

A literature review of a cognitive heuristic: The anchoring effect

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Abstract. The anchoring effect has gained popularity as a cognitive heuristic that aims to explain judgment errors people may make in their decision-making process. This article reviews and documents the literature in this area and finds that there is ample and extensive research available on this topic. By summarizing the results of previous research, it is found that the anchoring effect is a pervasive judgment bias when people are in an uncertain decision-making environment, taking different forms and having varying degrees of influence on decision outcomes. Therefore, this paper aims to summarize the existing findings and build on them for further exploration. To achieve this, the paper takes the type of anchor as an entry point and analyzes how externally provided anchors and decision makers' self-generated anchors respectively influence the decision-making process. Afterward, the article further explores the underlying logic of the anchoring effect through its two explanatory models. Since the anchoring effect has long been considered one of the most robust and common cognitive heuristics, this article then demonstrates the breadth of its application by documenting the various domains in which it has been shown to occur. Finally, this review article suggests several methods in which each of the two types of anchors can be weakened to some extent.

Keywords: Anchoring effects, explanation models, avoiding methods.

1. Introduction

In traditional economics, most of the existing models assume that people are guaranteed to be absolutely rational in their decision-making process in order to achieve utility-maximizing outcomes. However, due to the increasing number of deviations from model predictions and the failure of predictions in several financial crises, people are increasingly questioning some of the assumptions that exist in standard economic models, including the aforementioned "absolute rationality".

In fact, the concept of "limited rationality" was introduced by Simon as early as 1955. It suggests that human decisions are influenced by external circumstances as well as by their internal characteristics (Simon, 1955) [1]. In other words, rationality does not always exist in people's decision-making processes. Often, heuristics - characterized by intuition, speed, and automaticity - are the tools that people use for everyday decision-making (Shiloh et al., 2002) [2]. As heuristics have received increased public attention, the depth and breadth of research on them have grown significantly in recent decades. The anchoring effect, one of the most popular heuristics, has quickly proven to be present in a wide range of fields since it was introduced as "the disproportionate influence of the decision-maker's bias in favor of the initially presented value when making judgments" (Tversky and Kahneman, 1974) [3]. Subsequently, there has been a proliferation of studies related to its explanatory models, species differentiation, etc., which have been deepened and refined over the years.

The main focus of this paper is to provide an overview of the logic behind the operation of the anchoring effect and to demonstrate its breadth by reviewing research on the anchoring effect in various fields. For this purpose, the paper will first explore two types of anchors: experimenter-provided anchoring and self-generated anchoring. It will explain when anchors appear in people's decision-making processes and how they affect people's decisions in different ways. The second section of the article will focus on two mainstream explanatory models of the anchoring effect: the anchoring and adjustment model and the selective accessibility model. This article will base on previous findings to further explain the underlying logic of the anchoring effect through the reasoning

and application of these two models. After the operation of the anchoring effect has been clearly explained and its generality has been sufficiently demonstrated, the final section of the article will propose methods for weakening each of the two types of anchors.

2. Types of anchors

In order to gain a more comprehensive and in-depth understanding of the anchoring effect, it is first necessary to classify anchors from different generating environments and different sources. Based on a review of the current literature, the following two types of anchors can be broadly classified, which are experimenter-provided anchoring and self-generated anchoring. In this section, these two types of anchors are first discussed separately to identify the conditions and reasons for their creation. Then, it will describe the process of how these two types of anchors influence people's decisions through real-life examples.

2.1. Experimenter-provided anchoring

Experimenter-provided anchoring is defined as a reference value provided directly to decision-makers by an external source that has varying degrees of influence on their final decisions (Epley and Gilovich, 2001 and 2005; Wang and Bai, 2009) [4] [5] [6]. In other words, when the decision maker is in an environment with high uncertainty and without access to further reference information. Then the reference values provided by others become the main cues in the decision-making process. The reference in the above situation is referred to as experimenter-provided anchoring.

Use an example to illustrate. Firstly, two different comparison questions are asked for two randomly selected, undifferentiated sample groups. For the first group: Did Gandhi die before or after the age of 140? For the second group: Did Gandhi die before or after the age of 9? Then, ask both groups the same second question: What was Gandhi's age? Given the second question, the median answer for the first group is 67 years old, while the median answer for the second group is 50. In this example, the second question (Gandhi's age) was unknown to most of the subjects. This means that they were in a judgemental situation with high uncertainty and limited information. At this point, the 140 and 9 provided in the first comparison question were likely used as reference values for judging question two. The experimental data showed that the larger anchor 140 induced a larger answer of 67, whereas the smaller anchor 9 induced a smaller answer of 50. This result demonstrates the effect of experimenter-provided anchoring.

