

Study of Primacy Bias in Therapeutic Decision-Making in Medical Students

Alex Bronsard¹ | Thierry Merrot^{1,2} | Samuel Cogan³ | Gabriel Fonseca⁴ | Emmanuel Pelbois⁵ | Pierre Le Coz¹ | Trousselard M^{1,6,7*}

***Correspondence:** Trousselard M

Address: ¹UMR 7268 ADES, AMU, CNRS, EFS, Marseille, France; ²APHM, Department of Pediatric Surgery, CHU Timone-enfants & CHU nord, Marseille, France; ³Telecom Paris, France; ⁴Centrale Supélec, Université Paris-Saclay, France; ⁵Université Paris 1 Panthéon-Sorbonne, Paris, France; ⁶University of Lorraine, Inserm, INSPIRE, F-54000, Nancy, France; ⁷Institut de Recherche Biomédicale des Armées; Brétigny-sur-Orge, France

E-mail ✉: marion.trousselard@gmail.com

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ABSTRACT

Background: Cognitive biases are common in medicine, yet primacy bias—the tendency to give greater weight to the first piece of information received than to subsequent information—has received little attention, especially in clinical decision-making. This study aims first to examine how this bias affects caregivers' perceptions of patients' preferences and, consequently, their treatment choices. It also investigates whether personality traits such as empathy and mindfulness influence the presence of this bias.

Methods: A fictitious clinical case involving an ethical dilemma was presented to 123 medical students. Information about the patient's preferences was provided in a randomized order, and participants were asked to choose between two possible treatments. Their decisions were analyzed to determine whether the order of information presentation affected their judgment. Questionnaires assessing empathy and mindfulness were used to explore inter-individual differences.

Results: There is a significant effect of primacy bias on treatment choices: the first piece of information received had a stronger influence on participants' judgments than the second ($p = 0.018$). A tendency toward a possible reduced bias was observed among participants with higher levels of mindful acceptance ($p = 0.086$).

Conclusion: Caregivers should be aware of such cognitive biases when making ethical decisions highlighting the importance of specific training.

Keywords: Primacy Bias, Medical Decision-Making, Personalities, Medical Ethics

Short Communication

Cognitive biases are pervasive in medical practice, yet primacy bias - the tendency to give greater weight to the first information received—remains understudied. This study examined how primacy bias influences caregivers' perceptions of patients' preferences and subsequent treatment choices, and whether empathy and mindfulness mitigate this effect. 123 medical students were presented with a fictitious ethical dilemma describing a patient's preferences in randomized order and asked to select one of two treatment options. Results revealed a significant primacy effect: the first piece of information had a stronger impact on judgments and treatment choice than the second ($p = 0.018$). Moreover, higher mindful acceptance tended to be associated with reduced bias ($p = 0.086$). These findings highlight the need for healthcare professionals to recognize and manage cognitive biases in ethical decision-making. Targeted training programs fostering mindfulness and structured reasoning may help minimize the impact of such biases on clinical judgment.

Introduction

In medical practice, choosing the most appropriate treatment is not simply based on the clinical efficacy of drugs. Physicians must also take into account their patients' preferences and lifestyle, in an effort to minimize disruption to their daily lives. This approach requires careful listening, and open communication with the patient. Physicians should ask patients (or their families, if the patient is unable to express their wishes or give informed consent) about their habits and priorities. This information will help in selecting a treatment that respects the patient's choices and lifestyle as much as possible. Furthermore, taking these factors into account encourages adherence to the treatment plan, and optimizes the patient's quality of life. It is important that each piece of information gathered by the caregiver is given the importance it deserves. Care must be taken to ensure that the decision-making process is not distorted, and that the best-possible treatment is provided. The physician must assess the data that is provided objectively, and avoid being influenced by personal biases or preconceived ideas.

The literature highlights the importance of cognitive bias (Heuer, 1999; Kahneman, 2011) as a factor that can inhibit from making the best decisions. Cognitive bias has been widely studied to understand its impact on complex decision-making, including in the medical context. Such biases can affect how physicians interpret and use the information they receive, which can, in turn, degrade the medical decisions that are taken. For example, a cognitive bias that creates a misunderstanding about the patient's lifestyle could lead the physician to choose a treatment that would be deleterious to their patient's work or leisure activities. If this treatment is the only one available, and especially if the disease is severe, taking the

patient's preferences into account may be questionable. However, if an equally effective alternative exists that has less impact on the patient's activities and leisure pursuits, the other option is preferable. The approach ensures that treatment interferes as little as possible with the patient's usual activities, has the maximum benefit, and respects their lifestyle choices. It respects the biomedical ethics principles of beneficence, non-maleficence and autonomy (Beauchamp and Childress, 2019) particularly when several therapeutic options are available.

