word and co-citation networks discretely across distinct publication years, yielding three networks each. In order to prevent fluctuations in keyword and reference popularity (which may vary from year to year) from exerting undue influence on the network's structure, we decided to normalize co-occurred keyword data by the total frequency of each keyword mentioned within the annual pool of journal articles, using the Salton's index ([Aria and Cuccurullo 2017](#)). Likewise, co-cited reference data underwent normalization for the same reason, using the same index.

### 3.3. The Recruitment Process and a Final Pool

This bibliometric study employed a highly exploratory approach, utilizing broad search terms to encompass any articles related to the domain of psychology and JDM. Specifically, the search terms “judgment\*” OR “decision mak\*” for article titles and keywords were applied to the Scopus database. To reduce a false positive rate, these terms were not applied for abstracts (e.g., authors might have mentioned these terms to notify implications of their findings with no essence related to JDM). Further restrictions included subject area (“psychology”), document type (“article” OR “review”), language (“English”), source type (“journal”), and year (“2020”, “2021”, and “2022”). The resulting bibliometric data were obtained from 2733 articles published in 2020, 2586 articles published in 2021, and 2745 articles published in 2022. CSV files containing the data were retrieved at the end of April 2023. Although Scopus selects articles based on both author and indexed keywords under the keywords category, articles with the target search terms exclusively in the indexed keywords were not excluded, as some authors might choose more specific keywords without mentioning broader keywords like *judgment* and *decision-making*. Non-content articles were screened out, resulting in the exclusion of two award announcements and one correction of a previous publication. As a result, the dataset consisted of bibliometric data extracted from a total of 8061 articles, published over three years: 2731 in 2020, 2586 in 2021, and 2744 in 2022. This article pool might over-represent the scope of the psychology of JDM, but as the aim of the study was to explore a broad landscape rather than drawing a boundary between various topics related to the psychology of JDM, the over-inclusion of articles would be preferable to under-inclusion.

## 4. Results

### 4.1. Performance Analysis

In total, bibliometric data from a corpus of 8061 articles were analyzed by year of publication. The articles published in 2020 ( $n = 2731$ ) were written by 9961 authors, cited on average 10.0 times per paper (2.5 times per paper per year), and contained 138,847 references and 7675 keywords. The most cited article (with a total of 2513 citations) was the work by [Van Bavel et al. \(2020\)](#), published in *Nature Human Behaviour*, synthesizing social and psychological factors that can impact human judgment and decision-making processes in response to the COVID-19 pandemic. The articles published in 2021 ( $n = 2586$ ) were written by 8964 authors, cited on average 5.5 times per paper (1.8 times per paper per year), and contained 143,647 references and 7556 keywords. The most cited articles (equally with a total of 177 citations) were the works by [Marvaldi et al. \(2021\)](#), published in *Neuroscience and Biobehavioral Reviews*, meta-analyzing the prevalence of mental health concerns (e.g., depression, anxiety, and stress) among healthcare workers in the period of the COVID-19 pandemic, and by [Harwood et al. \(2021\)](#), published in the *Lancet Child and Adolescent*

Health, presenting the outcome of an online Delphi process in reaching a national consensus regarding the pediatric inflammatory multisystem syndrome temporally associated with COVID-19 as a decision guideline for healthcare teams. The articles published in 2022 ( $n = 2744$ ) were written by 9420 authors, cited on average 1.7 times per paper (0.8 times per paper per year), and contained 155,367 references and 8070 keywords. The most cited article was the work by [Mariani et al. \(2022\)](#), published in *Psychology and Marketing*, utilizing a bibliometric approach to cluster topics and theoretical frameworks within the realms of marketing, consumer research, and psychology with a focus on their relation to the intellectual corpus on artificial intelligence. For more details, please refer to Table S1 in the Supplemental Materials for the top five most cited articles by publication year.

Table 1 displays the top five journal outlets that have published the most articles related to the psychology of JDM, organized by year of publication. Although a direct comparison between these journal outlets may not be feasible due to varying total numbers of published articles each year, examining the trend in journal names across the years can yield valuable insights. Notably, *Frontiers in Psychology* has consistently published the highest number of articles with titles or keywords related to judgment or decision-making, which is in line with its broad coverage of psychology. *Cognition*, *Technological Forecasting and Social Change*, and *Journal of Experimental Psychology (General)* have also consistently been ranked among the top journal outlets for at least two years. However, two remarkable journal outlets were *Appetite* and *Journal of Interpersonal Violence*. In 2020, *Appetite* published a total of 41 articles purportedly connected to the psychology of JDM, reflecting the role of psychology in exploring consumer decision-making and behavior, particularly with regard to food choices (e.g., package labels; [Temple 2020](#)), food purchases (e.g., in supermarket stores; [Machín et al. 2020](#)), and efforts to reduce meat consumption ([Harguess et al. 2020](#)). Additionally, in 2021, *Journal of Interpersonal Violence* published 40 articles purportedly connected to the psychology of JDM, highlighting the applicability of JDM theories to research on interpersonal violence such as moral decision-making (e.g., morality-related emotions and moral rules; [Trivedi-Bateman 2021](#)), decisions made by victims of criminal acts (e.g., decisions to report incidents and to seek help; [Fissel 2021](#)), and the decision-making process involved in leaving an abusive partner (e.g., [Barrios et al. 2021](#)). These findings underscored the importance of the psychology of JDM in addressing contemporary societal concerns and the necessity of expanding research in these domains.

