

# **Investigating the Influence of Anchoring Bias on Thinking and Decision-Making**

Internal Assessment in Psychology

Personal Code:

Group Members' Personal Codes:

Session: May 2024

Date of Submission: 20th September 2023

Word Count: 2166

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## **Introduction**

This study explores the impact of anchoring bias on decision making. System 1 thinking, as per Dual Processing Model(Kahneman, 2011), relies on past experiences and knowledge(i.e.schema), ignores absent evidence, and uses shortcuts. It is quick but prone to errors. System 2 thinking, on the other hand, relies on conscious reasoning and requires effort. People tend to use System 1 thinking due to ego depletion(lengthy or difficult tasks leading to loss in focus), high cognitive load(too many things going on in our minds), and the fact that we are cognitive misers - we want to use minimum effort. According to Law of Least Effort, people choose the least demanding course of action(Kool et al., 2010). In practice, anchoring bias, a type of cognitive bias, often occurs because System 1 thinking is more efficient in daily mental processes. As a result, we tend to rely heavily on the first piece of information offered(‘anchor’) when we make decisions(Cho et al., 2017).

Strack and Mussweiler(1997) demonstrated how anchoring bias may occur in individuals. In each of the 2 conditions of high or low anchor, they were asked one of the following questions: “Did Gandhi die before or after the age of 9?”(low anchor) - or “Did Gandhi die before or after the age of 140?”(high anchor). Then, participants were asked the real age of Gandhi’s death. Results showed that estimation in high anchor condition was greater than that of low anchor. This shows that System 1 thinking and anchoring bias influences decision making process.

Aim of this investigation is to test if anchoring bias from an implausible high(140) or low(9) anchor would affect thinking and decision making shown by the estimation of age of Mahatma Gandhi in Korean highschool students aged from 16 to 18. The study is significant to our target population since given an anchor, students may subconsciously rely on it when

solving problems and affect their problem solving skills. Therefore, educators can create lessons that will teach pupils how to identify and counteract it, thereby enhancing their analytical thinking and academic performance.

In this experiment, independent variable is the anchor age given in the first question asked to participants. One group was asked “Did Gandhi die before or after the age of 140?”(high anchor) while the other was asked “Did Gandhi die before or after the age of 9”(low anchor). The dependent variable is participants’ estimated real age of Mahatma Gandhi in 10 seconds.

Null hypothesis: There would be no statistically significant difference between the estimation of Gandhi’s age given in 10 seconds by participants who were asked whether Gandhi died before or after the age of 140 (high anchor) or whether he died before or after the age of 9 (low anchor).

Research hypothesis: Participants who were asked whether Gandhi died after age of 140(high anchor) condition will give a significantly higher estimation of Gandhi's real age in 10 seconds compared to participants who were asked whether Gandhi died before the age of 9(low anchor condition).

## **Exploration**

In our experiment, we used independent samples design. 14 of participants were randomly assigned to high or low anchor condition. If we used repeated measures design, participants would be shown 2 anchors in a row in a short period of time, they may be influenced by both high and low anchors and affect the estimation. There must be a long interval between exposure to high and low anchors to minimise this, but this is not efficient in conducting the experiment.

We used opportunity sampling to select 28 participants based on how accessible they were in our school. Opportunity sampling was chosen because it is convenient and time-efficient. We chose participants over 16 to independently give consent to participate, and those who were fluent in English because all materials are all in English and they must thoroughly understand instructions. We ensured that participants were not psychology students and never have participated in the same study before to avoid demand characteristics such as expectancy effect. Higher Level and Additional Maths students were selected since participants must be confident with numbers for the age estimation process in the study. In this study, we assumed that individuals are not different in terms of the anchoring bias and thinking and decision making.

When developing our materials, Gandhi was chosen since Korean students are expected to know who he is, but aren't taught his exact age of death. Participants were either asked "Did Mahatma Gandhi die before or after the age of 140?"(high anchor) or "Did Mahatma Gandhi die before or after the age of 9?"(low anchor). We controlled the exposure time to the anchor and time given to answer the estimation question as 10 seconds. This was important because limited time forces participants to use System 1 thinking. With different amounts of time, some participants may be more prone to use System 2, which may not allow for the anchor to