Among the many cognitive biases, primacy bias, known as first-impression bias, is particularly important. This bias manifests as a tendency to give disproportionate importance to the first piece of information that is received, thus influencing how we interpret and understand subsequent information. In other words, the order in which information is presented plays a decisive role in how it is perceived and remembered. The phenomenon was first highlighted in 1946 by the psychologist Solomon Asch. Asch demonstrated that the perception of a series of adjectives could vary significantly according to their order of presentation, creating a more positive impression, or a more negative one (Asch, 1946). The psychological and cognitive mechanisms underlying primacy bias show that it affects not only how we interpret information, but also the importance we give to it and how we retain it (Asch, 1946; Anderson and Hubert, 1963). Information that is received earlier exerts a stronger influence on our judgment than information that is received later, even if the later information is just as relevant. Although this bias has been studied in the medical field, particularly regarding its impact on diagnoses (Mendel *et al.*, 2011; Atallah *et al.*, 2020), to the best of our knowledge, no studies have focused specifically on its influence in ethical therapeutic decisions. It is therefore important to better understand how this bias might affect caregivers' choices when they must take into account their patients' preferences and lifestyles in a sensitive clinical context.

Beyond this, several studies suggest that certain personal characteristics of the caregiver are associated with a certain degree of protection against cognitive biases. For example, the ability to be mindful seems to be correlated with greater protection against cognitive biases (Lachaud *et al.*, 2022). Mindfulness is defined as the ability to maintain an open, non-judgmental focus on the present moment, and is claimed to de-automatize the automatic decision-making found in cognitive biases (De Neys, 2023). A high degree of mindfulness is associated with greater empathy (Ardenghi *et al.*, 2023). In another study, Law suggests that empathy could impact ethical decisions (Law *et al.*, 2024). However, as far as we know, this ability has not been studied as a protective or risk factor against cognitive bias in the medical context.

Against this background, the general aim of our study is to assess how primacy bias affects therapeutic decision-making, based on a situation where there is an ethical issue. More specifically, we

study whether primacy bias has an effect on physicians' interpretations of the patient's lifestyle and preferences in a situation where there are two therapeutic alternatives, and whether primacy bias influences their choice of treatment.

Our main hypothesis is that the primacy effect significantly influences physicians' choice of treatment in an ethical situation where decisions must be based on the patient's preferences and lifestyle. A complementary hypothesis is that primacy bias influences physicians' confidence in the decision they take. We hypothesize that participants who make a decision contrary to the initial information received will feel less confident in their choice due to the influence of the primacy effect.

Secondarily, we explore relationships between mindfulness disposition and empathic qualities, and primacy bias in this population. Our secondary hypothesis is that physicians with a high level of mindfulness and empathy are less influenced by the order of presentation of information, and make more balanced decisions that are better-aligned with their patients' preferences.

Materials and Methods

Population

This transversal study was conducted in accordance with all applicable regulatory requirements, and was approved by the ethical committee of Aix-Marseille University (France) under registration number 2024-02-15-04. All volunteers provided written informed consent before participation. Data were collected between April and May 2024.

Out of the 123 participants, one was excluded due to incomplete data, resulting in a final sample of 122 French medical students aged between 18 and 25 years ($M = 21.24$, $SD = 1.62$). The sample included a majority of women (74 women, 60.6%). This cohort comprised students from the second to the sixth year of medical school, all of whom had completed hospital placements.

Paradigm

The experimental paradigm analyzes primacy bias in a situation where participants are asked to choose a treatment based on the patient's lifestyle and preferences, rather than on their technical knowledge. To this end, we designed a fictitious clinical case involving a disease and two invented treatments.

Participants play the role of physicians. They must treat a patient who is in a coma, and there are two treatment options: preserve the patient's hearing (Preserve Hearing) or preserve the patient's sense of taste (Preserve Taste). The two options are equivalent in terms of effectiveness, differing only by their side effects. Preserve Hearing may impair the patient's sense of taste and smell, while Preserve Taste may impair their sense of hearing.

Given that both treatments are equally effective, participants must base their decision on their adverse effects. However, the patient cannot express his preferences, and the physician is asked to consult his two sons, regarding what their father would prefer. They meet with them separately. Unfortunately, the two sons have divergent opinions. One son, the Taste Son prefers the Preserve Taste treatment. He points out that their father is a passionate cook, and would no doubt like to preserve his sense of taste. He also questions his brother's ability to understand their father's wishes. The other son, the Hearing Son, advocates for the Preserve Hearing treatment. He states that his father is a music lover, and would prefer to preserve his sense of hearing. He, in turn, questions his brother's ability to know their father's true preferences.

The paradigm is built upon a set of physician-son dialogues. Each conversation follows a three-part structure, as follows ([Table 1](#); see supplementary data):

1. Presentation of the son: The son introduces himself, and describes his relationship with his father, highlighting the positive aspects of their bond. This part aims to give us confidence in him.
2. Treatment preference: The son explains which option his father would prefer, and justifies this by referring to his father's passions: music in the case of the Preserve Hearing treatment; or food in the case of the Preserve Taste treatment.
3. Criticism of the other son: Each son criticizes his brother, and explains why the latter cannot know their father's true preferences. This part aims to make us suspicious of the other son.