Upon close examination of the top 10 keywords presented in the manuscripts by year of publication, four key findings have emerged (Table 2). First, moral judgment and decision-making consistently maintained its preeminent position across the three years. When the figures were normalized by the total number of articles per year, a slight upward trend was exhibited, indicating an enduring interest among researchers in delving into the ethical dimensions of JDM. Second, the psychology of JDM may be best studied through the integration of several processes, encompassing both intraindividual (e.g., cognition, emotion, attention, and motivation) and interindividual (e.g., social cognition) factors. Although these keywords may not reveal specific trends within the psychology of JDM, researchers can enhance their knowledge base and research repertoire by studying these fundamental concepts and their interplay. Third, the psychology of JDM may consistently intersect with health-related issues as we found the keyword *cancer* in 2020 publications and the keywords related to the pandemic (COVID-19) and to mental health concerns (depression and anxiety) in 2021 and 2022 publications. Fourth, while the trends associated with individual differences and assessment keywords may not be as transparent, they suggested that researchers may have started to incorporate the concepts and methodologies of investigating individual differences (as well as psychological assessment) into their JDM research endeavors. A more in-depth analysis of research trends within the psychology of JDM will be conducted by scrutinizing the co-occurrence of keywords, using network analysis and cluster analysis, as presented in a subsequent section.



**Table 1.** The most relevant journals.

Journal		Papers
Papers published in 2020		
1	Frontiers in Psychology	114
2	Cognition	70
3	Appetite	41
4	Decision Support Systems	39
5	Neuropsychologia	39
Papers published in 2021		
1	Frontiers in Psychology	126
2	Technological Forecasting and Social Change	82
3	Cognition	66
4	Journal of Experimental Psychology: General	41
5	Journal of Interpersonal Violence	40
Papers published in 2022		
1	Frontiers in Psychology	167
2	Technological Forecasting and Social Change	80
3	Cognition	64
4	Current Psychology	50
5	Journal of Experimental Psychology: General	44

**Table 2.** The top 10 most frequent keywords by year of publication.

2020		2021		2022	
Keywords	Articles	Keywords	Articles	Keywords	Articles
1. Moral judgment and decision-making	74	1. Moral judgment and decision-making	83	1. Moral judgment and decision-making	144
2. Open data	55	2. COVID-19	48	2. Metacognition	48
3. Metacognition	48	3. Metacognition	44	3. COVID-19	44
4. Attention	39	4. Emotion	52	4. Depression	41
5. Emotion	35	5. Motivation	32	5. Social cognition	40
6. Social cognition	33	6. Social cognition	29	6. Emotion	39
7. fMRI	31	7. Attention	28	7. Cognition	31
8. Cognition	30	8. Confidence	28	8. Attention	29
9. Individual differences	30	9. Uncertainty	27	9. Uncertainty	28
10. Cancer	28	10. Anxiety	26	10. Aging & Assessment & Gender	25

Note: The keywords judgment and decision-making were intentionally excluded from these lists because they were used as search terms in this bibliometric analysis. Including them in the lists would not provide additional information or even may be misleading. Keywords that were synonymous or closely related were combined to avoid redundancy.