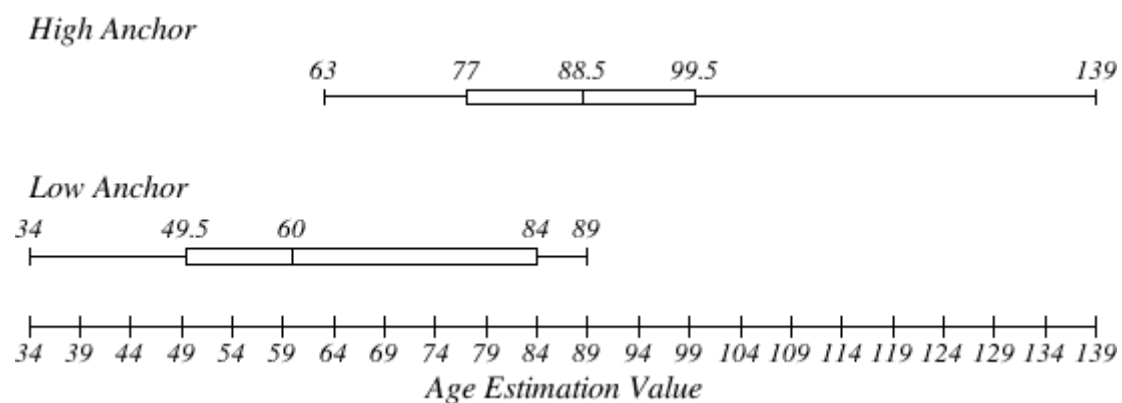
have its effect on decision making. This control was done through presenting all questions on the Google Slides, which was set to flip every 10 seconds. Prior knowledge about Gandhi was controlled by a question that asked whether participants knew the actual age of Gandhi's death. This prevented participants from writing the age by memory rather than estimation. Answer sheets(see appendix c) were made to make participants fill out the answers in the same form. This is important to minimise the confusion with how to answer.

We gave out the informed consent(see appendix a) form for participants. This included information that participants have the right to withdraw at any moment, guarantee that participants' identity will remain anonymous and confidentiality will be kept throughout the experiment. Brief description of aim and experiment was given too. Then we projected Google Slides with the standardised instructions. Participants were informed that they had 10 seconds to answer each question and that even if they don't know the answer, just go with their instinct. In both high and low anchor conditions, participants first had to circle on the answer sheet whether Gandhi was born before or after the age of 140 or 9, respectively. Next slide asked participants in both conditions "What was his age when he died?" and they had to write down an age on the answer sheet. Lastly, participants circled "yes" or "no" when the question on the last slide asked, "Prior to this experiment, did you know the actual age of Gandhi when he died?". After the experiment, each group received a hard copy debriefing form (see appendix d) about the true aim, and what we expected to find.

## Analysis

*Figure 1 Table of Median and Interquartile Range of estimation of Gandhi's age in High(140) and Low(9) Anchor Conditions*

	<b>Median</b> value of estimation of Gandhi's age of death	<b>Interquartile Range(IQR)</b> of the estimation of Gandhi's age of death
High Anchor (140)	88.5	22.5
Low Anchor (9)	60	34.5



*Figure 2 Box plot showing the median, upper and lower quartile, minimum and maximum of the age estimation of Gandhi in high anchor and low anchor condition*

Overall, the median of high anchor condition was 28.5 higher than low anchor condition (see Graph 1). This suggests that participants were forced to use system 1 thinking and those who saw high anchor on average ‘anchored’ their response to the first piece of apparent evidence 140 therefore gave a higher estimation. Both high anchor and low anchor conditions have a high IQR 22.5 and 34.5 respectively. Variation is high because some may be influenced more by anchors than others, and all individuals’ cognitive processes may differ. Box plot shows that while high anchor condition’s data is positively skewed, low anchor condition’s data is negatively skewed. The overlap between two conditions suggests that the data is less likely to have significant differences. However, median being outside of each

other's box suggests that there still is a significant difference between the two boxes to an extent. This will be further examined by inferential statistics test to observe if our data clearly has significant difference or not.

Mann-Whitney U test was conducted to test the statistical significance of the difference in the means because our data was at least ordinal, and used independent measures(see appendix f). According to the statistical test, p-value is 0.0008. This is smaller than critical value(0.05) hence suggests that observed result is not due to chance. Therefore, there is sufficient evidence to reject the null hypothesis and accept the research hypothesis. There is little concern about Type I error since the p-value is significantly smaller than the critical value. Participants in high anchor condition responded with significantly higher estimation of Gandhi's real age compared to participants in low anchor condition. In other words, it seems that the implausible high or low anchors initially given to an individual affect their decision making.



## **Evaluation**

Our results showed that participants in high anchor condition had a statistically significant higher estimation of the age of Gandhi's death compared to low anchor condition. Results support the Dual Processing Model(Kahneman, 2011). When there is time limit, due to the law of least effort(Kool et al., 2010) and because we are cognitive misers, participants were forced to utilise quick and automatic system 1 thinking. Those in both anchor conditions heavily relied on the first piece of apparent information given to them, which was the number 140 or 9 thereby gave estimations closer to that number.

