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Abstract: This study deals with the question of whether the anchoring effect is resistant to interferences. When many items of new information are presented in quick succession, the human capacity to take them in is soon overstretched. A large number of the new items of information are overlaid or deleted. Whether these interferences can also contribute towards a considerable reduction of the anchoring effect is the question which is examined here using an experimental approach. In this process it is revealed that the figure acting as an anchor is not affected by interferences. The anchoring effect is thus obviously not affected by interferences.

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Introduction

Even completely irrelevant figures can have a considerable influence on the assessments of subjects. This phenomenon, which is known as the anchoring effect, was discovered by Tversky and Kahneman (1974). The anchoring effect has subsequently been studied intensively for around four decades now. This has revealed that the anchoring effect causes a distortion of perception and judgement which is almost impossible to overcome (see, for example, Furnham and Boo, 2011; Kahneman, 2011; Oechssler, Roider and Schmitz, 2009; Campbell and Sharpe, 2009; Kaustia, Alho and Puttonen, 2008; Mussweiler, Englich and Strack, 2004; Mussweiler, 2001; Strack and Mussweiler, 1997; Chapman and Johnson, 1994; Cox and Summer, 1987). Even comprehensive information about the anchoring effect or obvious financial incentives usually do not safeguard subjects against the anchoring effect (see, for example, Chapman and Johnson, 2002; Stephan, 1999; Wilson et al., 1996). However, in the meantime some approaches which can lead to a reduction or mitigation of the anchoring effect have been developed. The presentation of good arguments against the anchor (Mussweiler, Strack and Pfeiffer, 2000), calls for people to discover arguments which speak against the anchor (Chapman and Johnson, 1999), and group decisions (Meub and Proeger, 2017) can lead to a mitigation of the anchoring effect.

The human ability to store information is subject to considerable limitations. If one enters a hall where one is welcomed by the host and introduced to 20 other guests, most people will be able to remember two or three of the names at the most. Frequently these are the first and last of the new names. At the same time, this means that minutes later one has completely forgotten 15, 16 or 17 of the new names. This is referred to as an overlaying or deletion of new information due to the immediate presentation of additional significant information. These so-called interferences counteract the storage of the new information in the long-term memory (see, for example, Underwood, 1957; Underwood and Postman, 1960; Ceraso, 1967; Spring, 1968; Mensink and Raaijmakers, 1988; Vester, 2018).

Until now, no studies have been carried out on whether interferences can substantially reduce the anchoring effect. Precisely this research topic is now being addressed by this study.

Experimental design and hypotheses

In order to examine the effect of interferences on the anchoring effect, two treatments are presented. In Treatment 1 (no interference) an anchor is set in the standard paradigm. At the end of November 2019, the subjects are asked whether the German stock index (DAX) at the end of 2019 would be more or less than 2,000 points (low anchor), or more or less than 25,000 points (high anchor). Directly afterwards, the subjects are asked which level they expected the DAX to have at the end of 2019. After this, nine items of information are presented which have nothing to do with events on the capital markets. At the end, questions are asked about this information.

In Treatment 2, first of all three of the items of information which have nothing to do with the events on the capital markets are presented. Then an anchor is set in the standard paradigm. Here again, at the end of November 2019 the subject are asked whether the level of the German stock index (DAX) will be more or less than 2,000 points (low anchor), or more or less than 25,000 points (high anchor) at the end of the year. Only 20 seconds later, the presentation of six additional items of information

which have nothing to do with events on the capital markets begins. Following this, questions are asked about the nine items of information and the subjects are asked to make a forecast for the future trend of the German stock index (DAX).

Table 1: Chronological sequence in Treatment 1 (no interference) and in Treatment 2 (interference)

Treatment 1 (no interference)	Treatment 2 (interference)
1. Setting of the anchor	1. Presentation of the item of information A
2. Forecast of the DAX	2. Presentation of the item of information B
3. Presentation of the item of information A	3. Presentation of the item of information C
4. Presentation of the item of information B	4. Setting of the anchor
5. Presentation of the item of information C	5. Presentation of the item of information D
6. Presentation of the item of information D	6. Presentation of the item of information E
7. Presentation of the item of information E	7. Presentation of the item of information F
8. Presentation of the item of information F	8. Presentation of the item of information G
9. Presentation of the item of information G	9. Presentation of the item of information H
10. Presentation of the item of information H	10. Presentation of the item of information I
11. Presentation of the item of information I	11. Questions are asked about the items of information A to I
12. Questions are asked about the items of information A to I	12. Forecast of the DAX

In Table 1 it can be easily recognized that the anchoring effect in Treatment 1 (no interference) cannot be impaired by interference, as the DAX forecast is requested immediately after the setting of the anchor. In Treatment 2 (interference), however, it is possible for information to be overlaid by other items of information. Before the anchor is set, three items of information are presented. For the anchor question (larger or smaller than…), only 20 seconds are given. Then the six remaining items of information are presented.