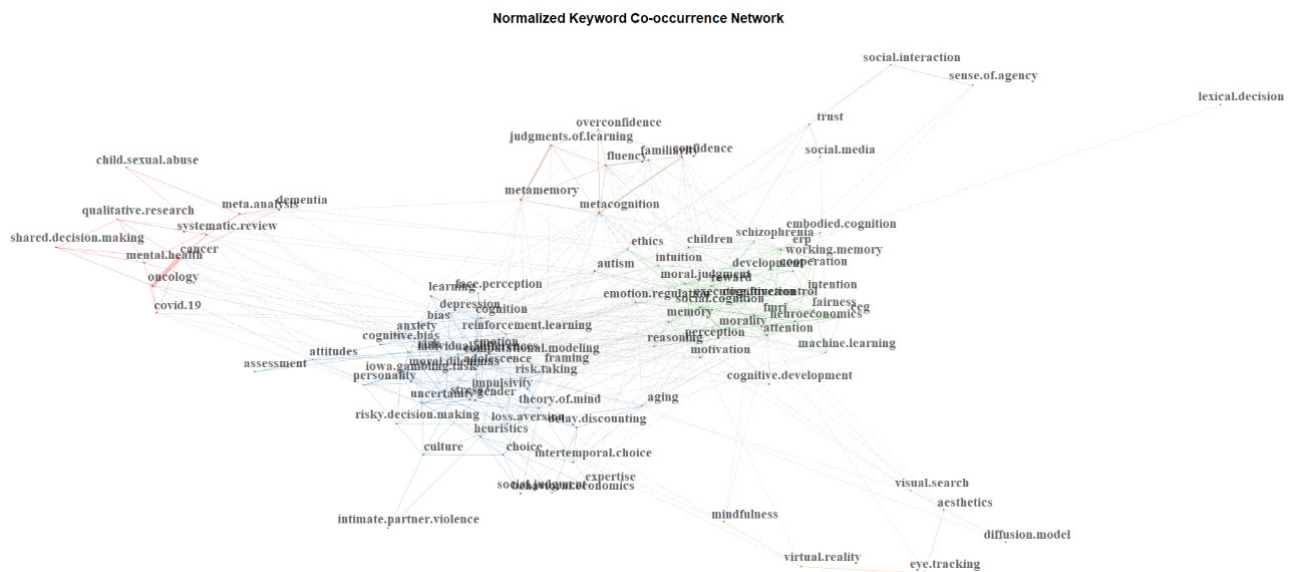
#### 4.2. Science Mapping

In terms of science mapping, this study employed two types of network analyses: keyword co-occurrence networks and reference co-citation networks. Within a network, a walktrap algorithm was used to detect network communities (i.e., keyword clusters and reference clusters), and a Fruchterman–Reingold algorithm was used to layout the network plot (both algorithms are from the networkPlot function of the bibliometrix package (Aria and Cuccurullo 2017)). To prioritize the consistency of themes across the three years rather than individual idiosyncrasies, we would present the results based on commonalities extracted from the three networks for each type. Any noteworthy inconsistencies or unique findings will be attended to in the discussion section.

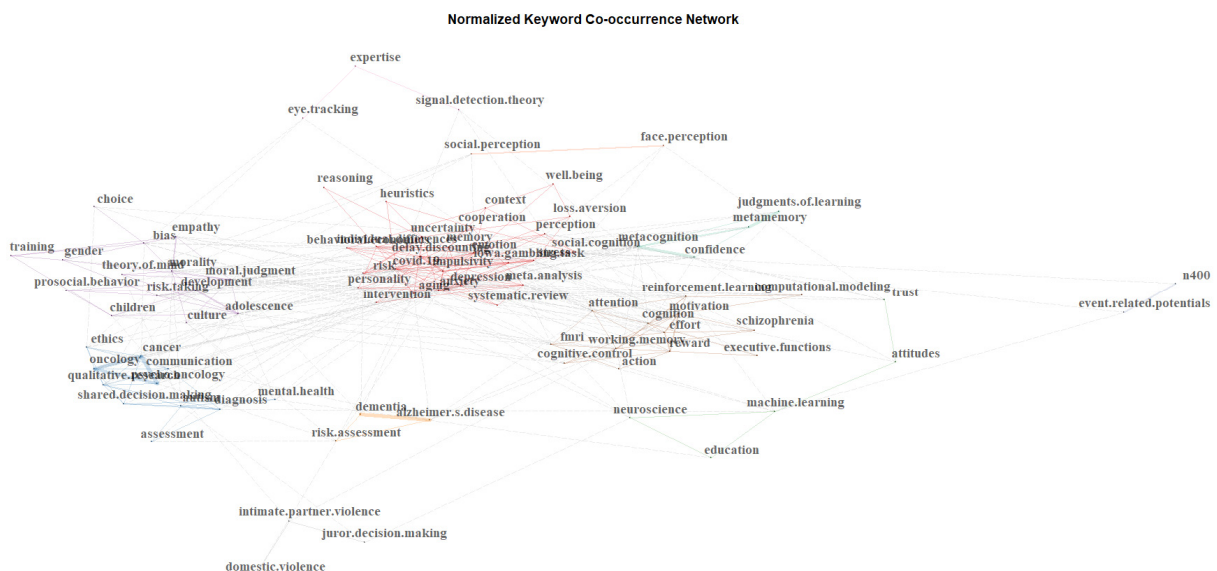
#### 4.3. Keyword Co-Occurrence Network Analysis