A strength of independent sample design is that it is more efficient, since participants only need to be exposed to one anchor thus increases the accuracy and efficiency of the experiment. If participants are exposed to both anchors, their estimations would be influenced by both anchors hence give inaccurate results. In repeated measures, there must be a long interval between exposure to high and low anchors to prevent participants relying on both anchors, but this has low efficiency in conducting the experiment.

A limitation in independent sample design is that we cannot control the effects of participant variabilities and this may act as a confounding variable. Although all participants replied they didn't know the real age of Gandhi, we cannot confirm the personal relevance nor prior knowledge about him. Some may have had more historical knowledge about Gandhi hence that knowledge could have informed their decision. One way to overcome the potential influence of this is to test the prior knowledge about Gandhi before the experiment by rating their knowledge about Gandhi in a Likert scale of 5. We then can match participants according to their knowledge thereby control for this variable.

A strength of our sample was that we chose participants who were confident in English;

therefore, their comprehensive skills in English were controlled for. This was important since all the instructions were given in English and we prevented the understanding of instructions acting as confounding variable in estimation.

A limitation of our sample was that they were slightly disinterested because y11s were in the middle of exams so it may be that they did not focus entirely on the instructions of the experiment. Y13s and y11s therefore had differences in level of attention which may act as a confounding variable. To control for this, the experiment should be held at another time where participants' attention is fully available - when the exams are not held.

A strength of our procedure was the choice of Mahatma Gandhi as the subject of age estimation. This enabled us to control the familiarity with the individual. As participants were Korean high school students, they have much more knowledge about a Korean historical figure which may lead to most of the students knowing the date of death of the figure. That is why Gandhi was chosen under the premise that he is famous enough but not too familiar to our sample. The follow-up question at the end of the experiment on the answer sheet which asked participants if they knew the actual age showed that all participants didn't know the exact age of death, which implies that he was a suitable figure to ask about.

However, a limitation of our procedure is that participants were sat too close to each other and so they could see what other participants were writing as their response. This could have further influenced their answers. Then the answers wouldn't be written with sole System 1 thinking; rather, they may copy down others' answers due to expectancy effect. One way to modify this would be to make all participants seat at least 2 seats apart. This would ensure that participants cannot see each other's answer sheets.

As a result of our study, we can conclude that at a  $p \leq 0.05$  level of significance that anchoring bias derived from the first piece of information offered, implausible high or low anchor, affects process of thinking and decision making of the Korean highschool students.

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## Appendices

### Appendix a: Informed consent

#### Letter of Consent

Hello, we are performing an experiment as part of our internal assessment for our IB Psychology class. We are investigating the effect of anchoring bias on thinking and decision-making processes. You will be answering a set of general knowledge questions. We would like to ask you to be part of our experiment. If you agree to take part in this experiment, you should know that:

- All data that we obtain will be kept confidential and anonymous.
- You have the right to withdraw at any moment.
- You will be debriefed about the nature of the experiment and our results after we have obtained results.

The experiment will take about 3 minutes to complete.

If you agree, we ask that you sign the form below and to fill in the following information relevant to our experiment.

- First Language : \_\_\_\_\_
- Year group: 11 / 12
- Have you ever taken a psychology lecture/class? Yes / No

I, \_\_\_\_\_, am 16 years old or older, and I understand the nature of this experiment and agree to participate voluntarily. I give the researchers permission to use my data as part of their experimental study.

Signature	Date

## Appendix b: Briefing notes/standardised directions

### Researcher Script

Hello,

Thank you for signing the informed consent. If you don't have any questions, we will continue with the instructions for this experiment.

*\*hand out answer sheet upside down\**

Now, we will begin the experiment. Please do not turn the answer sheet over until instructed to. You are about to see some questions on the PowerPoint slides. You will have 10 seconds to answer each question. Please write your answer on the answer sheet provided. Do **not** write your name on it because your answers are completely anonymous.

The first slide will remind you of the instructions given.

Ready? You may turn your answer sheets over.

*\*present the slides\**

The experiment is now finished. We will collect the answer sheets.

*\*hand out debriefing form\**

## Appendix c: Materials

### Answer Sheet

#### Answer Sheet

1. circle the correct answer : **Before / After**
2. \_\_\_\_\_
3. circle the correct answer : **Yes / No**

### High Anchor Google Slides

You will have **10 seconds** to answer each questions  
Even if you don't know the answer, just go with your instinct : )

1. Did Mahatma Gandhi die  
**before** or **after** the age of 140?

2. What was his age when he died?

The experiment is over!



Prior to this experiment, did you know the actual age of Gandhi when he died?

