

# HINDSIGHT BIAS

SE367: INTRODUCTION TO COGNITIVE SCIENCE

Rabi Shanker Guha

Dept. of Computer Science and Engineering

IIT Kanpur

[rabisg@iitk.ac.in](mailto:rabisg@iitk.ac.in)

Dr. Amitabha Mukherjee

Dept. of Computer Science and Engineering

IIT Kanpur

[amit@cse.iitk.ac.in](mailto:amit@cse.iitk.ac.in)

April 18, 2013

## ABSTRACT

*Hindsight bias is the tendency to associate more probability with events after they have occurred than before their occurrence. Also known as “creeping determinism” or “know-it-all-along” effect because of the tendency of seeing something as more predictable than they were. In the experiment, I have conducted experiments on students of various age groups (9 years – 23 years) to verify and demonstrate the claim by Bernstein et al.<sup>[1]</sup> that irrespective of age differences everyone exhibits hindsight bias and discuss the results in respect to the established theories of cognition, false recall and theory of mind. Also, a unique result was noticed that the degree of hindsight bias (measured by HB index) is directly proportional to the deviation of the original judgment from the correct judgment.*

## INTRODUCTION

Hindsight bias is a widely studied cognitive error documented by various noted psychologists including the likes of Amos Tversky and Daniel Kahneman <sup>[2]</sup>. Two heuristics identified at that time led the development of theory of hindsight bias at that time. The heuristics were “Availability Heuristic” and “Representativeness heuristic”. Availability heuristic allows people to associate the occurrence event with a probability by thinking about how easy it is to think about examples. Representativeness heuristics was defined as “the degree to which [an event] **(i)** is similar in essential characteristics to its parent population, and **(ii)** reflects the salient features of the process by which it is generated”.

The first experiment to investigate hindsight bias was developed by Fischhoff in 1975[4] in which he narrated a short story with four possible outcomes to a group of people and asked the likelihood of each ending. People often associated a higher likelihood to the ending they had been told was correct. Similar experiments are conducted even today where attempts are made to understand the bias and the effect of hindsight bias in various sectors like banking, investment, medical practise, etc.

## PREVIOUS WORK

In the paper **Hindsight Bias from 3 to 95 Years of Age** Bernstein et al. looked at the development of hindsight bias across the lifespan. They reported the shortcomings and limitations of existing work in this field and conducted two sets of experiment on people of age group 3 to 95 years and reported the development of bias across the lifespan. In my current work, I have adapted and repeated the given experiments on a set of students in the age group of 9 -23 years and reported my findings.

## EXPERIMENT

Two sets of experiments were conducted on students of different age groups. The experiments were adapted from the Verbal Hindsight and Visual Hindsight Task described by Bernstein et al.<sup>[4]</sup>. The experiments were adapted so that both Hindi and English speaking students of the afore-mentioned age group would be able to comprehend them. It may be of significance to state that the experiment was not conducted at one time but rather in separate groups, according to age group.

## VERBAL HINDSIGHT TASK

In this experiment subjects were asked a set of questions (*see Appendix*) and their answers noted. They were told that all answers were numeric and in the range of 1-100. The questions were tailored specifically to be interesting and educationally relevant to all age groups.

In the Original Judgment Round everyone answered all the 20 questions. Then the group was divided into two groups: the **experiment** and the **control** group. The experiment group learned the correct answer to the questions whereas the control group did not. Later during a surprise memory test people were asked to recollect their original answers and again their response was noted. The questions were presented to all the participants in a fixed order (as given below)

## VISUAL HINDSIGHT TASK

The visual hindsight task involved a computer-aided visual recognition task in which participants were presented with an array of images. The images were originally blurred and gradually clarified as time progressed. The images changed at the rate of 500 ms per image and the participants were asked to press "SPACE" on the keyboard as and when they identified the image which would take them to the next set of images. The point of recognition was automatically noted at the end of the process.

Again the group was divided into two: **experiment group** and **control group**. Later participants were asked when would a naïve peer guess the identity of the image had he been shown the same sequence. The control group were not told the value of their original judgment whereas the experimental group were. The degree to which they deviated from their original judgment is a marker of the hindsight bias.