When analyzing keyword co-occurrence networks, a preprocessing step was taken to group synonymous (e.g., moral judgment and moral judgments) or conceptually close (e.g., emotion and affect) terms in order to enhance subsequent cluster analysis. Keywords that did not denote content areas (but rather conveyed research policies such as open data or

preregistered) were excluded, while keywords representing research methodologies such as meta-analysis and qualitative research were retained. As the keywords “judgment\*” and “decision mak\*” were used to recruit the articles for this study, they were excluded from the analysis. Otherwise, they could magnetize other keywords to form a large cluster, potentially obscuring emergent themes. Only keywords that appeared in a minimum of 10 articles were selected for analysis. For the year 2020, a total of 94 keywords underwent network analysis, resulting in the identification of eight distinct clusters (see Figure 1). For the years 2021 and 2022, 87 and 100 keywords were subjected to network analysis, resulting in 11 and 15 clusters, respectively (see Figures 2 and 3).



**Figure 1.** Normalized keyword co-occurrence network from the manuscripts published in 2020.



**Figure 2.** Normalized keyword co-occurrence network from the manuscripts published in 2021.



words impulsivity and loss aversion in the 2020 and 2021 networks, and with the keyword intertemporal choice in the 2021 network, but the size of the clusters was so extensive that we could not assume their distinct interconnections. Fifth, juror decision-making and violent cases may have become more prominent recently. In the 2021 network, a group of keywords juror decision-making, intimate partner violence, and domestic violence was observed, and in the 2022 network, the keyword juror decision-making also formed a cluster alongside the keyword sexual assault. Sixth, the keyword trust seemed to play a role in the psychology of JDM. In the 2020 network, it was grouped with keywords such as social media, social interaction, and sense of agency. Although its cluster in the 2021 and 2022 networks was less clear, an interesting pattern emerged with other keywords such as machine learning, neuroscience, ultimatum game, and punishment. Seventh, similarly intriguing, the keyword mindfulness appeared in the 2020 and 2022 networks, but its grouping led to two different lines of research. In the 2020 network, it was grouped with keywords such as aesthetics, virtual reality, and eye tracking, whereas in the 2022 network, it was grouped with the keywords food choice and sustainability.

Eighth, the keyword aging consistently exhibited high closeness centrality throughout the three years—an unsurprising finding given the increasing prominence of the aging population among scholars in the domain of JDM over time (e.g., [Hess et al. 2015](#)). Although the placement of the keyword aging within an excessively large cluster posed challenges in constructing a specific theme related to it, the 2022 network presented an interesting pattern. That is, aging formed a distinct cluster alongside other keywords such as reward, reinforcement learning, cognitive control, and working memory (notably, aging and reinforcement learning were also clustered together in the 2020 network, yet their interrelationship remained elusive due to their location within an overwhelmingly large cluster). Ninth and finally, certain keywords denoting clinical populations including dementia, Alzheimer’s disease, autism, and schizophrenia also found their place in the psychology of JDM, but they did not exhibit a noticeable cluster. An exception was the co-existence of Alzheimer’s disease, dementia, and risk assessment within the same cluster in the 2022 network. Somewhat contrary to expectations, across the three years, the keyword aging did not consistently show associations with the keywords Alzheimer’s disease or dementia, suggesting that the field may not extensively investigate these pathologies in the context of cognitive decline during advanced age. Other keywords that denoted factors generally related to human decision-making processes (e.g., perception, cognition, emotion, personality, and mental health) and topics of broader significance in JDM (e.g., cognitive bias, heuristics, risk, uncertainty, and choice) were consistently present throughout the three years, but they did not form a cohesive cluster with other keywords indicative of the field’s directions, in part due to their frequent placement within extensive clusters.

#### 4.4. Reference Co-Citation Network Analysis

For reference co-citation analysis, certain references that do not specify particular research methodologies or statistical analyses (e.g., statistical programs, a non-specific treatment of power analysis, or crowdsourcing platforms) were excluded, but those that are related to explicit research methodologies or statistical analyses (e.g., mediation and moderation analyses, structural equation modeling, and meta-analysis) were retained. The rationale behind the retention of references related to explicit research methodologies and statistical analyses was inherently pedagogical. Readers may observe, in the reference co-citation network analysis, a grouping of certain methodologies with certain content areas and may use these reference lists as a starting point to explore appropriate methodologies for addressing research questions in particular areas of study. Data from different editions of books were combined, and the most cited edition was represented. This section will begin with an analysis of the most cited references across the three years (in contrast to the most cited articles presented in the performance analysis section). Subsequently, similar to the keyword co-occurrence network analysis, an analysis of three reference co-citation networks (one network for each year) will follow.

