sciendo

Proceedings of the 5th International Conference on Economics and Social Sciences (2022), ISSN 2704-6524, pp. 872-880

The 5th International Conference on Economics and Social Sciences
Fostering recovery through metaverse business modelling
June 16-17, 2022
Bucharest University of Economic Studies, Romania

How Convincing is Reliable Data? Lay Perception of Statistical Evidence

Maria-Magdalena ROȘU[1*], Marian NECULA[2], Eduard C. MILEA[3]

DOI: 10.24789788367405072-081

Abstract

Statistical communication has become crucial in recent years. People are often confronted with making decisions that require comprehension of data insights. Behavioral economics underline that decisions are rarely justified by objective information and that people tend to amend even the most clear-cut evidence. The current study investigates the impact of divergent perceptions of proposed evidence concerning an event on subsequent estimations. To this end, 325 volunteers read the most recent TE-SAT report concerning terrorist attacks from the previous year. The report ends with the official statistics stating that 13 people were killed in these terrorist acts. When asked to estimate the number of victims for the current year, participants' estimations differed based on whether they perceived 13 to indicate a low or a high level of terrorism. Those who perceived 13 as indicative of a big threat also estimated a higher number of victims for the current year. Pre-surveyed worry regarding terrorism determined the personal interpretation of official data. The perceived risk of terrorism did not influence the participants' positioning. Age, gender, and education had no impact on how people perceived the official data on terrorism. Neither did the level of conspiracy ideation, conservatism, religiosity, or optimism. However, numeracy had a significant impact. In their case, contextualizing terrorism as a lesser threat than other threats may be more apparent. However, general analytical thinking had no significant impact. These results show how evidence and perceptions interact. Even though we would expect a one-way causality from objective information to subjective perception, people process information such that evidence and perception are altering one another. This conclusion is most relevant in a data-driven environment that simultaneously triggers emotional reactions with implications for crisis management, public policy, and government communication.

Keywords: information processing, anchoring effect, statistical evidence, reliable data, public communication.

JEL Classification: M15, C10, D73.

[1] Bucharest University of Economic Studies, Bucharest, Romania, rosumaria13@stud.ase.ro.
[2] Bucharest University of Economic Studies, Bucharest, Romania, neculamarian18@stud.ase.ro.
[3] Bucharest University of Economic Studies, Bucharest, Romania, mileaeduard12@stud.ase.ro.
* Corresponding author.

© 2022 M.-M. Roșu, M. Necula, E.C. Milea, published by Sciendo. This work is licensed under the Creative Commons Attribution 4.0 License.

1. Introduction

The abundance of information today is one of the most challenging aspects of our daily lives. To avoid false information and the subsequent consequences of misinformation (e.g., the shift in political opinions, negative impact on well-being, biased perception of strangers; Tucker et al., 2018; Thompson et al., 2019; Ahler, 2014), the most common suggestion is to reduce our engagement solely to accurate information (Zhang, Ghorbani, 2019). However, even the controlled exposure only to trustworthy information sources has its limitations.

Even though statistics and numbers are regarded as more objective than stories or opinions, people deal poorly with understanding statistics. Behavioral studies show how, in an attempt to avoid uncertainty, people fixate on numbers, even when the numbers are arbitrary or wrong (Tversky, Kahneman, 1974; Ariely et al., 2003). People tend to fixate most strongly on the first number they encounter, especially when that number is shocking and seems precise. Even when people are warned that they are facing an unreliable anchor that might influence their decision, they are not able to neglect it (Wilson, 1996).

Even though studies observed an anchoring-and-adjusting tendency (Epley, Gilovich, 2006), further investigation is needed to determine whether people fully commit to these anchors, both rationally and emotionally. The existing literature indicates a possible discrepancy between the two (Roets, 2017; Lewandowsky et al., 2012; Nyhan, Reifler, 2010). This type of insight is most relevant in the case of statics describing real events together with understanding the mediators for a positive or negative adjustment to a supposed anchor.

To this end, we instructed our participants to read basic statistics on terrorist attacks in 2018 and their impact on life losses. We chose terrorism as it is a real event, but remote from Romanian participants ’cultural context. We anticipated that people's expectations will be primed into the proposed statistics, while marginal adjustment will depend on their mental representation of these statistics. The current paper intends to propose some factors driving participants' perception of statistical evidence and the consequential adjustments.