Some parts of the sons' dialogues are designed to be open to interpretation, and allow for variations in meaning.

A preliminary test was carried out on a dozen medical students, who did not participate in the main study. Here, the aim was to ensure that the content was perceived as positively or negatively valenced, in other words, that it was correctly labeled.

Table 1: Examples of interpretable content in the dialogue between the physician and each son, followed by interpretations (positive and negative) that the participant could be expected to make. See the appendix for the full text.

Statements made by <i>Taste Son</i>		Statements made by <i>Hearing Son</i>
Important text elements	<i>Taste Son</i> states: "I created my newspaper ten years ago, and I am more than pleased with its success today. [...]I would do anything to give back what he has given me. Last Christmas, I bought him a car. He smiled, and I was proud to make him smile." Argument: "cooking is his passion. I know because the last time he came to see me at work was the day a buffet was organized by a famous chef." If I remember correctly, he dreamed of taking my mother to the restaurant of the Marseille chef, "Alexandre Mazzia." He ends by disparaging <i>Hearing Son</i>: "since he got married to his wife, he has slowly moved away from the family. He only has his wife in mind, and he's become a bit single-minded about it. Dad feels he's forgotten us a bit since he got married."	<i>Hearing Son</i> states "That is why I organized a trip to Japan with Julie and my father a few years ago. Japan is one of my wife's favorite countries, and my father had never been there! It was also a chance for them to get to know each other better." Argument: "music is his passion. I'm sure of it because he was the one who chose the music for Julie's birthday. I don't think he ever misses an opportunity to listen to it. I believe Mozart is his idol. I remember that he and my mother used to listen to him a lot." He ends by disparaging <i>Taste Son</i> "my brother has distanced himself from the family. You know, he made a fortune by creating a newspaper, and since then, all he does is work. It's made him a bit strict and sure of himself. Dad is a little sad to see him working so much. But he seems happy that way, I'm glad he found his path."
Positive interpretation of the text	This extract highlights the positive aspects of the relationship. It underlines <i>Taste Son's</i> efforts to please his father, and his willingness to give back what he has received. This gives us confidence in him.	This extract highlights <i>Hearing Son's</i> efforts to please his father. He organizes a trip, and takes into account his interests, particularly his passion for music. This gives us confidence in him.
Negative interpretation of the text	This excerpt also reveals that <i>Taste Son</i> works very hard, and mainly expresses his affection through material gifts, rather than more personal or emotional gestures. This confirms <i>Hearing Son's</i> criticism that <i>Taste Son</i> works too hard, and has consequently become estranged from the family.	This excerpt also shows that <i>Hearing Son</i> often talks about his wife, which supports <i>Taste Son's</i> claim that his brother has become distant since his marriage.

Experimental Design

The primacy effect was tested by randomly assigning students to two groups based on their order of arrival (alternating assignment: first to Group 1, second to Group 2, and so on). All participants received written information describing the fictitious clinical case, which was read aloud at the start of the session. Each participant was then given a booklet containing two dialogues—each representing a discussion between the physician and one of the patient's sons (*Taste* or *Hearing*). The dialogues were of equal length and separated by a blank page. The experimental design, summarized in Table 2, counterbalanced the reading order: Group 1 read the *Taste Son* dialogue first, then *Hearing Son*; Group 2 read them in the reverse order.

Reading times were controlled and announced orally by the experimenter. Participants were allowed three minutes to read each dialogue, with a one-minute pause in between, marked by the blank

page. They were instructed not to take notes, or go back after turning a page. These instructions were designed to simulate a natural, realistic dialogue.

At the end of this controlled information intake, participants were asked to answer two main questions: How much do you trust each son? And Which treatment would you choose for the patient? They are then asked to indicate their level of confidence in their choice, along with the treatment they would have chosen had they been in the patient's shoes, reflecting their personal preference. Their answers were supplemented by a written statement justifying their choice of treatment. Finally, they were asked to fill in socio-demographic and personality questionnaires.

Table 2: Summary of the experimental protocol, showing the two randomization groups and the expected effects.

Presentation of the experimental study and the clinical case followed by time to read the physician-son dialogue			
Group 1		Group 2	
Taste Son meeting	1 Positive information about Taste Son	Hearing Son meeting	1 Positive information about Hearing Son
	2 Argument for Preserve Taste treatment		2 Argument for Preserve Hearing treatment
	3 Negative information about Hearing Son		3 Negative information about Taste Son
1 min break		1 min break	
Hearing Son meeting	4 Positive information about Hearing Son	Taste Son meeting	4 Positive information about Taste Son
	5 Argument for Preserve Hearing treatment		5 Argument for Preserve Taste treatment
	6 Negative information about Taste Son		6 Negative information about Hearing Son
A 1-minute break is followed by questions about their choice and level of confidence			
Questions	How much do you trust each son?		
	Which treatment would you choose?		
	How much confidence do you have in your decision?		
	Justify your treatment choice.		
	What are your thoughts on each son’s relationship with their father?		
	If you were in the patient’s position, which treatment would you have preferred?		
	Socio-demographic, Empathy, and Mindfulness questionnaires.		
Expected responses in the presence of the primacy effect			
Group 1		Group 2	
How much do you trust each son?	Higher level of trust in Taste Son	How much do you trust each son?	Higher level of trust in Hearing Son
Which treatment would you choose?	Preference for the Preserve Taste treatment	Which treatment would you choose?	Preference for the Preserve Hearing treatment