The lists enumerating the 10 most frequently cited references for each year can be found in the Supplemental Materials (Tables S5–S7). Some references appeared in the lists for three consecutive years, signifying their impact on psychology and JDM literature. These included three books and five papers. Among the three books, one is a book by [Kahneman \(2011\)](#) portraying the interplay between the dual systems of reasoning, judgment, and decision-making, one is the DSM-5 ([American Psychiatric Association 2013](#)), and the other is a research methodology book tutoring how to analyze mediation, moderation, and conditional process models ([Hayes 2013](#)). Among the five papers, three can be considered “classics” that have drawn the attention of scholars and the public to the role of psychology within the realm of JDM ([Kahneman 1979](#); [Tversky and Kahneman 1974, 1981](#)), one used neuroimaging techniques (e.g., fMRI) to investigate brain mechanisms underlying moral judgment ([Greene et al. 2001](#)), and the other tutored the use of the *lme4* package to analyze linear mixed-effects models ([Bates et al. 2015](#)). Additionally, two papers appeared on the lists for two out of three years. The work of [Haidt \(2001\)](#) emphasized moral JDM as a popular research domain within the field, and that of [Braun and Clarke \(2006\)](#) signaled an expansion of research repertoires among scholars in the field to encompass qualitative techniques, particularly thematic analysis.

In order to derive meaningful clusters in the networks, the analysis was restricted to references that met a minimum citation threshold of 10 articles. As one reference ([Charmaz 2014](#)) seemed to be an outlier (in terms of proximity in the network) and did not form a cluster with other references (in both 2020 and 2021 networks), it was excluded from the network analysis. The results revealed that the 2020 network yielded four distinct clusters from a pool of 71 references, the 2021 network yielded five clusters from 58 references, and the 2022 network yielded four clusters from 94 references. Across the three networks, it was observed that even though certain references consistently attained inclusion in the list of highest closeness centrality coefficients (i.e., indicating frequent co-citations with other references in the network), their groupings displayed variability across different years. In simpler terms, while one reference may form a cluster with certain references in one year, it may form a cluster with different references in another year. Detailed visualizations of the three networks can be found in Figures 4–6, supplemented with additional information found in Tables S8–S10 that present the top five references with the highest closeness centrality coefficients for each cluster. However, despite the aforementioned variations, two prominent groupings consistently emerged over multiple years. The first group consisted of two papers ([Kahneman 1979](#); [Tversky and Kahneman 1981](#)) and one book ([Kahneman 2011](#)), representing a foundational theory in the field and its subsequent extensions and refinements. The second group consisted of two papers ([Greene et al. 2001](#); [Haidt 2001](#)), representing the domain of moral JDM.

The reference co-citation networks revealed three further observations. First, even though the keyword diffusion model appeared in the keyword cluster only in the 2020 network, its relevant documents had been co-cited by a nontrivial number of articles. With R. Ratcliff being the main author, papers that documented mechanisms underpinning models predicting speed-accuracy tradeoffs in decisions during two-choice tasks ([Ratcliff and McKoon 2008](#); [Ratcliff and Rouder 1998](#); [Ratcliff and Smith 2004](#); [Ratcliff et al. 2016](#)) showed a discernable pattern of grouping in both the 2020 and 2022 networks. This pattern attested to their pivotal role in developing cognitive models to explain rapid decision-making phenomena. Second, papers pertaining to the use of neuroscientific techniques in general and electroencephalography (EEG) in particular ([Delorme and Makeig 2004](#); [Luck 2014](#); [Gehring and Willoughby 2002](#)) coalesced into a cluster within the 2021 network, and one paper ([Polich 2007](#)) pertaining to the P300 event-related brain potential appeared in the list of references exhibiting the highest closeness centrality in the 2020 network. Third, the 2022 network showcased a cluster of references (cluster 4, bottom-left in Figure 6) that focused on the application of social cognitive theories, especially self-efficacy theory, in investigating career decision-making and career self-management ([Bandura 1986, 1997](#); [Betz et al. 1996](#); [Lent and Brown 2013](#)). This line of inquiry has incorporated individual



**Figure 6.** A reference co-citation network from the manuscripts of 2022.

## 5. Discussion

By employing bibliometric techniques to explore the multifaceted landscape of the psychology of JDM through the structure of scholarly works, we can gain insights into the directions of the field and provide ideas for those seeking to elucidate conceptual themes and select materials for their pedagogical and academic works. Analyzing a total of 8061 articles allowed us to identify interesting aspects from performance analysis and interesting patterns from science mapping, which will be discussed below. In performance analysis, we can approximate the impact of articles based on their number of citations, pinpoint certain journal outlets that may lie outside the mainstream of JDM but still disseminate applications of the field in specific contexts, and capture the current academic trends by examining the prevalent keywords attached to these articles.