The items of information which are presented as well as the formulation of the questions and the wording of the entire survey are given in the appendices. Particular care is taken here that apart from the anchor, which is deliberately set, no other figures appear in the entire survey. This is in order to rule out any undesired distortion of the results. This is because the possibility of an anchor being formed incidentally and completely unintentionally cannot be excluded (see, for example Bergman et al., 2010; Critcher and Gilovich, 2008; Mussweiler and Englich, 2005; Ariely, Loewenstein and Prelec, 2003; Mussweiler, Strack and Pfeiffer, 2000; Mussweiler and Strack, 1999; Northcraft and Neale, 1987).

The human ability to store information is limited. Rapid sequences of new items of information lead to most subjects only remembering a part of the new information. When the presentation of the anchor is inserted into a series of items of information, interferences can occur. It can be presumed that this reduces the effect of the anchor. Hypothesis 1 is therefore: the anchoring index will be higher in Treatment 1 (no interference) than in Treatment 2 (interference).

The anchoring index (Kahneman, 2014, p. 157) is based on average values. Unfortunately, this does not enable statements to be made about the statistical significance of the results. The DAX forecasts in the two treatments (for both the high and the low anchors) should therefore be examined using the Wilcoxon-Mann-Whitney test to establish whether the results diverge significantly.

The DAX is by far the most significant stock market index in Germany. Over the course of 2019 its level fluctuates between 11,000 and 13,500 points. The positive trend during the year frequently results in headlines in the media. The subjects are Business Management students. It can thus be assumed that they know that the DAX is at just over 13,000 points at the time of the experiment.

Let us consider the high anchor first. The high anchor is 25,000 points. In Treatment 1 (no interference), the anchor should have a stronger effect than in Treatment 2 (interference). Hypothesis 2 is therefore: in the case of the high anchor, the DAX forecasts in Treatment 1 (no interference) are significantly higher than in Treatment 2 (interference).

Now let us look at the low anchor. The low anchor is 2,000 points. In Treatment 1 (no interference), the anchor should have a stronger effect than in Treatment 2 (interference). Hypothesis 3 is therefore: in the case of the low anchor, the DAX forecasts in Treatment 1 (no interference) are significantly lower than in Treatment 2 (interference).

3. Results

The experiment is carried out at Ostfalia University of Applied Sciences in Wolfsburg on 25 November 2019. The survey is carried out as a classroom experiment in four parallel lectures of the core curriculum. The subjects are students of Business Management in their initial semesters. A total of 182 students take part in the experiment. Of these, 66 are women (36.3%) and 116 are men (63.7%). The students are between 17 and 35 years old. Their average age is 21.7 years.

Table 2: Four survey groups

	Treatment 1 (no interference)	Treatment 2 (interference)
High anchor 25,000 DAX points	Group 1 44 participants	Group 2 45 participants
Low anchor 2,000 DAX points	Group 3 48 participants	Group 4 45 participants

The four parallel survey groups are as follows (Table 2): in group 1 there are 44 students. In this group, Treatment 1 (no interference) is played with the high anchor (25,000 DAX points). In group 2 there are 45 students. In this group, Treatment 2 (interference) is played with the high anchor (25,000 DAX points). In group 3 there are 48 students. In this group, Treatment 1 (no interference) is played with the low anchor (2,000 DAX points). In group 4 there are 45 students. In this group, Treatment 2 (interference) is played with the low anchor (2,000 DAX points).

In each group the ten most successful subjects receive a payment of €20. Overall a sum of €800 is paid out. This corresponds to an expected value of €4.40 per participant. In four ongoing lectures, the lecture is briefly interrupted and the experiment is carried out. The opportunity costs of participating in the experiment are therefore very low. There is thus no need to pay a show-up fee. The four surveys each last between 15 and 20 minutes. An average payment of €4.40 can therefore be viewed as attractive. As only the most successful participants receive payment, there is additionally an element of competition involved. The subjects give the impression of being highly concentrated and motivated. A large number of invigilators ensure that the subjects act on a strictly individual basis and cannot use any non-permitted aids.

Among the questions which are not related to the German stock index (DAX), a considerable amount of interference is revealed. Although only a few minutes pass between the relaying of the nine items of information and the answering of questions about them, the subjects can only answer an average of 3.64 of the nine questions (40.4%) correctly. This means that around 60% of the new items of information fall victim to the phenomenon of interference. If one also assumes that the subjects were already familiar with one or two of the nine items of information, this figure rises from around 60% to around 70%. Information is obviously being overlaid with other information, which makes it more difficult for it to be stored in the long-term memory.

However, the anchor is hardly affected by these interferences, as a comparison of the results of Treatment 1 (no interference) and Treatment 2 (interference) shows (Table 3).

Table 3: Comparison of Treatment 1 (no interference) and Treatment 2 (interference)

	Treatment 1 (no interference)	Treatment 2 (interference)
Anchoring index	83.7%	83.2%
High anchor	25,000	25,000
Average DAX forecast in the case of the high anchor	23,108	23,023
(standard deviation)	(8,643)	(6,825)
Low anchor	2,000	2,000
Average DAX forecast in the case of the low anchor	3,853	3,897
(standard deviation)	(3,624)	(4,153)

Level of significance: 1% ***, 5% **, 10%*

The anchoring index (Kahneman, 2014, p. 157) is indeed higher in Treatment 1 (no interference) than in Treatment 2 (interference). So hypothesis 1 does not have to be rejected. However, the difference is very small. In Treatment 1 (no interference), the anchoring index is 83.7%. In Treatment 2 (interference) it is 83.2%.

The tremendous robustness of the anchoring effect against the influence of interference is revealed when considering Hypothesis 2. The average DAX forecast of 23,108 in Treatment 1 (no interference) is, as expected, higher than in Treatment 2 (interference) at 23,023. However, this difference is very

small considering the high standard deviations. The Wilcoxon-Mann-Whitney test proves that this is not a statistically significant difference. The p-value is 0.6664.

The fact that interferences do not have a noteworthy influence on the anchoring effect is also revealed when considering Hypothesis 3. The average DAX forecast of 3,853 in Treatment 1 (no interference) is, as expected, lower than in Treatment 2 (interference) at 3,897. This difference is, however, very small considering the high standard deviations. The Wilcoxon-Mann-Whitney test proves that this is not a statistically significant difference. The p-value is 0.5903.

Hypothesis 2 and Hypothesis 3 both have to be rejected. It can thus be seen that it is very difficult to eradicate the anchoring effect. Interferences ensure that the subjects can only assimilate a relatively small part of the information presented in such a way that they are able to retrieve it shortly afterwards. However, this obviously does not apply to information which is presented in the form of figures. Whether the anchor is presented directly before the forecasts are made, or whether it is presented in a series of many other items of information has no significant influence on the forecast. Interferences become effective. However, the anchor is not affected by the interference. Items of information are overlaid. The anchor, however, is not overlaid. It continues to work. Putting it rather pointedly, one could describe this as the magic of figures.

Summary

The presentation of many new items of information very frequently overloads the human ability to remember them. In such situations, new information is overlaid or deleted by additional items of new information. Does this phenomenon, which is known as interference, also have a significant influence on the anchoring effect? Does a figure which is set as an anchor have less effect on the forecasts of the subjects when it is presented together with many other relevant items of information? That is the question posed by this study.

In the context of an experiment with 182 students of Business Management, two treatments are compared. In Treatment 1 (no interference), the forecast of the subjects is requested directly after the anchor has been set. Further relevant information is only presented after this, so that there can be no reduction of the anchoring effect due to interference. In Treatment 2 (interference), first of all three relevant items of information are presented which are not related to the subsequent forecasting question. Then the anchor is set, and subsequently six relevant items of information are provided which are not related to the subsequent forecasting question. Following this, questions are asked about the nine items of information which are not related to the forecasting question. The subjects' assessment of the trend of the DAX is only asked for right at the end. In Treatment 2 (interference), there can thus easily be a reduction of the anchoring effect due to interference.

However, contrary to expectations, this effect does not occur. There is indeed significant interference regarding the nine items of information which is not related to the forecasting question. The figure which is presented as an anchor is, however, not affected to a notable extent. The anchoring index is, as expected, higher in Treatment 1 (no interference) than in Treatment 2 (interference). However, the difference is very low at 0.5 percentage points. If one compares the forecasts made by the subjects in Treatment 1 and Treatment 2 separately according to high and low anchors, the

Wilcoxon-Mann-Whitney test shows that the forecasts of the subjects in the two treatments are not significantly different – either in the case of the high anchor or that of the low anchor.

The essence of this study is as follows: interferences also have a very noticeable effect in this experiment. However, the figures used as an anchor remain largely unaffected. The anchoring effect is obviously resistant to interferences.

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Appendix 1: items of information A to I

Information A: Sophie Dorothea von Braunschweig-Lüneburg was the only daughter and heiress of the Duke of Brunswick and Lüneburg, Georg Wilhelm Prince of Lüneburg. She married a Prussian king, the so-called Soldier King, and became the mother of Frederick the Great.