Sample Images for Visual Hindsight task

## ANALYSIS AND RESULTS

The experiment was conducted on a total of 25 people of which 13 were in the age group 21-23 years, 9 in the age group 14-16 years and 4 in the age group 9-11 years. Of them 15 people were in the experiment group and the other 10 in the control group.

For each of the individual in each of the experiment, the Hindsight Bias index (HB index) was calculated according to the following formula:

$$HB = | OJ - CJ | - | RJ - CJ |$$

Where, OJ := Original Judgment

RJ := Recollection Judgment

CJ := Correct Judgment

This metric allows us to estimate the deviation of recollection answer from the original answer. A positive index means a deviation towards the correct answer whereas a negative value indicates deviation away from the correct answer.

Sample data for one particular individual in both experimental and control cases is depicted in Fig. 1. The x-axis shows the nth question for which HB index is calculated. As is evident from the graph, the experiment group showed a wide deviation from their original answer whereas the control group stuck to their original answer (on an average). Even in cases where the control subject showed deviation from their original answer, the overall average for their HB index turned out to be close to 0.

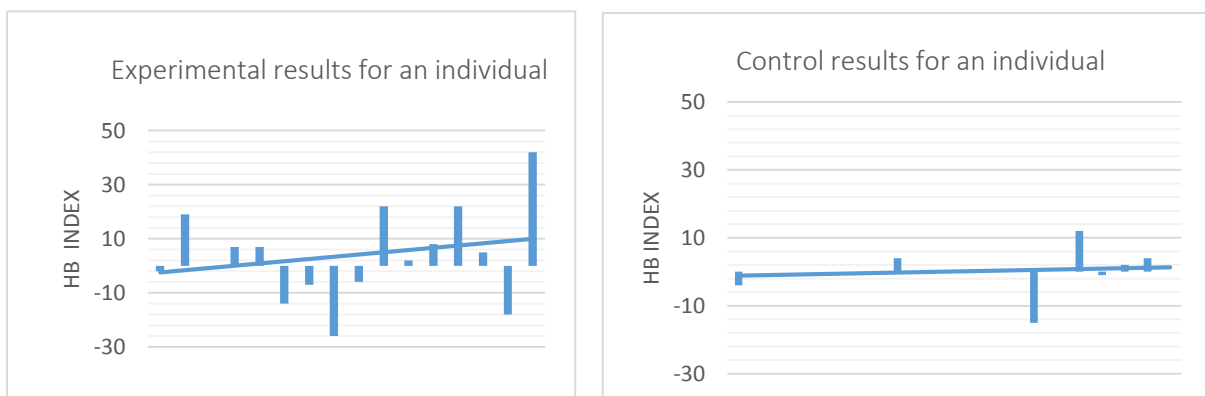


FIGURE 1: EXPERIMENTAL RESULTS FOR A PARTICULAR INDIVIDUAL IN BOTH GROUPS

Figure 2 shows the deviation of HB index across individuals of the experiment group and their average is depicted in the trend-line.