Although the number of citations may not definitively indicate the impact of the articles, given the relatively brief timeframe considered (from 2020 onwards), it was not surprising that the top three articles in 2020 and 2021 pertained to the utilization of psychological frameworks to aid individuals in making better decisions and managing their lives during and after the pandemic, whether they are addressing the pandemic's challenges in general (Van Bavel et al. 2020), handling fake news on social media (Pennycook et al. 2020), or even making food choices during lockdowns (Marty et al. 2021). Although it is uncertain when similar events might occur again, now is an opportune time for JDM scholars to integrate this knowledge into the broader body of JDM literature. Although the concepts related to health/medical decision-making have predominantly revolved around debiasing medical diagnosis, health literacy, shared decision-making, and health behavior change targeting chronic diseases (Chapman 2019; Stiggelbout et al. 2015), the psychology of JDM can also benefit individuals and society when confronting a pandemic, in which the need for rapid behavior change across entire populations becomes imperative.

The analysis of the most relevant journals revealed two journals that diverged from our expectations. One was *Appetite* in the 2020 list, and the other was *Journal of Interpersonal Violence* in the 2021 list, both prominently highlighting the widespread applicability of JDM to practical domains. For the former, articles within this journal have applied JDM to study consumer behavior and consumer decision-making, particularly concerning food products. For example, a study that combined priming, mindfulness, and consumer decision-making found that while priming may not affect individuals' choices between healthy and unhealthy food items, mindfulness (especially its non-judgment component) may diminish the likelihood of opting for unhealthy food options (Farrar et al. 2022). For the latter, there have been many decision tasks in the realm of interpersonal violence, wherein stakeholders can use JDM to alleviate interpersonal conflicts and protect the welfare of the victim, from the decisions to report incidents, seek professional help, and leave abusive partners (Barrios et al. 2021; Fissel 2021), to the decisions in the court. For example, in the case of intimate partner violence involving sexual minority individuals, Stanziani et al. (2018) had participants (acting as mock jurors) read a vignette depicting a violent case of assault by an intimate partner and decide whether the defendant was guilty or innocent. Overall, the decision was influenced by a myriad of factors, including the defendant's and victim's gender and the sexual orientation of the couples involved. Taken together, it is conceivable that decisions regarding food consumption and incidents of interpersonal violence have attracted attention from scholars as well as from the general public, and the psychology of JDM can play a vital role in helping stakeholders and policymakers understand the multifaceted factors that impact their decision-making processes. Decisions on food consumption may align with chapters on consumer decision-making or health decision-making (making healthy choices to prevent chronic diseases; Luce 2015), depending on the focus and scope of the subject matter (e.g., target variables, driving factors, and contexts). Furthermore, there was no chapter regarding JDM and interpersonal violence in Keren and Wu's (2015b) handbook, but several chapters in Fluke et al. (2021) edited book demonstrated the adoption of JDM concepts in child welfare and protection practices such as placement, removal and reunification, and substantiation. Ultimately, these two topics

should find their place within the handbook of JDM (and some JDM courses), either as standalone chapters or as integral components of a more comprehensive chapter.

From the two science mapping techniques, we can identify nine themes from the keyword co-occurrence network analysis and additional three themes (along with key references) from the reference co-citation network analysis. The following themes can be extracted from the keyword clusters: moral JDM, judgments of learning, oncology and decision-making processes, delay discounting, juror decision-making and violent cases, trust, mindfulness, aging and reinforcement learning, and JDM in clinical populations. Three more themes can be added from the reference clusters: neuroimaging techniques, diffusion models, and career decision-making. Fundamentally, most of these 12 themes are not new to the realm of JDM, as comprehensive reviews and book chapters have previously provided substantial insights into these topics (e.g., [Bartels et al. \(2015\)](#) and [Malle \(2021\)](#) for moral JDM, [Koriat \(2015\)](#) for judgments of learning and metacognition, [Tapp and Blais \(2019\)](#) and [Gessler et al. \(2019\)](#) for oncology, shared decision-making, and decision support tools, [Urminsky and Zauberman \(2015\)](#) for delay discounting, [Koebler and Meixner \(2015\)](#) for juror decision-making and [Lausi et al. \(2023\)](#) for violence, abuse, and decision-making, [Patent \(2022\)](#) for trust, cognitive bias, and decision-making, [Gershman and Daw \(2017\)](#) for reinforcement learning, memory, and decision-making, [Sanfey and Stallen \(2015\)](#) for neuroscientific accounts on JDM, [Ratcliff et al. \(2016\)](#) for diffusion decision models, and [Akosah-Twumasi et al. \(2018\)](#) and [Bian \(2023\)](#) for career decision-making and career indecision). To our knowledge, we have not been aware of any research programs or frameworks incorporating mindfulness as a core factor for delineating or improving one's JDM processes. According to the keywords that clustered around mindfulness, two lines of research may appear in the literature: mindfulness and aesthetic experience ([Harrison and Clark 2016](#)), and mindfulness and food choice ([Farrar et al. 2022](#)). Although these lines of research may not yet merit comprehensive reviews or complete chapters, they hold promise in advancing our understanding of the psychology of JDM by incorporating "the behavior of the mind" ([Mikulas 2011](#)) to explicate JDM processes and mechanisms. In addition, a myriad of research studies on JDM have been conducted with various groups of clinical populations such as individuals with Alzheimer's disease, dementia, and autism. Although we could not definitively pinpoint the direction in which the research on JDM and specific clinical populations will progress by merely speculating on a group of keywords, it is safe to say that as an interdisciplinary field, the psychology of JDM can offer considerable potential to mitigate the impaired aspects of JDM processes for patients and to enhance the accuracy of diagnosis and assessment for practitioners.