2.2. Self-generated anchoring

Self-generated anchoring is a reference value generated spontaneously by the decision maker, which is selected based on the individual's knowledge and experience. It is used to compare the target value in the decision-making process (Epley and Gilovich, 2001) [4]. In detail, in a decision environment with high uncertainty, the decision maker may choose a reference value that he or she knows to be wrong but is close to the right answer. Then adjust it to obtain a final judgement that meets his or her satisfaction. Such a reference value is self-generated anchoring.

Use an example to explain. Ask the question 'When did Washington become President of the United States?' For this question, many people may not know the exact answer. Without further information directly available, the decision-maker will then start to search for information he or she knows about, for example, that the United States became independent in 1776. Following on from this, Washington, as commander-in-chief of the Continental Army in the American War of Independence, might have become president near the year of American independence, 1776. However, Washington did not become president until 1789, thirteen years after independence. Following on from this, Washington, as commander-in-chief of the Continental Army in the American War of Independence, might have become president near the year of American independence, 1776. However, Washington did not become president until 1789, thirteen years after independence. In this case, the

year 1776 is the self-generated anchoring, which derives from the decision-makers own experiences and memories and affects the final decision.

2.3. Internal and external double anchors

Experimenter-provided anchoring and self-generated anchoring also have the potential to occur simultaneously, which is also worth investigating. Then a case study of 'corporate participation in green governance' will be used to describe the situation when both anchors are present at the same time. Green governance, as a sector that is vulnerable to changes in policy, prior returns, and other factors, has been subject to a high degree of uncertainty. Alongside this, due to the long-running nature of its returns, it has limited publicly available reference information. Accordingly, it matches the conditions for self-generated anchoring and experimenter-provided anchoring to arise.

2.3.1. Self-generated anchoring

In this case, the firm's previous experience with green governance, such as the amount of previous green governance inputs, can be a self-generated anchoring for the firm's decision-makers (Lu and Jiang, 2023) [7].

Firstly, green governance is not a standardized quantitative decision and there are no 'standard answers' to itself. Secondly, given the different government policies, different corporate profitability, different living environments, etc., each company's decision-making environment may be unique and lack the value of cross-referencing. As a result, corporate decision-makers are likely to treat previous expenditure data as self-generated anchoring, adjusting to changes in the market environment to determine the current decision to engage in green governance. Lu and Jiang (2023) conclude through descriptive statistics that self-generated anchoring leads businesses' current green expenditures to some extent toward businesses' previous green expenditures [7].

2.3.2. Experimenter-provided anchoring

In the case where corporate decision-makers have but lack experience. The pre-green governance of linking enterprises becomes the experimenter-provided anchoring for the enterprise decision-makers (Lu and Jiang, 2023) [7]. For example, the previous green governance returns and the amount of green governance investment of the linking enterprises (Lu and Jiang, 2023) [7].

As with the above analysis, green governance is decision-making that is fraught with uncertainty. Hence, when the decision makers of a company do not have empirical reserves, they are likely to take the values given directly from outside as a reference. For example, the expenditure of a linked company on previous green governance is not only informative but also interoperable and available. In this case, the linking company's previous green governance expenditure becomes the experimenter-provider anchoring, which has an impact on the amount of green expenditure the company sets for itself. This leads to the phenomenon that the higher the previous green expenditure of the linked company, the higher the current green governance expenditure of the company (Lu and Jiang, 2023) [7].

Notably, when both internal and external anchors are present, the influence of the internal anchor on the final decision is usually greater than that of the external anchor. This case also follows this pattern (Lu and Jiang, 2023) [7].

3. Explanation of the anchoring effect

However, exploring the workings of the anchoring effect only through the type of anchor is not sufficient in terms of the details involved. Therefore, the second section of this paper will focus on the two dominant explanatory models of the anchoring effect: the anchoring and adjustment model, and the selective accessibility model, to provide a deeper insight into the underlying logic of its operation.

3.1. Anchoring and adjustment model

Tversky and Kahneman (1974) stated that anchoring bias, which is defined as the phenomenon of final judgments assimilating towards the initial provision of a starting point, exists because of inadequate adjustment [3]. This theory was later further explained by Jacowitz and Kahneman (1995), their paper stated that the reasons why inadequate adjustment exists are as follows [8]. Generally, the adjustment outcome that satisfies individuals is a feasible interval, rather than an exact value. Therefore, when the adjustment falls into the acceptable interval, the decision maker will often choose to end the adjustment. However, there is still a gap between the judgement that falls within the interval and the exact judgement, and this gap, due to inadequate adjustment, forms the anchoring bias.

This model's operating logic is explained using the case of expected inflation. Based on the principle that economic markets change rapidly, the subjective process of individual judgement of expected inflation is full of uncertainty. Moreover, for the majority, there is limited accessible and valuable information. Consequently, individuals are almost unable to make an accurate judgement on expected inflation either directly or after consideration. In such cases, individuals are likely to choose publicly available, relevant data such as inflation and CPI from previous periods as reference points. Then adjust with current market characteristics and changes for the prediction of future inflation. However, the adjustments made by individuals are often inadequate. This is because they cannot see the full picture of the market. Therefore, the forecast that satisfies them is usually an interval rather than an exact value. This caused the individual to often choose to stop adjusting when the adjustment reached the boundary value of the satisfaction interval. A bias towards the anchor point is thus created.

The findings of Xiao, for China's consumer price index from January 1994 to September 2007, are consistent with the above analysis. He indicates that inflation expectations, after being affected by the anchoring effect, appear to be biased toward past inflation rates (Xiao, 2008) [9]. A similar conclusion was found in an article by Yang et.al, published in 2011. They suggest that in China, individuals tend not to adjust their predicted inflation sufficiently and are influenced by previous periods' inflation rates (Yang et al., 2011) [10].

3.2. Selective accessibility model

In order to explore people's decision-making process and the influence of the anchoring effect on people's decisions in more detail and depth, Mussweiler and Strack (1999) divided the situations of people encountering decisions into three broad categories [11].

The first is where the target value is known; the second is where the exact target value is not known but can be estimated from relevant knowledge; and the third is where the exact target value is neither known nor can it be simply inferred from existing knowledge (Mussweiler and Strack, 1999) [11]. In the third case, the participants' decision-making process usually follows a more complex process, which is known as the selective accessibility model. Within this model, 'anchoring as activation' and 'hypothesis testing' are the two central elements. This section will first introduce how 'anchoring as activation' triggers anchoring bias. Then explain the activation process through 'hypothesis testing'. Finally, use case studies to combine the operating process with reality.

Chapman and Johnson (1999) explain 'anchoring as activation' as follows: anchoring affects the accessibility, retrieval, and construction of the target-value feature being judged [12]. To be specific, when the decision maker is in a third decision situation, he or she will attempt to obtain information from memory or outside sources that can be used to determine the target value. In general, when no reference value is provided, people's decisions, although not necessarily accurate, should generally be free of significant bias or prejudice. However, when an available and representative anchor is provided, the decision maker's retrieval process is susceptible to influence, allowing for an anchoring effect in the final judgement. Explained in other words, the presence of an anchor activates information about its common characteristics with the target value. This makes it easier for the decision-maker to extract anchor-consistent knowledge during the retrieval process. Simultaneously, the availability of features different from the anchor is reduced.

Tversky (1977) stated that when the decision maker is judging whether the target value is above or below the anchor, its actual consideration is how similar the anchor is to the target value [13]. This has resulted in more attention being paid to the common characteristics of the anchor and the target value, and less attention to their differences.

4. Application of anchoring

The anchoring effect has been receiving enthusiastic attention from researchers since its introduction, and research related to it covers a wide range of fields. This paragraph will demonstrate the widespread nature of the anchoring effect, using three areas - finance, law, and corporate governance - as examples.

4.1. Impact of anchoring effects on financial markets

Z Shapira (2005) states that when investors aim to maximise profit and forecast the marginal profit of an investment, they choose to treat the average profit of the previous investment as the anchor, which has an impact on the current investment decision [14].

In addition to investment, stocks, a highly regarded segment of the financial market, have also received a great deal of attention from researchers. Researchers have found that stock prices are influenced to some extent by 'auspicious numbers'. A 2008 study by Rao et.al and a 2009 study by Zhao and Wu have demonstrated that stock prices may be influenced by the 'cult of numbers. Even though these 'auspicious numbers', which are regarded as anchors by some stockholders, have essentially no correlation with the price of stocks (Ran et.al., 2008; Zhao and Wu, 2009) [15] [16].

4.2. Impact of anchoring effects on legal judgements

Mussweiler (2001) used experienced, on average 15 years of successful courtroom experience, judges as experimental subjects in a mock courtroom study to demonstrate that judges' judgements are influenced by the anchoring effect [17]. An article in the Chinese People's Court newspaper indicates that criminal trials may be affected by the anchoring effect in three ways (Tang, 2020) [18]. They are:

4.2.1. Anchoring effect between the investigation and trial departments

The anchoring effect may lead to more serious interlocking errors because of the cross-reference between the investigation and trial departments.

4.2.2. Anchoring effect between different trials

For example, the second trial treats part of the outcome of the first trial as an anchor and makes a judgement in favour of the first trial.

4.2.3. Anchoring effect of external factors acting on the trial

As the trial process is not a completely closed environment, it is impossible to avoid external views becoming an anchor in the judicial decision process. For example, the second trial, to a certain extent, regards the outcome of the first trial as the anchor.

4.3. Impact of anchoring effects on corporate operations and governance

In terms of companies setting the price of the share reform. Xu and Wu (2007) state that companies that have not yet undergone share reform will use the consideration paid by the company that initially underwent the share reform and the consideration paid by the company that recently passed the share reform program as the anchor when setting the consideration [19].

In terms of business acquisition. Chen and Li (2016) collected and studied mergers and acquisitions among A-share listed companies in China from 2004-2011 and found that there is also an anchoring effect in the M&A premium of firms [20].

Besides the two aspects mentioned above, executive pay setting has also been shown to be influenced by the anchoring effect. By collating and analyzing data on executive salaries of listed companies in China from 2002-2005, Liu and Ding (2009) concluded that firms would regard the salaries of their main competitors in the industry as an anchor and influence the setting of their own firm's executive compensation [21].

5. How to weaken the anchoring effect

Epley argues that although the anchoring effect cannot be completely avoided, its impact on decision-making can be mitigated with the right strategy (Epley and Gilovich, 2005) [5]. In this section, the corresponding solution of two types of anchors, experimenter-provided anchoring, and self-generated anchoring, will be discussed.

5.1. Experimenter-provided anchoring solution:

5.1.1. Reverse thinking

Epley and Gilovich's study (2005) reported that the strategy of 'reverse thinking' can reduce the impact of experimenter-provided anchoring to various degrees [5]. According to the 3.2 selective accessibility model, one of the reasons why people are influenced by experimenter-provided anchoring is the activation of information about the similarity of the anchor to the target value and the omission of information about the differences between them. Therefore, if the decision maker is prompted to think about the differences between the anchor and the target value, activating more information related to the differences. Then may reduce the bias in decision-making caused by experimenter-provided anchoring.

Early computer simulations by Chapman and Johnson (1999) of flat rental prices, and later experiments of the price of the second-handed car (Mussweiler et al., 2000), have both demonstrated the effectiveness of the 'backward thinking' strategy [12] [22].

5.1.2. Holistic thinking

When decision-makers use experimenter-provided anchoring as a reference value, as the reference information is provided directly and singularly, it leads to a certain amount of one-sidedness and superficiality in their thinking process. Therefore, if conditions permit, decision-makers may reduce the influence of experimenter-provided anchoring to a certain extent in three ways. Firstly, by looking at the issue from a more diverse perspective. Secondly, by gathering and referring to the advice of more people. Thirdly, by thinking outside the box.

5.2. Self-generated anchoring's solution:

5.2.1. Analogical anchors and Casual adjustment

Experimental data suggest that analogical anchors and casual adjustment can help decision-makers to reduce the impact of self-generated anchoring to some extent (Klenk & Paritosh, 2017) [23]. Based on section 2.2 of the article, the process of decision-making based on self-generated anchoring can be summarized as follows: extracting reference values from experience, making adjustments, and arriving at a final judgement. Specifically, if the decision maker can first empirically extract an analogical anchor and then casually adjust it with additional valid information obtained in the decision environment, it is possible to achieve a reduction in the error of the self-generated anchoring. The effect of self-generated anchoring.

For example, the valuation of a house. One first selects an anchor empirically, based on the type and size of the house, and then adjusts the price concerning the terrain in which the house is located. This is an effective analogical estimation, which reduces anchoring bias to some extent.

5.2.2. Improving individual motivation of pursuing answer accuracy

Epley and Gilovich (2006) suggest that differences in the degree to which decision-makers pursue answer accuracy can affect the accuracy of their decisions [24]. Therefore, if decision-makers can be motivated to pursue the right answer, it is possible to reduce the impact of the anchoring effect. To be specific, incentives for decision-makers in the form of warning of the outcome of their judgement or money may increase their pursuance of the right answer to some extent. The effectiveness of this approach was demonstrated by Epley and Gilovich in 2001 and 2006 [4,24].

6. Discussion

Based on reviewing and organizing the existing literature on the anchoring effect, the main body of this paper provides an overview and further discussion of research findings in this area with a four-part study focusing on, types of anchors, explanatory models of anchors, examples of real-life applications of anchors, and ways to weaken the anchoring effect. This leads to the following conclusions.

The first finding is that the anchors that trigger the anchoring effect can be broadly classified into two types, which are experimenter-provided anchoring and self-generated anchoring. There are both similarities and differences between these two types of anchors. The similarity is that they both occur in a decision-making environment that is fraught with uncertainty. The three differences include the different sources from which the two anchors emerge, the difference in the degree to which the decision maker has a grasp of how well the two types of anchors fit the target value, and the difference in the amount of knowledge required of the decision maker by the two anchors.

The second finding is that the underlying logic of the anchoring effect can be explained in different contexts by the anchoring and adjustment mode and the selective accessibility model respectively. The deductive logic of the Anchoring and adjustment model can be summarized as follows: when decision makers are in an uncertain decision environment, their estimate of the target value is an interval rather than an exact value. Therefore, the adjustments they make based on the anchor usually fail to reach the exact answer. Such inadequate adjustment leads to decision-making errors. Then the reasoning logic of the selective accessibility model can be broadly summarized as follows: since people do not know whether the externally provided anchor matches the target value, they may perform hypothesis testing before making a final decision. This process activates the information that supports the consistency of the anchor with the target value, leading to an increase in the accessibility of the relevant information and bias in the final decision.

The last finding is that although the anchoring effect cannot be completely avoided, it may be weakened to some extent by developing solutions for different types of anchors respectively. It was shown that activating information about an anchor's inconsistency with the target value, which is known as the process of backward thinking, and suggesting that the decision maker thinks more holistically about the problem, can effectively undermine experimenter-provided anchoring. Then, for self-generated anchoring, effective analogical estimation consisting of analogic anchors and casual adjustment, as well as methods that increase the rigor of the decision maker by increasing the individual's quest for correctness, are considered useful.

7. Conclusion

Until recently, the anchoring effect has been studied for almost 50 years and is one of the prevalent topics which deserve to be continuously explored. This review article intends to first outline and analyse the conditions, circumstances, and forms of anchor creation by dividing anchors into experimenter-provided anchoring and self-generated anchoring. Subsequently, a detailed inference of the anchoring and adjustment model, as well as the selective accessibility model, is presented, based on the conclusions drawn from the previous explanatory models of the anchoring effect. It is hoped that the process of reasoning will add depth to the paper's exploration of the underlying logic

of the anchoring effect. After completing the basic introduction and operational inference of the anchoring effect, this paper attempts to demonstrate its prevalence and importance in real life through examples in three fields: finance, law, and corporate governance. Finally, after demonstrating the widespread nature of the anchoring effect, this paper is intended to provide the reader with ways to weaken the anchoring effect and thus reduce the decision errors it may bring about through the final body paragraph.

Overall, although the article attempts to summarise existing research on the anchoring effect through the four sectors of the main body of the article, there are limitations to the article's discussion. First, the discussion addresses the types of anchors. In addition to the classification of anchors as experimenter-provided anchoring and self-generated anchoring, there are many other ways of classifying anchors, such as feasible and infeasible anchors, or psychological and physical anchors. Second, the explanatory models for the anchoring effect. Besides the two mentioned in the text, there are also other models, such as attitude change models that have received a lot of attention from researchers. Therefore, future studies in the review category can focus more on these topics not covered in this paper, thus providing a more comprehensive and deeper exploration of the anchoring effect. Meanwhile, case studies of the anchoring effect or ways to mitigate its effects are also worthy of further research in the future.

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