2. Problem Statement

When discussing the assessment of public communication, most authors propose partisanship and political convictions as drivers for perception (Sunstein, 2018; DellaVigna, Kaplan, 2007). Although the entire political spectrum is prone to biased information processing (Harper, Baguley, 2019), the lean toward prior perceptions is more substantially observed among conservatives (Harper, Baguley, 2019; Pennycook, Rand, 2019). Therefore, prior perception of terrorism might moderate how people interpret statistical evidence regarding terrorism with potentially stronger effects for conservatives, those already adopting conspirational ideas, and eurosceptics.

Secondly, the existing literature debates the role of critical or analytical thinking in information processing. Empirical studies agree that successful information processing requires considerable cognitive effort (Pennycook, Rand, 2019) and deliberate attention (Allcott, Gentzkow, 2017). Other studies propose that general critical thinking does not suffice in identifying accurate information and correctly adjusting to misinformation. In this vein, specific analytical skills and direct engagement with a proposed topic are more relevant (Rosu et al., 2021). Therefore, analytical thinking might be less relevant than specific numerical abilities when discussing the interpretation of proposed evidence.

3. Research Questions / Aims of the Research

Hypothesis 1 (H1): Statistical evidence drives readers into the "anchoring effect".

Hypothesis 2 (H2): Statistical evidence drives divergent interpretations, which further influences the estimations regarding the evolution of the event in question.

Hypothesis 3 (H3): The interpretation of proposed evidence is dependent on emotional triggers.

Hypothesis 4 (H4): The interpretation of proposed evidence is dependent on the specific ability to understand and work with numbers.

Hypothesis 5 (H5): The perception of proposed evidence is not dependent on partisanship or event rationalizations (i.e., conspiracy ideation, conservatism, or Euroscepticism).

Demographics such as age, gender, and education are considered control variables.

4. Research Methods

Data were collected at the end of 2019 (November) through an online questionnaire assessing baseline characteristics and a secondary short survey registering perception and estimation after a text reading. A total of 260 participants completed the two surveys with one month gap between them.

4.1 Baseline Characteristics

The first questionnaire consisted of items concerning demographics (age, gender, and education), respondents' prior perception of terrorism (perceived risk and worry regarding terrorism), analytical thinking, specific ability to understand and work with numbers (numeracy), and partisanship and social rationalizations (conservatism, conspiracy ideation, euroscepticism).

Table 1 presents the descriptive statistics fort the demographics.

Table 1. Demographics and socioeconomic variables.

Variable	Statistics
Gender: Male Female Other	 20.64% 79% 0.36%
The highest level of completed education: High school degree Bachelor's degree Master's degree PhD studies	 75.7% 20.7% 2.86% 0.74%
Age	Min = 18, Max = 48, Mean = 21.17 (SD = 4.45)

Source: Descriptive statistics conducted in Rstudio.

The risk of terrorism was assessed on the recommendations of Nellis and Savage (2012) with two components dimensions: perceived risk to oneself (comprising five items) and perceived risk to someone whom the respondent knows (similar to the same five items).

The worry about terrorism was also assessed through the measurement proposed by Nellis and Savage (2012) by the question "How worried are you about the situation of terrorism in Europe?" on a 1-10 scale (1 = no worried at all, 10 = extremely worried).

Conservatism was measured through respondents' perception of abortion, military and national security, religion, traditional marriage, traditional values, the family unit, and patriotism. The negative or positive leaning towards these seven items was assessed as a score of 1 (greater negativity) through 100 (greater positivity) as recommended by Everett (2013).

Conspiracy ideation was approached through the generic conspiracist beliefs scale (Brotherton et al., 2013), which tackles government malfeasance, extraterrestrial cover-up, malevolent global conspiracies, personal well-being, and control of information.

Euroscepticism was measured on the dimensions proposed by Lubbers and Scheepers (2005) considering the agreement with the empowerment of the European institutions for international policies, immigration policies, sociocultural policies, and country benefits from membership of the EU.

Numeracy was assessed as the score for correctly solving 7 items implying the calculation and understanding of proportions, percentages, and chances as proposed by Lipkus et al. (2001).

Analytical thinking was measured with the short version (Toplak et al., 2014) substitute for the Cognitive Reflection Test (CRT; Frederick, 2005).

4.2 Statistical Evidence and Readers' Following Perceptions

Statistical evidence on terrorist attacks in 2018 was presented as concluded by Europol. The text presented general information regarding Europol's activity, and the TE-SAT reports and followed with the listing of the 2018 terrorist attacks with the corresponding number of victims per attack. The text can be found in Appendix A.

To investigate the anchoring effect, a control group (N=141) received the same text but with coverings for the number of victims per attack. Therefore, these participants had to estimate both the number of victims for 2018 and for 2019.