Pertaining to the educated guesses mentioned earlier, despite the lack of detailed information, the three guesses generally aligned with the results, though to varying degrees of precision. First, we observed certain keywords relevant to neuroscientific and neuroimaging methods (e.g., fMRI and EEG) as well as technology-based applications aiding JDM processes (e.g., machine learning and virtual reality). These keywords were mentioned so frequently in the literature that their inclusion in the network analysis was warranted, but their thematic cohesion with other keywords appeared to be less consistent and less clear. Neuroscientific understanding has a solid ground in moral JDM (potentially stemming from highly cited works by [Greene et al. \(2001, 2004\)](#)), where emotions play a vital role in the courses of operations. Hence, our conjecture was that neuroscientific explanations and methods would be expanded to other parts of the psychology of JDM, especially those involving judgment and decision tasks that evoke strong emotional responses. For technology-based applications, even though discernable patterns related to these areas were not readily observed in the science mapping analyses, the highly cited article by [Mariani et al. \(2022\)](#) may provide insights into at least eight prospective domains where integrating psychological mechanisms with machine learning and artificial intelligence could yield substantial insights (e.g., technology acceptance and adoption in JDM and data mining through social media).

Second, the keyword COVID-19 was identified in the keyword co-occurrence networks across the three years. Notably, three highly cited articles published in 2020 and 2021 presented JDM approaches and interventions aimed at addressing issues related to the pandemic ([Marty et al. 2021](#); [Pennycook et al. 2020](#); [Van Bavel et al. 2020](#)), underscoring the widespread use of JDM theoretical and technical perspectives to drive behavioral change during the pandemic. Although we could not definitely identify major research topics solely related to the keyword COVID-19 within the keyword co-occurrence networks (due to its location within a large cluster), it is undeniable that the field of JDM has learned so much from the pandemic that taking stock of knowledge about the use of JDM techniques for large-scale behavioral change may potentially warrant a dedicated chapter or a substantial section of it. Third, certain keywords previously outside the mainstream of JDM have emerged, including but not limited to intimate partner violence, child sexual abuse, theory of mind, mindfulness, social media, and career decision-making. Collectively, these keywords have painted a broader picture of JDM in diverse contexts, extending beyond laboratory and a gambling paradigm, to facilitate judgment and decision-making processes in the milieu of real-world problems.

From a pedagogical standpoint, three references that should be included in the reading list for any JDM course are [Kahneman \(1979, 2011\)](#) and [Tversky and Kahneman \(1981\)](#) to prepare learners with major theoretical frameworks and historical perspectives in the psychology of JDM. In cases where requiring a book for reading may be impractical or infeasible, either financially or logistically, instructors might consider using [Kahneman \(2003\)](#) as a compact alternative to [Kahneman \(2011\)](#). As the informal survey of the course syllabi revealed that heuristics and biases, prospect theory, and the two systems of reasoning were common topics across most courses, we speculated that most instructors have incorporated these references to solidify the common ground of the learners of JDM. Furthermore, from the analyses of the most cited references and the reference co-citation networks, instructors can select additional references relevant to their course content; for instance, [Tversky and Kahneman \(1974\)](#) and [Gigerenzer and Gaissmaier \(2011\)](#) for more about heuristics and biases, [Haidt \(2001\)](#) and [Greene et al. \(2001\)](#) for moral JDM, [Damasio \(1994\)](#) and [Bechara et al. \(1994\)](#) for emotional and neurological aspects of JDM, [Ratcliff and Smith \(2004\)](#) and [Ratcliff et al. \(2016\)](#) for rapid decision-making with two-choice tasks, [Bandura \(1986\)](#) and [Ajzen \(1991\)](#) for social and cognitive influences on JDM, and [Delorme and Makeig \(2004\)](#) and [Polich \(2007\)](#) for working with EEG. Turning to methodological standpoints, while the inclusion of methodological and statistical references could not (and should not) be entertained in JDM courses, instructors of the psychology of JDM should still be aware of essential methodologies and statistical analyses, as well as their materials, to guide learners interested in JDM research. For research examining individual differences, [Hayes' \(2013\)](#) book and its recent edition, which contain principles and practices in mediation, moderation, and conditional process analysis, may be worth exploring. For research involving experimental manipulation, [Bates et al. \(2015\)](#) article, which introduces the *lme4* package for analyzing hierarchical and nested data such as repeated measurements in experimental designs, may be an invaluable resource.