Variables

Sociodemographic information

Sociodemographic data include age, gender, marital status, level of medical education, and training in ethics

Evaluation of Primacy Bias

These data assess primacy bias. Questions include: (i) The level of trust in each of the brothers, measured using a visual analog scale ranging from 0 (no trust at all) to 10 (full trust). (ii) The choice of treatment (Preserve Taste or Preserve Hearing). (iii) The level of confidence in the therapeutic choice made, measured using a visual analog scale ranging from 0 (no confidence at all) to 10 (full confidence). (iv) The participant's personal preference regarding the treatment (Preserve Taste or Preserve Hearing).

Personality questionnaires

The following validated personality questionnaires were administered.

Sub-factors C (Conscientiousness) and O (Openness) of the Big Five Inventory (Rammstedt and John, 2007). The Big Five model is widely recognized for assessing personality traits in a taxonomic system. The Openness sub-factor, measured by nine items, reflects a personality dimension centered on the appreciation of art, emotion, adventure, unconventional ideas, curiosity, and imagination. The Conscientiousness sub-factor, measured by 10 items, focuses on moral conscience, self-discipline, obligation respect, organization over spontaneity, and goal-oriented actions. These sub-factors have been translated into French by Plaisant, *et al.* (2010) and are expressed on a 5-point Likert scale ranging from strongly disagree to strongly agree.

The Freiburg Mindfulness Inventory (Walach *et al.*, 2006) measures mindfulness disposition. The validated French version (Trousselard *et al.*, 2010). consists of 14 items with four response options (almost never, occasionally, quite often, almost always). This instrument measures two dimensions of mindfulness: Presence (focused attention on the present moment) and Acceptance (an open attitude toward sensations, emotions, and thoughts).

The Basic Empathy Scale (Carré *et al.*, 2013). The validated French version consists of 20 items that measure cognitive empathy, affective empathy, and two other dimensions: emotional disconnection and emotional contagion.

Qualitative Data

Qualitative data captured participants' reasoning for their choices.

Participants were asked two open-ended questions: (i) Justify your treatment choice, and (ii) What are your thoughts on each brother's relationship with their father? Participants could respond freely, with no limitation on how much information they gave.

Statistical Analyses

All analyses were performed using Excel and Statistica software (version 7.1; StatSoft France, Maison-Alfort, France). Quantitative data were analyzed descriptively (numbers, mean, 95% confidence interval (CI)). For numerical data, the distribution of variables followed a normal distribution — or was close to it. The effectiveness of randomization was compared by comparing numbers using Chi-2 tests, and scores using Student's parametric test for independent samples. Statistical significance was considered when $p \leq 0.05$, and $p \leq 0.10$ was considered as evidence of a trend when comparing means.

With regard to the main objective, mean confidence scores were compared using Student's parametric test for independent samples, and nominal confidence preferences and treatment choices were compared using Chi-2 tests.

The secondary objective was to examine potential statistical relationships between participants' levels of mindfulness and empathy, and their susceptibility to cognitive bias. To this end, participants were reclassified—independently of their initial allocation to Group 1 or Group 2—based on two variables: their chosen treatment for the patient and the treatment they would have chosen for themselves. This analytical approach resulted in the formation of four groups. However, it primarily reflects the degree of adherence to personal values or resistance to external influence, rather than providing a direct measure of primacy bias.

Probable primacy bias: This group includes participants who chose the treatment proposed by the first son they met, even though their personal preference differed from that treatment. These individuals appear to have been influenced by the first son's opinion, making them the most likely to exhibit a primacy bias effect.

Possible primacy bias: This group includes participants who selected the treatment proposed by the first son they met, and whose personal preference was consistent with that treatment. Because their choice aligns both with their own preference and the first son's proposal, it is uncertain whether their

decision was truly influenced by primacy bias or simply reflected their initial preference.

Unlikely primacy bias: This group includes participants who chose the treatment proposed by the second son they met, and whose personal preference matched this choice. In this case, a primacy bias appears unlikely, as their choice followed the second son's advice. However, since this decision also aligns with their personal preference, it remains unclear whether they were influenced by the second son or merely followed their own inclination.

Impossible primacy bias: This group includes participants who chose the treatment proposed by the second son they met, despite it being contrary to their personal preference. For these participants, primacy bias can reasonably be ruled out. Their decision suggests that they considered the arguments of both sons and were ultimately more persuaded by the second."