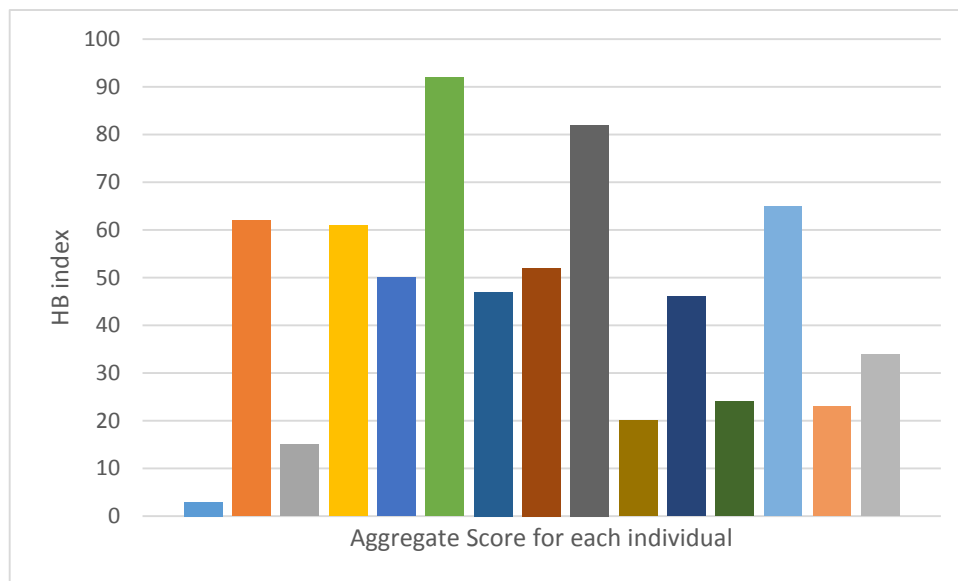


FIGURE 3: AGGREGATE HB INDEX FOR EXPERIMENT SUBJECTS

Figure 3 shows the weighted mean of HB index and its variation across age groups

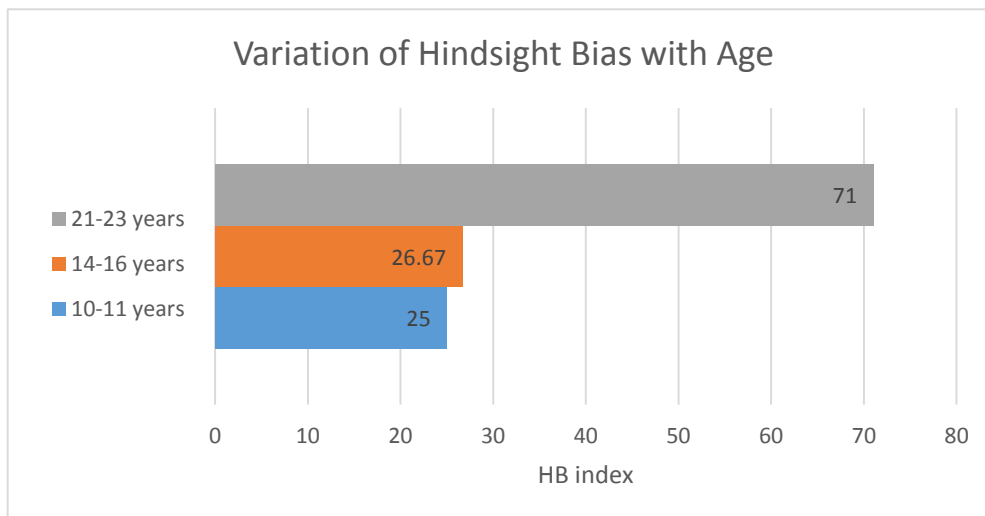


FIGURE 3: HB INDEX GROUPED ACCORDING TO AGE

Answers in which the Original Judgment differed from the Correct Judgment by +/- 5 were collected. It was seen that if someone's answer was within the range of  $CJ - \delta$  or  $CJ + \delta$  then there was a higher probability that he would recollect his OJ. A sample of this data is depicted in Figure 4.

Rajnish Prajapati		16 years	
Original Judgment	Recollection Judgment		Correct Judgment
55	55		56
8	8		8
29	29		29
17	17		13
62	62		66

Figure 4: Sample Data in which the participant correctly recalled his Original Judgment (OJ). It was noticed that in cases where the participant's OJ was close to CJ, there was a higher probability that his RJ would be close to or even equal to his OJ

## CHALLENGED FACED AND FURTHER IMPROVEMENTS

Due to lack of time the recollection round (or the second round) of experiments in both cases had to be conducted in a short span. To be more precise, around 15-20 minutes. The experiment would have been better conducted at a later period (around 1 hour). Also Visual Hindsight task could not be successfully conducted on the age group of 9-12 year olds as they had difficulty comprehending the task at hand. Furthermore as there was a wide difference on the background of the subjects (21-23 years old were from an English-medium background whereas the other age-groups were from a Hindi medium background) which may have affected the outcome of the experiment especially in the case of comparison of HB index v/s age. But since people in the same age-group were from the same background, the results could not have been affected much.

On the other hand this study can be further improved upon by conducting the study on the other side of the age spectrum. Also effects of ethnicity, gender, etc on hindsight bias can be explored.

## DISCUSSION

Various Cognitive Models have been proposed to explain the cause of Hindsight Bias. Of these RAFT (Reconstruction After Feedback with Take the Best), SARA (Selective Activation and Re-constructive Anchoring) and CMT (Causal Model Theory) are the most widely accepted.

**SARA** was proposed by Rüdiger Pohl<sup>[5]</sup> in which he argues that humans have a pool of images to draw their memory from. Hindsight Bias occurs due to the selected activation of set of images i.e. when people are presented with the correct answers the previous image is re-activated and goes under the capability to be modified. Thus the new memory serves as a memory anchor causing people to believe in that biased image to support their opinions.

**RAFT**<sup>[6]</sup> assumes a probabilistic memory model in which people use their assessment of probability from their knowledge and then interpret those probabilities. Then they “Take the Best” model in reaching conclusions. Basically, it is a form of adaptive learning and feedback information updates a person's knowledge base. Thus at a later time (after they know the answer) they are unable to process the same situation according the same probability they had.

**CMT**<sup>[7]</sup> proposes that people try to make sense of unexpected events that have occurred by “creating causal reasoning for the starting event”<sup>[8]</sup>. This can lead people into believing that the event was inevitable and nothing could prevent it.

## CONCLUSION

The results support the claim by Bernstein et al.<sup>[1]</sup> that hindsight bias is shown by everyone irrespective of age. Also a previously unreported result was noticed that the degree of hindsight bias is directly proportional to the deviation of the original judgment from the correct judgment. One possible explanation for this observation is that in case of small deviations, people remember their answers as difference from the original judgment and the triggering of the old memory with episodes like “being 1 less than the correct judgment” helps them recollect it better at a later time. It surely is an area for further research and can lead to insights not only in understanding of Hindsight Bias but also in the cognitive process of understanding and interpretation of numbers.

## REFERENCES

- [1] Bernstein et al. (2011) Hindsight Bias from 3 to 95 Years of Age. pg. 1
- [2] Fischhoff, B. (2007). An early history of hindsight research. Social cognition. pg. 25
- [3] Kahneman, Tversky, Daniel, Amos (1972). "Subjective probability: A judgment of representativeness". In. Judgment under uncertainty: Heuristics and biases.
- [4] Bernstein et al. (2011) Hindsight Bias from 3 to 95 Years of Age. pg. 7-8
- [5] Pohl, R., F., Eisenhauer, M., & Hardt, O. (2003) SARA: A Cognitive Process Model to Stimulate the Anchoring Effect and Hindsight bias. 337-356.
- [6] Hertwig, R., Fenselow, C., & Hoffrage, U. (2003). Hindsight Bias: Knowledge and Heuristics Affect our reconstruction of the Past. 357-377.
- [7] Blank, H., & Nestler, S. (2007). Cognitive Process Models of Hindsight Bias. 132-147.
- [8] [https://en.wikipedia.org/wiki/Hindsight\\_bias](https://en.wikipedia.org/wiki/Hindsight_bias) Hindsight Bias

## APPENDIX

### List of Questions (and Correct Answers) Used in the Verbal Hindsight Task

1. How many millimetres across is the eye of a elephant? (34)
2. How many neck bones does a giraffe have? (7)
3. How fast can a tiger run in km/h? (56)
4. How many minutes does it take light from the sun to reach Earth? (8)
5. How many legs does an octopus have? (8)
6. How many states does US have? (50)
7. How many days can a cockroach live without a head? (9)
8. How many years can a parrot live? (15)
9. How many teeth does an alligator have? (76)
10. How many km per hour can a hippo run? (32)
11. How many countries are in South America? (13)
12. How many muscles are there in the face? (43)
13. How many teeth does a mosquito have? (47)
14. How many kilos is a elephant's brain? (5)
15. How many hours does a lion sleep in a day? (20)
16. How many countries are in Europe? (45)
17. How many moons does the planet Saturn have? (46)
18. How many inches tall is Aamir Khan? (66)
19. How many countries are there in Africa? (53)
20. How many feet can a kangaroo jump in one leap? (30)