Altogether, the recommendations presented above were largely consistent with the perspectives put forth by [Weiss and Shanteau \(2021\)](#), who considered the following four approaches of JDM to be successful: the classical conceptualization of heuristics and biases (e.g., [Gilovich et al. 2002](#)), the adaptive toolbox perspective on heuristics (e.g., [Gigerenzer 2008](#)), medical decision-making (e.g., [Chapman 2019](#); [Kaplan and Frosch 2005](#)), and signal detection theory (e.g., [DeCarlo 2002](#)). In the nomenclature of Weiss and Shanteau, the term *successful* was defined as “[an approach] continues to be routinely used by people who are not lineal descendants (students, grandstudents, post-docs) of the developers” (p. 10). Although Weiss and Shanteau’s list of less successful JDM approaches was notably more extensive and included some topics found in our bibliometric analysis, we maintain an optimistic outlook on the future of JDM by observing the application of JDM approaches across various contexts. Equipped with advanced modeling techniques to solve behavioral



challenges in real-world decisions, we anticipate that more JDM approaches will eventually earn a place on the “successful” list, meeting the expectations of both scholarly and non-scholarly audiences. Following Montazeri et al. (2023), we provide a “take-home message” for the readers. In particular, while certain topics that emerged from the analysis have been recognized by scholars in the field (as evidenced by reviews and book chapters), other topics may escape the scholars’ attention or may not yet be mature enough and need more focus. As some scholarly activities may seek novelty (e.g., research integration and course design) or comprehension (e.g., book/chapter outlines), the themes and key references from this study can facilitate these activities to achieve greater academic rigor.

With the intention of gaining a comprehensive understanding of the landscape of the psychology of JDM, the lack of details in the themes emerging from our analyses may be a shortcoming of this study. The expansive nature of each theme may potentially hinder the specific articulation of the scopes and directions within the themes. Interested readers are encouraged to explore in-depth sub-topics and additional materials for use in their research campaign and/or course design. Moreover, some clusters within the keyword co-occurrence networks and reference co-citation networks contained over 20 items, making it challenging to distill precise themes and topics from these clusters. This limitation may be inherent to the criterion that only keywords and references with a substantial number of mentions in the articles were included in the analysis. As a consequence, some topics may have too few a number of keywords or references to form an autonomous cluster. Broadening this criterion might nonetheless lead to the inclusion of less significant themes, but we aimed to identify a reasonable number of themes and topics that have genuinely attracted attention from scholars and researchers in the field. Furthermore, as our plan was to analyze the articles published during a relatively short timeframe at the beginning of the 21st century (2020–2022), topics with fluctuating popularity trends may not be fully represented in this study. Expanding the years of publication might alleviate this limitation, but it might compromise our year-by-year analyses, which is a distinctive feature of the present study. Given that the articles included in the analysis were restricted to the psychology subject area, as indexed by Scopus, it can be implied that the extracted themes and related keywords/references would emphasize *primarily* intra- and inter-individual processes of JDM in diverse contexts. Other subject areas such as medicine or computer science would offer different themes and landscapes (e.g., JDM applied in medical settings or human-computer interactions). Despite its limitations, this study has offered a glimpse into the evolving landscape of JDM, featuring 12 established themes and potential areas of expansion derived from various bibliometric analyses. Scholars can use the information from the articles and keywords highlighted in this study as a starting point. Coupled with prominent references related to their areas of interest, this information can serve as a valuable resource for scholars to direct research programs, outline book chapters, and develop academic courses. With a vast and diverse area of study under the scope of JDM evidenced in this study, we believe that the field has as much to offer more than ever before.

**Supplementary Materials:** The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/admsci14080162/s1>, Table S1: The five most cited papers by year of publication; Table S2: Keyword clusters extracted from the papers published in 2020; Table S3: Keyword clusters extracted from the papers published in 2021; Table S4: Keyword clusters extracted from the papers published in 2022; Table S5: The 10 most cited references from the papers published in 2020; Table S6: The 10 most cited references from the papers published in 2021; Table S7: The 10 most cited references from the papers published in 2022; Table S8: References with the highest closeness centrality in the 2020 network; Table S9: References with the highest closeness centrality in the 2021 network; Table S10: References with the highest closeness centrality in the 2022 network.

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