Information B: The volume of poetry entitled *Der Schlaf des Trommlers* was of great significance for the fame of Werner Söllner, who died recently. He is still considered to be the outstanding Romanian-German poet of our time.

Information C: Nicolaus Copernicus is considered to be the founder of the heliocentric conception of the universe. According to this, Earth is a planet which turns on its own axis and – together with other planets – moves around the sun. The heliocentric theory of the universe replaced the previously dominant geocentric model.

Information D: The former British prime minister Margaret Thatcher was a follower of the so-called neoliberal school of economic thought. It is said that she always used to carry a copy of a book by Friedrich August von Hayek in her handbag, in order to be able to consult it at any time. Friedrich August von Hayek was an Austrian economist, and to this day he is considered the most important proponent of neoliberalism.

Information E: The law of the lever can be traced back to the ancient Greek mathematician, physicist and engineer Archimedes. In ancient times he formulated the law of the lever which has remained valid to this day.

Information F: The Federal Assembly is a non-permanent constitutional body of the Federal Republic of Germany whose only task is to elect the Federal President. The Federal Assembly consists of members of the German Parliament and the same number of members who are chosen by the elected representatives of the federal states (*Länder*). The Federal Assembly is thus the largest parliamentary body of the Federal Republic of Germany.

Information G: Paramaribo is the capital and at the same time one of ten districts of the Republic of Suriname in South America. Suriname lies between Guyana and French Guyana, and is thus north of Brazil and east of Venezuela.

Information H: Machiavellism is the term for a political theory ascribed to Niccolò Machiavelli, according to which any means – regardless of the law or moral objections – is reasonable in order to obtain or retain political power.

Information I: Witold Lutoslawski was a Polish composer and conductor. Alongside his musical training Lutoslawski also studied mathematics and natural sciences. He found that music and mathematics had many things in common, which had an influence on his career as a composer. His fame is largely based on his works “Concerto for Orchestra” and “Bukoliki for Solo Piano”.

Appendix 2: Questionnaire (Treatment 1, high anchor)

Dear Participants,

In this experiment you are asked to answer questions. A few of the questions are about the future trend of the German stock index (DAX). Most of the questions, however, are about general knowledge.

By answering the questions correctly you can collect points, whereby every question contributes the same number of points to the overall result.

As the general knowledge questions are fairly difficult, you will receive some information about them in advance.

Taking notes is not allowed

Phones or smartwatches may not be used

Having a quick grasp of things is the most important factor here. How much of the information can you remember and subsequently reproduce correctly?

How well you do is measured by the total number of points. For approximately the quarter of participants who are the most successful, there is a cash payment equivalent to the hourly wage of a skilled metal worker. So it's worth making an effort!

Please be absolutely quiet

No questions are allowed during the experiment

Do not look at your neighbour's answers

Do not turn to the next page until the person in charge asks you to do so.

Page A

DAX forecasting question A:

What is your forecast for the trend of the German stock index (DAX) until the end of the year? Please select one of the two alternatives.

O The DAX will be over 25,000 points.

O The DAX will be at 25,000 points or below.

DAX forecasting question B:

What do you think the level of the German stock index (DAX) will be at the end of this year?

At the end of the year, the DAX will be at _____ points.

Page B

Please pay attention to the person in charge

Teaching phase

Page C

Please answer the following general knowledge questions!

Task A: What was the name of the wife of the Soldier King and the mother of Frederick the Great?

_____

Task B: What was the name of the only volume of poems by Werner Söllner to be published in Zurich? This book was decisive for his fame as the outstanding Romanian-German poet of our time.

_____

Task C: What is the name of the theory of the universe proposed by Nicolaus Copernicus according to which Earth is a planet which turns on its own axis and – together with other planets – moves around the sun?

_____

Task D: What was the name of the Austrian economist who to this day is considered the most important proponent of neoliberalism? Margaret Thatcher is said to have always carried one of his books in her handbag in order to be able to look things up at any time.

_____

Task E: What was the name of the Greek mathematician, physicist and engineer who in ancient times already formulated the law of lever?

_____

Task F: What is the name of the largest parliamentary body of the Federal Republic of Germany, whose only task is to elect the Federal President?

_____

Task G: What is the capital of the Republic of Suriname?

_____

Task H: What is the name of the political theory according to which any means – regardless of the law or moral objections – is reasonable in order to obtain or retain political power?

_____

Task I: What was the name of the Polish composer and conductor who wrote the works “Concerto for Orchestra” and “Bukoliki for Solo Piano”?

_____