To control for participants' engagement with proposed evidence, the text ended with a question requiring mathematical computation: "How many human lives losses (people killed) were registered as a result of the terrorist attacks in 2018 in Europe?" Participants were asked to fill in a blank space with the correct calculation, meaning a total of 13 life losses.

Finally, the experimenter presented the participants with the correct calculation, and the participants registered their perception of the number of life losses from terrorist attacks (high or low), and they were asked to estimate the number of life losses for the current year for which no TE-SAT report was yet released (*How many human lives do you think will be registered as a result of the terrorist attacks in 2019 in Europe?*).

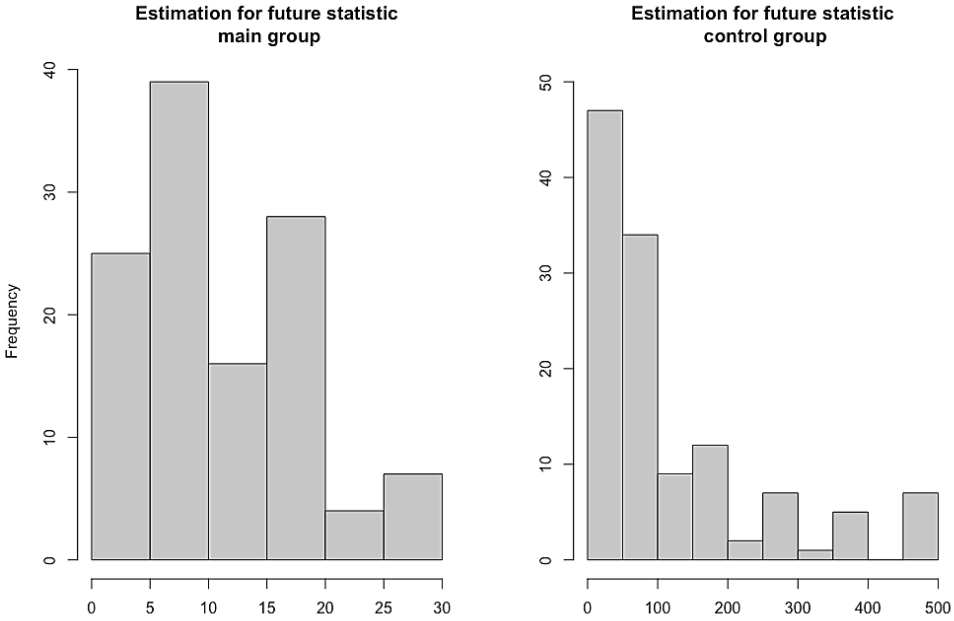
5. Findings

Figure 1 reveals the anchoring effect as the difference between the estimations for future statistic between the main group (Min = 0, Max = 30, Mean = 12.93, Median = 10, SD = 7.65) and the control group (Min = 0, Max = 500, Mean = 131.6, Median = 84, SD = 134.9). For the control group, only 16% of the participants (N = 21) reported estimations below 30.

Of all participants, 11% perceived the proposed evidence (i.e., 13 people being killed in terrorist attacks in 2018) to indicate a high level of terrorism, while 89% perceived it as low.

The second hypothesis was confirmed as results revealed a significant difference between the estimations provided by those perceiving 13 as a large number and those perceiving it as a small number (Kruskal-Wallis H = 4.2851, p = 0.04, df = 1). The results are illustrated in Figure 1.

Figure 1. Estimation between perception groups



Source: Descriptive statistics conducted in Rstudio.

For those perceiving 13 as a small number, further estimations were significantly above 13 ($p = 0.01$). For those perceiving 13 as a large number, the estimation is not significantly different than 13 ($p = 0.22$).