It is important to note that this classification does not allow us to conclude with certainty that a participant was biased. It cannot be used to determine whether a specific individual was influenced by primacy bias. This method operates solely at the group level, highlighting general trends in decisions

As the distributions of the studied variables did not follow a normal distribution, non-parametric statistical tests were used. Specifically, the Kruskal–Wallis test, which is suitable for small samples and non-normally distributed data, was chosen to compare personality questionnaire scores between the four groups.

Finally, the reasons for the therapeutic choice reported by each participant were analyzed thematically to understand how participants interpreted the information presented to them as a function of their randomization group.

Results

Comparison of Randomization Groups

At inclusion, 61 medical students were allocated to each of the two groups defined in Figure 1. There were no differences between the two groups in terms of socio-demographics or personality in terms of age, gender, medical education and experience in ethics.

Assessment of Confidence Level and Choice of Treatment

As shown in Figure 1 left, group 1 assigned mean confidence of 6.2 (95% CI: ± 0.33) to Taste Son (presented first) and 5.95 (95% CI: ± 0.35) to Hearing Son (presented second). In this group, 19 participants

(31.16%) had more confidence in Taste Son, 16 participants (26.23%) had more confidence in Hearing Son, and 26 participants (42.62%) gave the same score to both sons (neutral). Group 2 participants assigned mean confidence of 6.58 (95% CI: ± 0.39) to Hearing Son (presented first) and 5.58 (95% CI: ± 0.40) to Taste Son (presented second). Here, 33 participants (54.1%) had more confidence in Hearing Son, 10 participants (16.39%) in Taste Son, and 18 participants (29.51%) gave the same score to both sons (neutral).

When the two groups are considered together, the 122 participants assigned a mean confidence score of 6.4 (95% CI: ± 0.26) to the first son they met, and 5.8 (95% CI: ± 0.26) to the second son they met (Fig. 2b). Among all participants, 52 (42.6%) had more confidence in the first son they met, 26 participants (21.3%) in the second, and 44 participants (36.1%) gave the same score to both sons (neutral). There was a significant difference in the level of trust in the brother they met first, whether neutral ratings were included ($p=0.035$) or not ($p=0.005$) as shown in Fig. 1 left.

As shown in Fig. 1 right, group 1, 34 participants (55.7%) chose the Preserve Taste treatment proposed by Taste Son (presented first), while 27 participants (44.2%) opted for the Preserve Hearing treatment proposed by Hearing Son (presented second). For Group 2, 40 participants (65.6%) chose the Preserve Hearing treatment proposed by Hearing Son (presented first), while 21 participants (34.4%) chose the Preserve Taste treatment proposed by Taste Son (presented second). Taking all participants together, 74 participants (60.5%) chose the treatment proposed by the first son they encountered, while 48 participants (39.5%) chose the treatment proposed by the second son ($p = 0.018$).

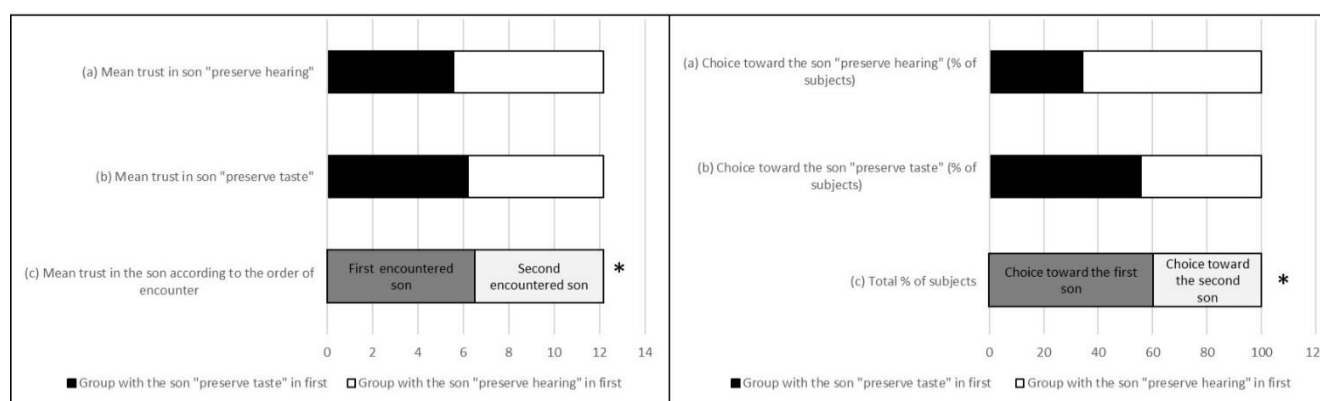


Figure 1: Left: Mean scores in trust according to order of the encountered son. (a): Mean trust for the group with the encountered Hearing Son in first; (b) Mean trust for the group with the encountered Taste Son in first; (c) Mean trust for all participants according to the order of the encountered son; Right: Distributions of participants in percentage (%) according to treatment choice. (a): Choice for the group with the treatment proposed in first by the Hearing Son; (b) Choice for the group with the treatment proposed in first by the Taste Son; (c) Choice for all participants according to the treatment proposed by the first son they encountered. *: $p < 0.05$

Evaluation of The Participant's Confidence in His/Her Choice

In Group 1, participants who chose the Preserve Taste treatment, proposed by Taste Son (who they met first), gave a mean confidence level of 5.57 (95% CI: ± 0.6). Those who opted for the Preserve Hearing treatment, proposed by Hearing Son (who they met second), reported a mean confidence level of 6.1 (95% CI: ± 0.7).

In Group 2, participants who chose the Preserve Hearing treatment, proposed by Hearing Son (who they met first), gave a mean confidence level of 6.1 (95% CI: ± 0.6). Those who chose the Preserve Taste treatment, proposed by Taste Son (who they met second), reported a mean confidence level of 6.2 (95% CI: ± 0.8).

When the two groups are combined, the degree of confidence of participants in their choice of treatment is 5.9 (95% CI: ± 0.3) for those who chose the treatment proposed by the first son they met, and 6.1 (95% CI: ± 0.3) for those who chose the treatment proposed by the second son they met. No significant difference was observed between these two confidence levels.

The Relationship Between Primacy Bias and Personality

The distribution of participants in each group is as follows: 29 participants were in the probable primacy bias group; 45 in the possible primacy bias group; 36 in the unlikely primacy bias group; and 12 in the impossible primacy bias group.

There were no differences between the four groups in levels of empathy, awareness, openness, mindfulness-total and mindfulness presence. A trend was identified for the mindfulness-acceptance sub-factor between the four groups. As shown in Fig. 2, participants in the probable primacy bias group scored lower on mindfulness acceptance ($H(3, N=122) = 6.590521$; $p = 0.086$; Fig. 2).

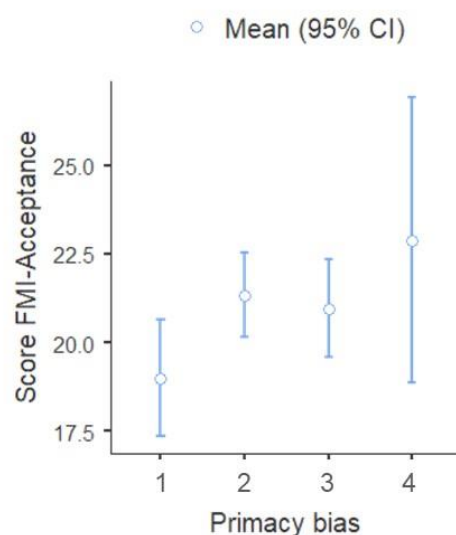


Figure 2: Means and confidence intervals of the mindfulness FMI-acceptance sub-factor for each “primacy bias” group. 1: Group with probable primacy bias; 2: Group with possible primacy bias; 3: Group with unlike primacy bias; 4: Group with impossible primacy bias.

Participants’ Justification for Their Choice of Treatment and Interpretation of The Information Given

Regarding the description of qualitative data, 60% of participants justified their choice on the basis of biographical information provided by the sons about their fathers and themselves. A further 30% used medical arguments, while 40% formulated arguments that did not fit into either of these two categories. These arguments mainly fell into two other categories: one related to work and money, and the other to the son’s relationship with his partner (Table 3).

Seventeen participants in Group 2 justified their choice by arguing that Taste Son’s work, and concern for money tainted his relationship with his father, compared to ten in Group 1. Fourteen participants in Group 1 justified their choice by saying that the relationship between Hearing Son and his wife negatively influenced his relationship with his father, while only six participants in Group 2 argued the relationship between Taste Hearing and his wife was a negative influence.

Table 3: Examples of verbatim in the son-money-work and son-couple categories.

	Group 1: Positive <i>Taste Son</i>	Group 2: Negative <i>Taste Son</i>
<i>Taste Son. Work and money (gift example)</i>	"He seems closer and more indebted to his father. He really wants to please him with giving him the car at Christmas."	"A mostly materialistic relationship, with the thought that money can buy everything, even time. Buying a car when his father would like to see him more, shows that he doesn't know his father."
	"Taste Son seems to spend more time with his father, for example, the buffet, while Hearing Son now has a wife and child."	"A good relationship, however, too material in the sense that he thanks his father by giving him a car instead of spending time with him."
	Group 1: Negative <i>Hearing Son</i>	Group 2: Positive <i>Hearing Son</i>
<i>Hearing Son. Relationship with his wife (travel to Japan example)</i>	"I think Hearing Son loves his father, but lives for his wife. The story of the trip shocked me. He should only have gone with his father if it was really to thank him and choose a destination that his father wanted. His wife is always involved in his decisions."	"A good relationship with his father. They share some quality time together during the trip to Japan. This helps create memories and strengthen ties."
	"I have the impression that (Taste Son) knows more about his father than Hearing Son, who refers to Julie (his wife) at every opportunity- where they travelled to, music, etc. This confirms Taste Son's comments."	"I chose the <i>Preserve Hearing</i> treatment because [...] a person who has a more stable family relationship, through marriage and through their work, is better-able to understand someone else."

Discussion

The main aim of this study was to examine the influence of primacy bias on the treatment decisions of caregivers, in this case medical students, in a situation where it is necessary to take patients' preferences and lifestyles into account. In other words, we sought to assess whether the order in which patient information is presented influences medical ethics decisions.

Given earlier work on primacy bias, we hypothesized that the primacy effect significantly influences physicians' decisions in ethical situations where the choice of treatment is based on patients' preferences and lifestyle. Specifically, in our experimental paradigm, we had expected participants in Group 1 to perceive Taste Son positively (initially presented positively, then negatively) and Hearing Son negatively (initially presented negatively, then positively). For Group 2 participants, we had anticipated the opposite effect, as we had reversed the order of presentation to test the impact of primacy bias. Finally, we had expected participants with high levels of empathy and mindfulness to be less influenced by primacy bias.

Additionally, it should be noted that the distribution of students between groups according to age, gender and year of study was checked retrospectively. The between-group comparison found no significant difference. It should be noted that, overall, the higher number of women compared to men (76 vs. 45) reflects the actual proportion in the Faculty of Medicine, while the higher number of students in the first cycle of medical studies compared to those in the second cycle (77 vs. 45) is linked to timetable constraints

in the different years of study.

Primacy Bias and The Treatment Decision

Our sample consisted of a cohort of medical students who had completed hospital placements. Our results indicate that the order in which information was presented influenced both the degree of trust participants had in the family member who provided information, and their choice of treatment. Among the 122 participants, most trusted the first brother they met than the second: 42.6% trusted the first son, 21.3% the second, and 36.1% reported equal trust. We consistently observed that the majority of participants chose the treatment proposed by the first son they met (60.5%) rather than that proposed by the second (39.5%). Furthermore, the descriptive analysis of qualitative responses indicated possible differences in how participants interpreted and retained information according to their inclusion group. These observations suggest that some participants may have been influenced by the statements of the first brother they met. Thus, the findings tentatively indicate that a primacy effect could have influenced how participants interpreted the information. This effect might have increased their confidence in the son they encountered first and, consequently, their likelihood of selecting the treatment he proposed. Thus, we conclude that the primacy effect did influence the interpretation of information. It increased participants' confidence in the views of the son they met first. This led them to choose the treatment proposed by the first brother.

The Limited Influence of Personality

While empathy had no impact on the primacy effect, a trend was observed for the acceptance dimension of mindfulness. This observation may indicate that acceptance could serve as a potential protective factor for caregivers, helping to reduce susceptibility to cognitive bias. Mindfulness refers to welcoming affect, emotions and thoughts without judgment (Kabat-Zinn, 2003). It has been associated with better emotional regulation in situations of professional overload (Glomb *et al.*, 2011; Klussman *et al.*, 2022). People who accept, rather than judge their mental experience enjoy better psychological health, partly because acceptance reduces negative emotions in response to stressors (Ford *et al.*, 2018). Although our findings remain preliminary and require confirmation in future studies, they tentatively suggest that acceptance might play a beneficial role in moderating cognitive biases, as the primacy bias. Considering this precaution is particularly important, as the four groups mainly capture the extent of adherence to personal values or resistance to external influence, rather than directly measuring a primacy bias.

Cognitive Bias and Medical Decision-Making

A review of the literature shows that the primacy effect is present in many domains, including clinical medicine (Mendel *et al.*, 2011). However, no studies have demonstrated that caregivers' perceptions of their patients' lifestyles and preferences could be influenced by this cognitive bias. This raises important issues in medical decision-making, particularly ethical dilemmas, where choices must be based not only on technical considerations, but also on patients' values and preferences.

In this context, the principle of justice is relevant. Justice is explored in depth by Beauchamp and Childress, in their approach to the principles of bioethics (Beauchamp and Childress, 2019). The principle promotes fairness and equality in treatment, requires medical decisions to be fair and impartial, and advocates against the use of unfounded preferences or unconscious biases. However, the primacy effect can affect caregivers' perceptions. Information is interpreted according to the order in which it is received, which risks subtly biasing decisions. This observation raises the question of equity in care, and highlights the importance of developing strategies to better-understand and limit the influence of cognitive biases, in order to promote more balanced and ethical decision-making.

The influence of primacy bias on decision-making has direct consequences for medical ethics. To fully respect the three principles of medical ethics (Beauchamp and Childress, 2019), it is crucial to have a clear and impartial vision. Being aware of potential biases is therefore essential to ensure that medical decisions respect these principles, and guarantee truly patient-centered care.

Limitations

The aim of our study was to demonstrate that primacy bias influences medical decisions relating to the patient's lifestyle and preferences. Although we did not set out to precisely measure the impact of this bias in real-life practice, the differences we observed are significant, and suggest that it exerts a strong influence on participants' choices. Our experimental paradigm was designed to amplify bias, so that it could be measured, while bias may have less impact in practice. Hence, while our study confirmed the existence of primacy bias in medical ethics, further research is needed to assess its impact in real-life medical practice.

Otherwise, it would be relevant to include more experienced students and physicians, in order to assess if clinical experience modulates the primacy effect. Although our experimental paradigm was designed to be as realistic as possible, participants knew that the case was fictitious. The fact that the patient, and his illness, did not exist could explain why their level of confidence in their decisions was

slightly higher than average. Besides, it is important to note that each participant made his or her decisions in isolation, whereas medical practice is generally collegial (van Baalen and Carusi, 2019). It is legitimate to propose that solitary decision-making in our sample amplified the primacy effect, and this could explain the low level of confidence observed in their treatment choices. The role of shared decision-making as a countermeasure to cognitive biases can be assessed in a collegial setting. Shared decision-making is based on interpersonal and interdependent interaction between physicians, patients and caregivers, who collaborate and influence each other to make decisions about a patient's care (Légaré *et al.*, 2018).

Finally, although between-group differences were statistically significant, and the primacy effect could explain this difference, a significant proportion of participants chose the treatment proposed by the second brother. This shows that cognitive bias cannot explain all of the observed treatment choices. Moreover, we found no difference in the level of confidence in choices between those who opted for the treatment proposed by the first brother and those who chose the treatment proposed by the second. This result suggests that primacy bias does not influence individuals' confidence in their decisions.

Suggestions for Future Research

Progress on the issue of cognitive biases in medicine requires further studies. Firstly, further experiments are needed to find out how other cognitive biases might affect medical practice, including ethical requirements such as justice. For example, it would be interesting to study how cognitive biases affect decisions about treatment priorities when resources are limited (such as when triaging patients in a health crisis), and how we ensure that medical decisions respect our values as caregivers. Secondly, we need to assess and understand factors that protect against cognitive biases, so that they can be incorporated into decision-making processes, and taught to students. Mindful acceptance could be an interesting resource, although further studies are needed to confirm this. In this context, meditation programs could reinforce this cognitive function (Pinnock *et al.*, 2021). It is also necessary to replicate our work with similar studies that analyze other factors and personality traits. This would establish typical profiles that would enable training to be tailored to caregivers' profiles. The present paradigm is a useful starting point in this respect.

Usefulness of The Present Paradigm

We have demonstrated the existence of primacy bias in medical ethics. Our study adds to previous work that highlights its role in clinical decision-making, and underlines the importance of integrating the understanding and prevention of cognitive biases into medical training. In 2023, the French Haute Autorité de Santé alerted physicians about the influence of these biases, and the need to develop solutions to protect

against them, notably by integrating them into training programs (Haute Autorité de Santé).

Our paradigm can be used for this purpose. The experiment is easy to set up and — once appropriate questions have been developed — can be carried out in 15 minutes. Widely available, easy-to-use information technology, such as live surveys and web applications, can be used to analyze the results and make them available immediately after participants have responded. The paradigm is therefore an effective, fun-to-use tool that teachers can easily use to raise students' and caregivers' awareness of their own cognitive biases. Moreover, when evaluating the effectiveness of training, our simple-to-perform experiment is a good way to quantify the influence of cognitive biases.

The simplicity of the clinical case means that non-health professionals can participate in the exercise. The clear differences that were observed in our experiment make our paradigm a valuable tool for measuring protective and aggravating factors, by analyzing which subgroup is most biased. For example, to study the impact of fatigue, we could compare results for a group of caregivers at the start of their 24-hour shift with another group at the end of the same shift. Numerous other contextual and collective factors could also be studied. The simplicity of implementation, combined with significant results even with a small sample size, makes this a particularly useful tool.

Conclusion

Our study highlights the significant impact of primacy bias on medical decision-making. It reveals that the initial information received by caregivers influences their treatment choice, even when provided with additional information. We demonstrate the effectiveness of our paradigm, both in terms of results and ease of implementation. It can be used for further training that seeks to help healthcare professionals to identify the influence of cognitive biases, take them into account, and thus improve their ability to perceive and respect their patients' preferences and lifestyles. Further research is needed — both regarding the impact of various cognitive biases, and the protective factors that can mitigate their effects. By integrating this knowledge and pursuing further investigations, we will be able to make progress towards fairer and more ethical medical decision-making, and ensure better quality care for patients. Recognizing and understanding cognitive biases will enable healthcare professionals to better-navigate complex situations, improving both the efficiency and ethics of their clinical decisions.

Ethics: The study was approved by the ethical committee of Aix-Marseille University (France) under registration number 2024-02-15-04. All volunteers provided written informed consent before participation.

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