Low Anchor Google Slides

You will have **10 seconds** to answer each questions  
Even if you don't know the answer, just go with your instinct : )

1. Did Mahatma Gandhi die  
**before** or **after** the age of 9?

2. What was his age when he died?

The experiment is over!

Prior to this experiment, did you know the actual age of  
Gandhi when he died?

Appendix d: Debriefing notes

High Anchor	Low Anchor
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### Debriefing Form

Dear Participant,

First, we would like to thank you for your participation in our experiment for the Psychology IA.

The full aim of this experiment was to examine the effect of anchoring bias on decision-making processes. To further explain, we wanted to examine the effect of the first piece of information provided to you, the implausible anchor, on decisions being made afterwards.

There were two conditions in the experiment: high and low anchor conditions. You were in the **high anchor condition** and so you were provided with a **high age (140)** of Gandhi's death by our first question. We then asked you to estimate the age of Gandhi, to observe whether you give a high or low estimation of his death.

We expect that your estimation of Gandhi's age of death will be **higher compared to the low anchor condition** as you were in the high anchor condition. This means that we expected you to give a higher estimation of Gandhi's age of death since you were exposed to a higher anchor, which is the first piece of information you have been exposed to when you were asked a question about Gandhi's death, 140. This is because this first piece of information acts as an anchor which "pulls" your decision closer to it.

The actual age of Gandhi's death was 78.

If you have any further questions or wish to receive the results of this experiment, please feel free to contact any of the researchers.

Thank you again, for your participation in our experiment.

### Debriefing Form

Dear Participant,

First, we would like to thank you for your participation in our experiment for the Psychology IA.

The full aim of this experiment was to examine the effect of anchoring bias on decision-making processes. To further explain, we wanted to examine the effect of the first piece of information provided to you, the implausible anchor, on decisions being made afterwards.

There were two conditions in the experiment: high and low anchor conditions. You were in the **low anchor condition** and so you were provided with a **low age (9)** of Gandhi's death by our first question. We then asked you to estimate the age of Gandhi, to observe whether you give a high or low estimation of his death.

We expect that your estimation of Gandhi's age of death will be **lower compared to the high anchor condition** as you were in the low anchor condition. This means that we expected you to give a lower estimation of Gandhi's age of death since you were exposed to a lower anchor, which is the first piece of information you have been exposed to when you were asked a question about Gandhi's death, 9. This is because this first piece of information acts as an anchor which "pulls" your decision closer to it.

The actual age of Gandhi's death was 78.

If you have any further questions or wish to receive the results of this experiment, please feel free to contact any of the researchers.

Thank you again, for your participation in our experiment.

### Appendix e: Raw data

	High Anchor (140)	Low Anchor (9)
Average estimation value of participants	92.2	63.5

### Appendix f: Calculations of inferential statistics

### Data Entry:

count	Ranks for		Raw Data for	
	Sample A	Sample B	Sample A	Sample B
1	1	24	34	94
2	5.5	11	53	70
3	2	18	45	87
4	12	8.5	72	63
5	8.5	26	63	101
6	7	13	57	76
7	4	27.5	50	139
8	3	22.5	49	90
9	10	25	67	98
10	20.5	27.5	89	139
11	20.5	15	89	79
12	18	18	87	87
13	5.5	14	53	78
14	16	22.5	81	90
Reset	Calculate from Ranks		Calculate from Raw Data	

Mean Ranks for					
Sample A	Sample B	$U_A =$	167.5	$P_{(1)}$	$P_{(2)}$
9.5	19.5	$z =$	-3.17	0.0008	0.0015

Note that mean ranks are provided only for descriptive purposes. They are not part of the Mann-Whitney test. ~ Note also that the z-ratio is calculated only if  $n_a$  and  $n_b$  are both equal to or greater than 5.

### Critical Intervals of $U_A$ for $n_a=14; n_b=14$

	Level of Significance for a		
	Directional Test		
	.05	.025	.01
	Non-Directional Test		
	--	.05	.02
lower limit	61	55	47
upper limit	135	141	149

The adjacent critical intervals are calculated only if  $n_a$  and  $n_b$  both fall between 5 and 21, inclusive. For sample sizes smaller than 5, you can refer your results to a standard table of Mann-Whitney critical values, such as the following, provided by the Department of Mathematics & Statistics at the University of Saskatchewan:

<http://math.usask.ca/~laverty/S245/Tables/wmw.pdf>

with  $n_a=14$ ,  $n_b=14$ ,  $U_A=167.5$ , and  $U_B=28.5$

The observed value of  $U_A$  is significant at or beyond the designated level if it is equal to or smaller than the indicated lower limit for that level or equal to or greater than the upper limit. It is non-significant if it is larger than the lower limit and smaller than the upper limit.