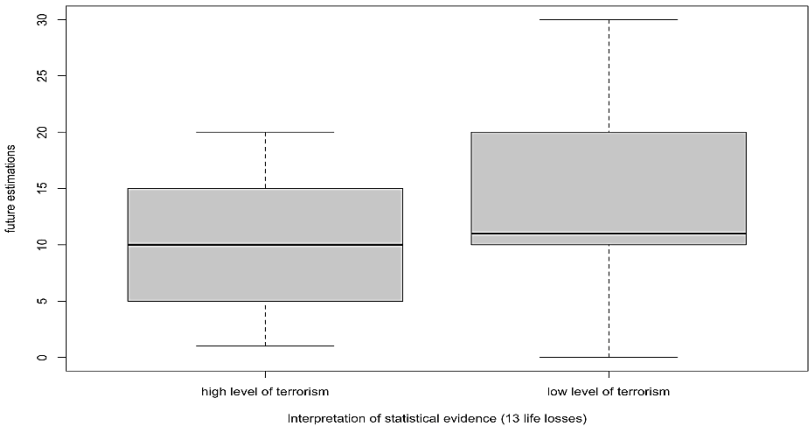
The third hypothesis was confirmed as worry concerning self-person (Kruskal-Wallis $H = 7.5477$, $p < 0.01$, $df = 1$) and a family member (Kruskal-Wallis $H = 6.663$, $p < 0.01$, $df = 1$) having a significant influence on the perception of proposed evidence. The perceived risk to self (Kruskal-Wallis $H = 0.023402$, $p = 0.88$, $df = 1$) or risk to others (Kruskal-Wallis $H = 1.8892$, $p = 0.17$, $df = 1$) had no influence on whether participants considered 13 to be a large or a small number.

The fourth hypothesis was confirmed, with numeracy having a significant impact on how the proposed evidence is perceived (Kruskal-Wallis $H = 4.1183$, $p = 0.04$, $df = 1$). Analytical thinking revealed no significant impact on the perception of proposed evidence ($p = 0.41$).

The fifth hypothesis was confirmed with conspiracy ideation (Kruskal-Wallis $H = 2.7026$, $p = 0.10$, $df = 1$), conservatism (Kruskal-Wallis $H = 0.43312$, $p = 0.51$, $df = 1$), or euroscepticism (X-squared $= 0.0092608$, $df = 2$, $p = 0.9$) having no impact on the perception of proposed evidence.

As for the control variables, gender revealed no significant impact (X-squared $= 2.4771$, $df = 2$, $p = 0.12$). There was no significant difference (Figure 2) in perception with respect to education (X-squared $= 4.0193$, $df = 3$, p-value $= 0.3$) or age (Kruskal-Wallis $H = 2.6219$, $p = 0.11$, $df = 1$).

Figure 2. Future estimations by level of terrorism



Source: Descriptive statistics conducted in Rstudio.

6. Conclusions

When presented with statistical evidence, people are primed by the numbers they encounter, and they make subsequent estimations accordingly with the "anchoring effect". However, the mental alignment to numerical evidence is not uniform among participants, and people base their expectations also on emotional representations.

In our study, the interpretation of the proposed evidence as indicating a low level of terrorism impacted their expectations so that they estimated a higher level for the future. For those who perceive a high level of terrorism based on the same statistical evidence, no such expectation was identified.

When looking at the factors that lead to divergent interpretations, we identified the worry of terrorism to play a significant role as opposed to the perceived risk of terrorism. This may be indicative of the weight of subjective representations rather than objective calculations, personal worry vs. risk. These results stand both in terms of risk and worry regarding the self-person or others.

As for analytical thinking, it did not reveal any impact on how people interpreted statistical evidence. However, the specific ability to understand and work with numbers had a significant impact.

This type of anchoring-and-adjusting is a general effect, with age, gender, and education revealing no significant differences among participants. Moreover, conspiracy ideation, conservatism, and Euroscepticism did not significantly influence participants' perceptions. This underlines once again the relevance of specificity and contextualization when discussing information processing.

The conclusions of this study are of greatest impact for policymakers and public administrators in the case of successful public communication.

Further investigations should tackle not only the perception but also the behavioral impact of divergent interpretations of statistical evidence and should also adapt to different topics of interest.

References

[1] Ahler, D.J. (2014). Self-fulfilling misperceptions of public polarization. *The Journal of Politics*, 76(3), pp. 607-620.

[2] Allcott, H., Gentzkow, M. (2017). Social media and fake news in the 2016 election. *Journal of Economic Perspectives*, 31(2), pp. 211-236.

[3] Ariely, D., Loewenstein, G., Prelec, D. (2003). "Coherent arbitrariness": Stable demand curves without stable preferences. *The Quarterly Journal of Economics*, 118(1), pp. 73-106.

[4] Brotherton, R., French, C.C., Pickering, A.D. (2013). Measuring belief in conspiracy theories: The generic conspiracist beliefs scale. *Frontiers in Psychology*, p. 279.

[5] DellaVigna, S., Kaplan, E. (2007). The Fox News effect: Media bias and voting. *The Quarterly Journal of Economics*, 122(3), pp. 1187-1234.

[6] Epley, N., Gilovich, T. (2006). The anchoring-and-adjustment heuristic: Why the adjustments are insufficient. *Psychological Science*, 17(4), pp. 311-318.

[7] Everett, J.A. (2013). The 12 item social and economic conservatism scale (SECS). *PloS One*, 8(12), p. e82131.

[8] Frederick, S. (2005). Cognitive reflection and decision making. *Journal of Economic perspectives*, 19(4), pp. 25-42.

[9] Harper, C.A., Baguley, T. (2019). "You are fake news": Ideological (A) symmetries in perceptions of media legitimacy.

[10] Lewandowsky, S., Ecker, U.K., Seifert, C.M., Schwarz, N., Cook, J. (2012). Misinformation and its correction: Continued influence and successful debiasing. *Psychological Science in the Public Interest*, 13(3), pp. 106-131.

[11] Lipkus, I.M., Samsa, G., Rimer, B.K. (2001). General performance on a numeracy scale among highly educated samples. *Medical Decision Making*, 21(1), pp. 37-44.

[12] Lubbers, M., Scheepers, P. (2005). Political versus instrumental Euro-scepticism: Mapping scepticism in European countries and regions. *European Union Politics*, 6(2), pp. 223-242.

[13] Nellis, A.M., Savage, J. (2012). Does watching the news affect fear of terrorism? The importance of media exposure on terrorism fear. *Crime & Delinquency*, 58(5), pp. 748-768.

[14] Nyhan, B., Reifler, J. (2010). When corrections fail: The persistence of political misperceptions. *Political Behavior*, 32(2), pp. 303-330.

[15] Pennycook, G., Rand, D.G. (2019). Lazy, not biased: Susceptibility to partisan fake news is better explained by lack of reasoning than by motivated reasoning. *Cognition*, 188, pp. 39-50.

[16] Roets, A. (2017). 'Fake news': Incorrect, but hard to correct. The role of cognitive ability on the impact of false information on social impressions. *Intelligence*, 65, pp. 107-110.

[17] Rosu, M.M., Cosmoiu, A., Ianole-Călin, R., Podina, I.R. (2021). When is reliable data effective? The role of media engagement in reducing the impact of fake news on worry regarding terrorism. *Current Psychology*, pp. 1-15.

[18] Sunstein, C.R. (2018). # Republic. Princeton university press.

[19] Thompson, R.R., Jones, N.M., Holman, E.A., Silver, R.C. (2019). Media exposure to mass violence events can fuel a cycle of distress. *Science Advances*, 5(4), eaav3502.

[20] Toplak, M.E., West, R.F., Stanovich, K.E. (2014). Assessing miserly information processing: An expansion of the Cognitive Reflection Test. *Thinking & Reasoning*, 20(2), pp. 147-168.

[21] Tucker, J.A., Guess, A., Barberá, P., Vaccari, C., Siegel, A., Sanovich, S., ... , Nyhan, B. (2018). Social media, political polarization, and political disinformation: A review of the scientific literature. Political polarization, and political disinformation: a review of the scientific literature (March 19, 2018).

[22] Tversky, A., Kahneman, D. (1974). Judgment under Uncertainty: Heuristics and Biases: Biases in judgments reveal some heuristics of thinking under uncertainty. *Science*, 185(4157), pp. 1124-1131.

[23] Wilson, T.D., Houston, C.E., Etling, K.M., Brekke, N. (1996). A new look at anchoring effects: basic anchoring and its antecedents. *Journal of Experimental Psychology: General*, 125(4), p. 387.

[24] Zhang, X., Ghorbani, A.A. (2020). An overview of online fake news: Characterization, detection, and discussion. *Information Processing & Management*, 57(2), p. 102025.

Appendix

Statistical Evidence

Europol is the European Union's law enforcement agency. Europol supports law enforcement authorities throughout the EU on crime-fighting activities in all its mandated areas. Analysis is at the core of our activities. Our criminal analysts are among the best trained in Europe. They use state-of-the-art tools to support investigations by law enforcement in Member States on a daily basis. We produce regular assessments that offer comprehensive, forward-looking analyses of crime and terrorism in the EU.

Every year, the agency produces the EU Terrorism Situation and Trend Report (TE-SAT), which gives a detailed account of the state of terrorism in the EU.

According to the TE-SAT 2019 Report, in 2018, these are the terrorist attacks that resulted in human life losses:

MARCH Carcassone, France — 4 people killed

MAY Paris, France — 1 people killed

MAY Liège, Belgium — 3 people killed

DECEMBER Strasbourg, France — 5 people killed

How many human lives losses (people killed) were registered as a result of the terrorist attacks in 2018 in Europe?

Answer: