

WHAT COGNITIVE BIASES ATTACK POTENTIAL CUSTOMERS IN USER REVIEWS THE MOST?

[Jaká kognitivní zkreslení nejvíce útočí na potenciální zákazníky v uživatelských recenzích?]

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Abstract: Reading reviews is a common activity for many potential customers when deciding to buy a product from a particular retailer. It is such a common activity that many of them may be unaware that they are influenced not only by the content of the review itself, but also by its style, display, length, and distinctiveness, with a particular cognitive bias behind each of these elements. This has an impact on their decision-making, which may ultimately be illogical. In reality, however, we are affected by hundreds of confirmed distortions that force us to think and act irrationally. If people are not always able to make rational decisions, then many of the economic assumptions need to be reviewed. The aim of this paper is therefore to uncover the cognitive biases that attack potential customers in user reviews and to determine their influence on e-shop popularity ratings. In order to accomplish the objective, a survey was conducted among the TOP 100 e-shops on the Czech market, from which were selected 70 e-shops to identify the most frequently occurring cognitive biases. In the first step, the heuristic method of observing e-shop websites was used. In the second step, a chi-square two-sample test was used to obtain results due to the nominal nature of the data under study. It was found that in terms of the user interface, the most emerging biases are bandwagon effect, apophenia, authority bias and social proof. Then, in the case of examining the reviews themselves, it was found that availability bias, story bias, processing difficulty effect, negativity effect and authority bias were determined to be the most likely to influence potential customers. Some of these biases were also found to affect the popularity ratings of the e-shop, which marketing managers should pay attention to because of the link between popularity and loyalty.

Keywords: apophenia, authority bias, bandwagon effect, e-shops, negativity effect, online reviews, processing difficulty effect, story bias.

JEL classification: M30, M31, C12

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Introduction

In economics theory, the standard model is that everybody is rational, self-interested, calculating and have all the available information, in contrast, psychologists' research often suggests a much more skeptical view of our cognitive abilities. Kahneman (2011) shows the importance to identify and understand mistakes in judgments and decisions of others and over

time of themselves, as well as efforts to limit bad judgments and decisions. If people are not always capable of making rational decisions, then a lot of what economists had inferred on the basis of those assumptions really needed to be re-examined. For these reasons, it is important to monitor the psychological factors that affect a person in decision-making. At this time, purchasing decisions are very often moved to the online space, where consumers are affected by various cognitive biases.

From an evolutionary perspective, cognitive biases seem somewhat mysterious because they deviate from standards of logic and accuracy (Haselton, Nettl and Andrews 2015). Cognitive biases refer to cases in which human cognition produces representations that are systematically distorted relative to some aspect of objective reality. The concept of cognitive biases has been explored in the literature from many different perspectives, ranging from their effect on decision making by mitigating more costly errors (Johnson, Blumstein, Fowler and Haselton 2013) and optimizing behaviour (Marshall, Trimmer, Houston and McNamara 2013), to their use in a specific domain. Studies dealing with the effect and use of cognitive biases in online marketing communication, specifically in the context of reviews, are relevant to this paper. Bandwagon effect (Wu and Lin 2017), analysis paralysis (Houdek et al. 2018), authority bias (Sundar, Xu and Oeldorf-Hirsch 2008), and negative bias (Yang and Unnava 2016) can be considered the most important cognitive biases for reviews in the web environment framework. Overall, however, consumers in the study setting are also influenced by many other biases such as story bias, availability bias, social proof, apophenia effect, Von Restorff effect, humour effect and processing difficulty effect confirmation bias, loss aversion, blind spot bias, anchoring bias, social influence, the effects and synergistic effect of which are worthy of inclusion in the study. However, according to Haselton, Nettle, and Andrews (2015), the idea that human judgment is flawed is itself flawed. Indeed, the evolution of cognitive biases suggests that humans are precisely through them adapting to the environment in which they live and may be functional traits designed by the wisdom of natural selection.

Cognitive biases are naturally part of everyone's life and have a significant impact on society-wide behaviour as well. It is a very broad topic covering a myriad of errors that can be committed not only by consumers when making purchasing decisions, but by anyone confronted with a situation in which they have to make a specific decision. Given the fact that nowadays internet users are influenced by various fraudulent messages or fake product reviews, it is more important than ever before to identify ways to avoid falling prey to these fraudulent practices. At the same time, in the growth of consumer trust in online product reviews, i.e. in the opinions of other entirely unknown people, it is also important to formulate the ways in which the company can influence the decision-making of the consumer.

Therefore, the purpose of this study is to uncover the cognitive biases that attack potential customers in user reviews and to determine their influence on e-shop popularity ratings. The observing sample is Top 100 largest e-shops in Czechia, from which were closely monitored 70 e-shops. In order to fulfil the aim of the paper, a heuristic method of analysing e-shop websites and the types of cognitive bias is used. The impact of cognitive biases on the popularity rating is analysed by Pearson Chi-square test. This paper first introduces the cognitive biases that have been found to affect review readers. Subsequently, the methods section mainly presents how the data was collected and analysed. The results chapter first presents general findings on the proportion of e-shops allowing their customers to post reviews. Subsequently, attention is paid to the results already focusing on the specific cognitive biases that were revealed in our investigation and their possible influence on the

popularity ratings of the e-shops under study. The paper concludes with a summary of the most important findings and their scientific and managerial implications.

1 Cognitive biases in the domain of user reviews

Although consumers typically seek both positive and negative reviews to evaluate products (You et al. 2015), it is not only the negativity and positivity of reviews that influence their final purchase decision, but many other cognitive biases. Already when viewing a review page, *analysis paralysis* can begin to affect the consumer. This bias consists in displaying a certain number of reviews per page. Therefore, analysis paralysis causes consumers to feel that if consumers have too many choices, they tend not to choose any (Houdek et al. 2018). This is consistent with the finding that those consumers who face too many choices, even if they are pleasant choices, suffer from decision fatigue, which causes them to be less focused and more likely to give up more quickly when trying to complete the task (Worth 2009). Consumers postpone their purchasing decisions when they are "spoilt" for choice, whereas they buy faster when they have fewer options to choose from (Iyengar 2010). More options have been found to lead to greater dissatisfaction because customer expectations are increased (Kurien et al. 2014). Consumers may experience choice paralysis when it is difficult to find all relevant options and effectively check available feedback such as reviews (Basuroy, Chatterjee and Ravid 2003; Breugelmans, Kohler, Dellaert, and de Ruyter 2012; Khare, Labrecque and Asare 2011).

Reading the reviews then the bandwagon effect starts to have an effect. The assumption of the *bandwagon effect* is that the probability of adopting a viewpoint increases with the number of people who hold that viewpoint (Muchnik et al. 2013; Vosoughi, Roy and Aral 2018; Sundar, Oeldorf-Hirsch and Xu 2008; Xu et al. 2012). For online consumer reviews to serve as decision-making guides, consumers must first trust the reviewer. However, unlike in-person communication where trust develops overtime, consumers must rely on personal information to establish trust in the reviewer in the context of online shopping. The results of a study examining reviewer trust showed that the cues of the reputation and profile picture differentially contributed to users' affective trust and the cognitive trust toward the reviewer (Xu 2014). Kim and Gambino (2016) focused on personalization features and herding effect stimuli (star ratings and specific reviews) in the case of a restaurant website. Their research showed that personalization features and herding effect stimuli increased positive perceptions and their behavioral intentions toward the website and the recommended restaurant. Another experiment that examined web users revealed that online ratings are highly sensitive to irrational herding behavior and that herding can be manipulated (Bohannon 2013). This effect is also associated with the authority effect in many papers. The creation of more positive attitudes toward a product review website was found to be related to the source of information, where if an expert was cited as the source of information for a product review, such a product review elicited more favorable attitudes toward the website (Kim et al. 2015). This study also revealed that *perceived authority* and herding heuristics mediated the relationship between the presence of social plugins and favorable attitudes toward a website through perceived trustworthiness. The findings not only highlighted the strength of authority and herding stimuli in the rapid appraisal of a product review site, but also discovered a theoretical pathway that explained the role of social plugins on e-shops websites. Research suggests that new media features such as large numbers of "likes", shares, comments, or high ratings can induce a herding effect that positively influences the effectiveness of online word-of-mouth (e-WOM) messages (Sundar, Oeldorf-Hirsch and Xu 2008; Xu et al. 2012). In studies examining e-WOM in the form of online reviews in conjunction with the herding effect, positive reviews have been found to influence both perceptions of the review itself and

perceptions about the product (Sundar, Oeldorf-Hirsch and Xu 2008; Xu et al. 2012; Wu and Lin 2017). Within the online shopping environment, the herding effect influences reviews and sales rankings, which in turn affects the perceived popularity and customer's intention to purchase the product (Sundar, Oeldorf-Hirsch and Xu 2008). Comment ratings also positively affect the perceived credibility of reviews, which influences the perceived usefulness of reviews, product attitude, and purchase intention (Sundar, Oeldorf-Hirsch Xu 2008; Wu and Lin 2017). Therefore, from the group of user interface (UI) elements, the next focus will be on authority bias.

Based on the theory of *authority bias*, consumers trust authority more. Therefore, mentioning phrases such as 'verified customer', 'registered customer' and 'expert' for specific reviews can influence consumers' judgement (Kreimer 2016; Ngo-Ye and Sinha 2014; Liu and Du 2020). Authority bias occurs when the opinions and instructions of authority figures are unquestionably accepted and followed. Research in this area has found that statements attributed to prestigious persons scored higher in agreement with the rater's opinion than anonymous statements (Kreimer 2016). Furthermore, reviewer characteristics and the authority of the member in a given community have been found to help predict the usefulness of reviews (Ngo-Ye and Sinha 2014). Research focusing on the influence of product photography in reviews has found that reviews using an image can directly indicate the socioeconomic status of reviewers, which is quite different from text-based reviews (Liu and Du 2020). The publication of these images was found to have a significant effect on consumer purchase intentions, suggesting that consumers have higher purchase intentions when they feel that products are recommended by reviewers with high socioeconomic status. Other research has focused on how the verified purchase label of reviewers influences consumers' product purchase decisions (He et al. 2020). Such reviewer labeling evokes consumers' perception that the reviewer has experience with the product and maximizes the utility of his or her review. Thus, research by He et al. (2020) confirmed that reviews by verified reviewers are directly related to obtaining higher sales for products reviewed by those reviewers. Related to the strength of authority is the credibility of the source. As part of research focusing on this credibility before and after making a purchase, it has been found that if customers purchase a product based on credibility and are subsequently dissatisfied with it, they will reconsider their judgement of the credibility of the entire website (Hsieh and Li 2020). Therefore, credibility in online reviews is not only a short-term influence when purchasing products, but also a long-term influence, as it can affect future purchases. As part of the power of authority, this bias has been found to be significantly enhanced when all information is consistent across the Internet (Lankes 2008).

The value of an online review, whether anonymous or supported by authority bias, can be enhanced by *social proof bias*. Hilverda, Kuttschreuter and Giebels (2018) analysed the social proof bias which affects the perceived number of interactions for reviews. Thus, a review with more "likes" may be perceived as more valuable. However, the diversity of text within the story bias can also contribute significantly to the perception of a review as valuable. *Story bias* is associated with the conjunction fallacy, whereby consumers believe the review more if there is a story with more details (Fico, Richardson, and Edwards 2004). Story bias is connected with the *Von Restorff effect*. This effect represents the tendency to remember what stands out in some way (Chee and Goh, 2018). In reviews, this can include using emojis, writing the review in capital letters only, using bullets, and other symbols. However, attention must be paid to the length of the text itself. Chevalier and Mayzlin (2006) found that the *processing difficulty effect* played an important role in reviews. The authors suggested that longer reviews decrease the relative share. We can also judge the value of a review by

whether we are familiar with the reviewer's style of expression. In this case, *availability bias* plays a role. Availability bias makes familiar things seem good (Dimara, Dragicevic, and Bezerianos 2016). This bias is very difficult to study because it is based on the individuality of the consumer. Nevertheless, there are commonly known phrases that we can include and examine here, such as "I recommend" or "Super". Related to this is also apophenia bias, which is based on people's tendency to identify meaningful patterns where none actually exist. As a result of Jones and Martin (2021) study, people tend to prefer positive results over negative ones. The final choice of the customer can also be affected by *confirmation bias*. Confirmation bias describes a condition in which consumers tend to favour information and interpretations that support their view while ignoring or undervaluing those that contradict their beliefs or interpreting ambiguous information to be consistent with their own view (Del Vicario et al. 2017).

Another important element is emotions. Emotions can significantly influence the way reviews are processed. For this reason, the *humour effect* described by positive emotions in reviews will be analysed. The empirical evaluation by Garcia and Schweitzer (2011) or Malik and Hussain (2017) found that trust, joy, and anticipation have a greater impact on perceived helpfulness. On the other hand, *negativity effect* means a tendency to place more emphasis on negative experiences rather than positive ones. Consumers suffering from this bias feel that "negative is stronger than positive" and will perceive threats rather than positives in a given situation (Kim and Hwang 2020). A study using eye tracking and self-reporting showed that consumers spend more time on negative reviews and orient themselves more by the number of positive and negative reviews than by the quantity of product sold (Shi et al. 2020). Many studies confirm that negative reviews were perceived as more useful (Chen and Lurie 2013; East, Uncles, Romaniuka Lomax 2016; Yang and Unnava 2016; Kim and Hwang 2020). However, another study, also using the eye tracking method, found that although consumers underestimate the ratings of high-volume products compared to low-volume products due to negativity effect (Shi et al. 2020), presenting a percentage of positive reviews can eliminate the rating difference. In addition, when both the percentage of positive reviews and the sales volume are high, consumers prefer products with lower sales volume but a higher percentage of positive reviews over products with higher sales volume but a lower percentage of positive reviews. However, when evaluating the usefulness of a review, there was a relationship between the usefulness rating and its negative content, the more negative the review was, the more useful it was rated, which also confirms the effectiveness of negativity effect in the study area (Cui et al. 2012). The findings of these studies highlighted the importance of emotions in online reviews and the significant implications for consumers and e-commerce retailers.

Based on the literature review, it is evident that there are many cognitive biases in user reviews. Therefore, the following research question was formulated to uncover which biases have the greatest impact on an e-shop popularity rank. The research question is 'Which cognitive biases found in user reviews can affect the popularity of an e-shop?'

2 Methods

We applied the mentioned cognitive biases to the top 100 largest e-shops according to a study on the *českýkošíkroku.cz* website. In order to fulfil the aim of the paper, a heuristic method of observing e-shop websites and analysing the types of cognitive bias on the evaluation of the offered products is used. The main object of research is the reviews of products sold.

Heuristic analysis is a basic method of examining websites. It is an expert analysis performed on the basis of already known and practically verified knowledge concerning the selected qualitative characteristics of the web presentation. This knowledge can take the form of a list of points that need to be checked on the website, or the analysis is based only on the theoretical knowledge and practical experience of person processing it. The main advantages of heuristic analysis are the relative ease of implementation, lower time requirements and the possibility to apply both theoretical knowledge and practical experience in research.

Data collection

As part of the observation of the researched websites, two main categories of services provided at the e-shop were selected. The choice of these main categories was based on the focus of the e-shop. Consequently, two subcategories of the main products were identified. These subcategories included mainly the most popular, best-selling or most expensive products. Thus, 4 significant products were selected for each e-shop, for which it was possible to assume the highest number of reviews. If product did not have any reviews, no distortion was examined. In the case of 30 e-shops, it was not possible to perform analyses. The author collective carried out a total of 280 observations according to precisely defined criteria and metrics (70 e-shops and 4 products for each of e-shop). Subsequently, cognitive biases and their metrics were defined for analysis. For the purpose of this paper, we analysed a total of seven user interface elements and eleven specific elements that may be present in the reviews. These elements are part of the tables in results. All available reviews were taken into account for each product. Totally more than 10 000 reviews were analysed. The individual observations were carried out in the period of October 2021. The list of TOP 100 e-shops, selected categories and products and the total number of reviews is available in the appendix.

Data analysis

Firstly, frequency analysis was conducted focusing on the number of e-shops that allow the inclusion of reviews on their websites. Subsequently, only those e-shops that allow their customers to post reviews were examined. The results of the popularity of the examined e-shops were taken from the study on the [českýkošíkroku.cz](https://www.ceskykošíkroku.cz) website. The popularity scores were divided into four categories. The less popular category, where e-shops achieved between 51% and 60% popularity; the popular category, where e-shops achieved between 61% and 70% popularity; the more popular category, where e-shops achieved between 71% and 80% popularity; and the most popular category, where e-shops achieved between 81% and 90% popularity. None of the e-shops studied achieved less than 51% popularity and none achieved more than 90% popularity. During data cleaning, e-shops that do not allow their customers to post reviews of their products were removed from the dataset. There was a total of 30 such e-shops in the study. This step resulted in the category of less popular e-shops disappearing from the dataset. The analysis further investigated the cognitive biases of the website users in terms of UI elements and the element in reviews. Subsequently, attention was paid to investigating the possible influence of cognitive biases from the perspective of UI and reviews themselves on the level of popularity of e-shops. In this step, a chi-square two-sample test was used to obtain results due to the nominal nature of the data under study.

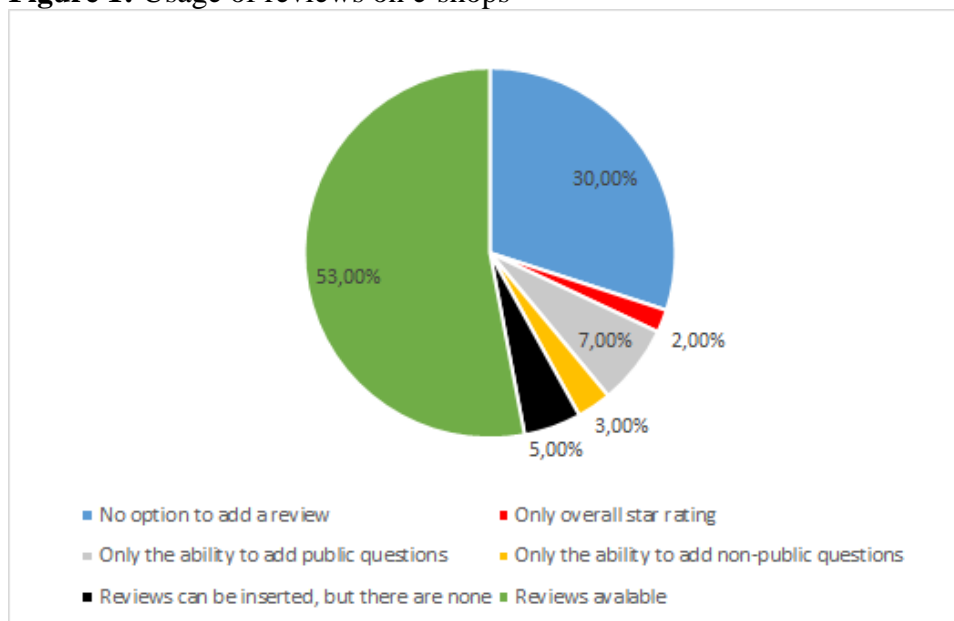
This method gives us the basic characteristics of the relationship between the observed variables. Due to the high number of monitored variables, this method selects important elements to which it will be possible to pay more attention in further research. The Pearson chi-square tests the match of expected and actual frequencies in parts of the range of possible values. A test of independence assesses whether observations consisting of measures on two variables, expressed in a contingency table, are independent of each other. The aim is to

calculate Pearson's cumulative test statistic, which asymptotically approaches. Pearson's chi square test is calculated by means of a nonparametric test in the statistical program SPSS. The results are discussed in relation to the chosen null hypothesis about the independence of the observed traits.

3 Results

Based on an analysis of the total number of e-shops surveyed, according to the TOP 100 metric, it was found that 58% of e-shops allow their customers to post text reviews of the products they have purchased. Almost one-third of e-shops do not allow to post reviews of purchased products at all. As shown in Figure 1, other e-shops, although not allowing text reviews, allow customers to rate products with stars or allow potential customers to ask questions.

Figure 1: Usage of reviews on e-shops



Source: websites of the analysed e-shops; own illustration

An examination of specific elements within the user interface (UI) revealed that users are most often shown the overall percentage of customers recommending a product. In this case, there may be a bandwagon effect, whereby when a higher percentage of recommending customers is reached, this may have a positive effect on the perception of the appropriateness of purchasing product. Furthermore, very often the date of the review is indicated next to the review. In this case, the apophenia effect may act on customers, where they may unconsciously give more weight to more recent reviews. Up to 66% of e-shops that allow the insertion of reviews show a certain number of reviews per page, which may mitigate the effect of analysis paralysis. Since this is an effect where a potential customer browsing reviews may be paralyzed and not complete their intended purchase due to this bias, all e-shops should pay attention to sorting options within their UI to avoid this situation. The following table shows the specific values of the use of elements within UI and their assignment to specific cognitive biases.

Table 1: Percentage of used UI elements

Cognitive biases	Web elements examined	Yes	No	Not possible to determine
Analysis paralysis	Showing a certain number of reviews per page	66.04%	18.87%	15.09%
Bandwagon effect	Indication of the total percentage of customers recommending the product/Indicated average star rating	92.45%	5.66%	1.89%
	The overall position of the product in the category/e-shop	24.53%	75.47%	0.00%
Authority bias	Reviewers' photos	3.77%	92.45%	3.77%
	Verified customer/professional review	35.85%	60.38%	3.77%
	Evaluation by the e-shop itself	13.21%	86.79%	0.00%
Negativity effect	Number of negative reviews listed	43.40%	52.83%	3.77%
Social proof	Option to like/dislike a specific review or yes/no to a question about the usefulness of a review	33.96%	62.26%	3.77%
	Option to add questions to the product	33.96% (+1.89% non-public)	60.38%	0.00%
Apophenia	The date the review was posted appears	84.91%	11.32%	3.77%
Bandwagon and negativity effect	The positives and negatives of the purchased product are highlighted	45.28%	50.94%	3.77%

Source: websites of the analysed e-shops; own calculation

In terms of the content of the user reviews themselves, the focus was on eleven specific elements (Table 2) that may be present in the reviews. Very often, reviewers rated the product using familiar phrases (up to 73% of reviewers), where the use of these phrases may have a positive/negative impact on the reader of the review in terms of availability bias. Often reviews are also written in the form of storytelling (up to 71% of reviewers), where story bias may influence the reader.

Table 2: Proportion of specific elements in reviews

Cognitive biases	Specific elements examined in the review	Yes	No
Story bias	Stories in reviews	71.13%	28.87%
Von Restorff effect	Visually different reviews	38.66%	61.34%
Availability bias	Familiar phrases in reviews	73.20%	26.80%
Negativity effect	Spelling mistakes	41.54%	58.46%
	Negative emotions in reviews	13.85%	86.15%
	Negative content reviews	42.05%	57.95%
Humour effect	Positive emotions in reviews	41.54%	58.46%
Processing difficulty effect	Long reviews (two or more lines)	67.01%	32.99%
Authority bias	Name and surname of the author of the review	20.51%	79.49%
	Only the name of the reviewer	43.88% (+2.04% occasionally)	54.08%
Negativity effect	Unreliable reviews	12.24%	87.76%

Source: websites of the analysed e-shops; own calculation

Our research found that several different cognitive biases affect the reader of a review, both from the position of the e-shop itself (the possibilities within the UI) and from the position of the customers who created the review. Realistically, there are certainly many more cognitive biases within review affecting the reader, but in our research, we have uncovered the possible effects of analysis paralysis, bandwagon effect, authority bias, negativity effect, social proof, apophenia, story bias, Von Restorff effect, Availability bias.

Furthermore, the possible influence of cognitive biases in terms of UI and reviews themselves on the level of popularity of e-shops was investigated. The null hypotheses are formulated as follows: "Cognitive biases (examined) within UI do not affect the popularity of e-shops". The following table presents the results of the investigation.

Table 3: The effect of cognitive biases in UI on e-shop popularity

Cognitive biases	Web elements examined	Pearson Chi-Square Value	df	Asymp.Sig.
Analysis paralysis	Showing a certain number of reviews per page	1.598	4	0.809
Bandwagon effect	Indication of the total percentage of customers recommending the product/Indicated average star rating	4.740	4	0.315
	The overall position of the product in the category/e-shop	1.968	2	0.374
Authority bias	Reviewers' photos	4.332	4	0.363
	Verified customer/professional review	2.809	4	0.590
	Evaluation by the e-shop itself	2.660	2	0.264
Negativity effect	Number of negative reviews listed	1.620	4	0.805
Social proof	Option to like/dislike a specific review or yes/no to a question about the usefulness of a review	1.510	4	0.825
	Option to add questions to the product	5.045	2	0.080
Apophenia	The date the review was posted appears	1.423	4	0.840
Bandwagon and negativity effect	The positives and negatives of the purchased product are highlighted	1.873	4	0.759

Source: websites of the analysed e-shops; popularity study on českýkošíkroku.cz; own calculation

Null hypotheses cannot be rejected based on test results. The results show that cognitive bias within the user interface did not affect the popularity of the e-shops studied. For this reason, the value of the contingency coefficients is not shown in the table.

The same procedure was also applied to examine the effect of cognitive biases within the user reviews on the level of e-shops' popularity. The results (Tab. 4.) show different findings.

Table 4: The effect of cognitive biases in user reviews on e-shop popularity

Cognitive biases	Specific elements examined in the review	Pearson Chi-Square Value	df	Asymp.Sig.	Contingency Coefficient Value
Story bias	Stories in reviews	12.995	2	0.002*	0.251
Von Restorff effect	Visually different reviews	7.344	2	0.025*	0.191
Availability bias	Familiar phrases in reviews	5.383	2	0.068	0.165
Negativity effect	Spelling mistakes	14.685	2	0.001*	0.266
	Negative emotions in reviews	4.943	4	0.293	0.158
	Negative content reviews	2.968	2	0.227	0.123
Humour effect	Positive emotions in reviews	9.306	2	0.010*	0.214
Processing difficulty effect	Long reviews (two or more lines)	9.938	2	0.007*	0.221
Authority bias	Name and surname of the author of the review	20.062	4	0.000*	0.307
	Only the name of the reviewer	19.841	12	0.070	0.305
Negativity effect	Unreliable reviews	3.071	4	0.546	0.125

Source: websites of the analysed e-shops; popularity study on českýkošíkroku.cz; own calculation

The investigation confirmed the possible influence of cognitive biases in user reviews on e-shop popularity ratings. It was found that story bias, Von Restorff effect, Negativity effect, Humour effect, processing difficulty effect and authority bias are the biases that can influence the perception of popularity. In the case of story bias and processing difficulty effect, these are also biases that appear very frequently in user reviews. On the other hand, the remaining mentioned biases affecting the popularity of the e-shop (Von Restorff effect, negativity effect, Humour effect and authority bias) do not occur in almost every second review, yet they also influence the popularity rating of the e-shop.

4 Discussion

Interestingly, the results show that many cognitive biases affect consumers, and the less frequent ones have not been shown to have less of an effect on popularity ratings of the e-shop, as might be expected. The results confirm previous findings that analysis paralysis has a significant effect on consumers (Iyengar 2010; Basuroy, Chatterjee and Ravid 2003; Breugelmans et al. 2012; Chevalier and Mayzlin 2006; Khare, Labrecque and Asare 2011)

specifically in our research, it shows a strong effect on e-shop popularity ratings. Companies appear to be aware of the importance of the brandwagon effect, which was found in more than 90% of the e-shops surveyed, but this effect was found to have only a weak to moderate effect on e-shop popularity ratings. This may be due to the fact that while this effect is one of the most important for purchase decisions, within the e-shop popularity it is possible that consumers perceive it as already standard. Thus, especially in the elements examined, which were indication of the total percentage of customers recommending the product, indicated average star rating or information about the overall position of the product in the category/e-shop. Within authority bias, the mention of verified customer or professional review was found to be the most significant element. These findings confirm the results of previous studies (Kreimer 2016; Ngo-Ye and Sinha 2014; Liu and Du 2020) that mentioned that mentioning 'verified customer' or "expert" can influence consumers' judgement. The results of the social proof bias show that this effect does not only operate in terms of the number of interactions received by the reviews (Hilverda, Kuttschreuter and Giebels 2018), but also significantly influences the opinion on the popularity of the e-shop. The apophenia bias examined whether the date the review was published appears to have an effect on the popularity of the e-shop. The assumption was, in line with Jones and Martin (2021) findings on this bias that people may tend to perceive more recent reviews as better, which may influence them. This assumption was confirmed as the effect of the date the review was added on the popularity of the e-shop. An interesting finding is that the negativity effect has a much greater effect on the popularity rating of an e-shop when it is present in the AI (as the number of negative reviews listed), whereas within user reviews alone the negativity effect is not significantly associated with the popularity rating of an e-shop. Perhaps only in the case of spelling mistakes appearing in reviews can a stronger effect be observed, which shows that even here negative review sentiment can negatively affect the overall popularity rating of the e-shop, confirming previous findings on the significance of this cognitive bias (Chen and Lurie 2013; East et al. 2016; Yang and Unnava 2016; Kim and Hwang 2020). Overall, the results show that cognitive biases in user reviews have a very weak effect on e-shop popularity ratings compared to cognitive biases that appear in the UI.

These results need to be interpreted with caution, because this study has its limitations. One of the limitations of the study is the method used to obtain secondary data. The results of the heuristic analysis are only partial in nature, typical of basic research. Thus, it is likely that there are also additional cognitive biases in the text reviews, but these may not have been present in the given sample of secondary data. Intuition is used in the heuristic analysis, which could influence the attribution of specific biases for a particular review. Therefore, the authors of this paper attempted to mitigate this bias problem by creating a set of specific variables that were assigned to each bias. If these variables were present in a given review, a team member followed this formula to assign the appropriate type(s) of cognitive bias to that review. Another limitation is the selection of monitored research items and the research sample. In this research, 70 e-stores were analyzed after the data cleaning process and reviews were conducted for 4 selected products each time. The selection of the research sample was not random as the TOP 100 e-shops on the Czech market were included in the research. For further research, it would be advisable to examine e-shops also in terms of the product range sold and expand the sample. This might have revealed the connection between the product category and the cognitive biases used in it. However, this was not the aim of this research. The authors of the paper aimed primarily to uncover the cognitive biases that appear in reviews because in future research they want to focus on the already specific biases that actually occur and determine their weight in product purchase decisions. To do this, however,

the authors of the paper will need to use a different research method that is able to examine the influence of each bias on consumer behaviour in more depth.

Conclusion

The aim of the paper was to uncover the cognitive biases that attack potential customers in user reviews and to determine their influence on e-shop popularity ratings. First, various cognitive biases were described. Then a heuristic method of observing e-shop websites and analysing the types of cognitive biases was used. The sample consists of the top 100 largest Czech e-shops. The main object of the research was the product reviews. Two product categories were chosen on each website. These included mainly the most popular, best-selling, or most expensive products. Analysed were a total of seven user interface elements and eleven specific cognitive bias elements that may be present in the reviews.

Only 58 % of TOP 100 Czech e-shops allow their customers to post product reviews. Almost one third of e-shops does not allow their customers to post product reviews at all, the rest allows only to rate products with stars or ask questions. The research uncovered which cognitive biases influence review readers the most and which the least. In terms of the UI, the most used are bandwagon effect with 92.45 %, apophenia with 84.91 %, and avoidance to analysis paralysis with 66.04 %. The least used are authority bias (measured by three elements ranging from 60.38 % to 92.45 %) and social proof (measured by two elements, 30.38 % and 62.26 %). In terms of review' texts the most used availability bias with 73.2 %, story bias with 71.13 %, and processing difficulty effect with 67 %. The least used were negativity effect bias (measured by three elements ranging from 67.95 % to 86.15 %) and authority bias (measured by two elements, 54.08 % and 79.49 %). Surely, other cognitive biases can also play a role in customer decision making while reading product reviews in the biggest Czech e-shops, but this research gives a solid conclusion on which ones are currently used and should be considered by the consumers.

Moreover, based on the results of our research, we can say that companies cannot influence the popularity of their e-shop through UI variation, i.e. how they display reviews. This is because only cognitive biases appearing in the customer reviews themselves can affect the popularity ratings of an e-shop. Since popularity is an important predictor of customer loyalty, we recommend that companies focus on promoting specific elements that influence the popularity of their e-shop with their reviewers. Thus, the answer to the research question is that the cognitive biases in user reviews that may affect the popularity of an e-shop include in particular the use of stories in reviews, visually different reviews, removing spelling mistakes, hinting at positive emotions in the text, longer reviews and inserting first and last names.

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Annex 1 Specifics of the examined e-shops and selected product categories

The name of the e-shop	Selected subcategories	Selected product	reviews on the web	The name of the e-shop	Selected subcategories	Selected product	reviews on the web
Astratex	Brassieres	Podprsena Angelia New	YES	Lidl	Hits of the Week	PARKSIDE® Invertorová svářečka PISG 120 B3	YES
		Podprsena Maia 4D Soft Control Deluxe				LIVARNOLIVING® Otočný stojan na boty	
	Underpants	Brazilky Carole Brazilky Ester			Fashion	LUPILU® Divčí softshellová bunda PEPPERTS® Chlapecké tepláky	
Footshop	Sneakers	Raf Simons	YES	Mall	Mobile phone	Xiaomi Redmi 9A, 2GB/32GB, Global Version, Granite Gray Xiaomi Redmi 9A, 2GB/32GB, Global Version, Sky Blue	YES
		Adidas ZX				Kärcher SE 4001	
	Boots	Filling Pieces Timberland			Hobby and garden	Kärcher Zametací stroj S 4 Twin (1.766-360.0)	
Alza.cz	Mobile phone	iPhone 11 64GB	YES	Marimex			NO, only the questions section (public)
		Xiaomi Redmi Note 10S		Max-Shop	Mobile phone	Apple iPhone 11 Pro 64GB Midnight Green Samsung G525F Galaxy XCover 5	
	Notebooks	Macbook Air 13 M1 HP Pavilion Gaming 15ec-1900nc			Smart watches	Garmin (010-02174-03) Vivoactive 4 Apple Watch (MY1H2C/A) SE 44mm	
4Home	Bed linen	Bavlněné povlečení Nordic Friends Krepové povlečení Podzim	YES	Mega knihy	Fiction	Šikmý kostel Má cesta za štěstím - Karel Gott Listopád Zuzanin dech	YES
	Sheets	Jersey Jersey Podzim					
AB-COM.cz			NO				
AboutYou			NO				
akoupelnatopeni.cz	Electric Boilers	Protherm kotel RAY 12 KE Protherm kotel RAY 9 KE	YES	Megapixel Megatel	Lens	Nikon 70-300 mm F4.5-6.3 G AF-P DX ED VR Sony FE 85 mm f/1.8 Sony Alpha A7 III tělo CYESn EOS R6 tělo	YES
	Combination toilet bowls	Aqualine JALTA RIMLESS WC kombi			Camera		
Alfa.cz			NO	Mironet			NO
Answer			NO	Mojekolo			NO, only the questions section (public)
Asko Nabytek			NO	Mobil Pohotovost			NO
Benu	Over-the-counter medicines	OLYNTH HA 1MG/ML nosní podání IBALGIN 400MG potahované tablety Vitamins MedPharma Vitamin C 1000mg s šípky Preventan Akut	YES	Muziker	Guitar	Elektrická kytara Klasická kytara studiová beyerdynamic studiová lewizt	YES
Bonami	Seating furniture	Sada 2 koženkových židlí Actona Batilda Černá jídelní židle s prvky v dekoru dubového dřeva Actona Roxby Sofas and couches Variabilní pohovka Karup Design Roots Raw/Light Grey Variabilní pohovka Karup Design Fresh Natural Clear/Dark Grey	YES	NOSICE-STRESNL.cz			YES
					Women's perfume	Dior Lancome	
					shampoos	Kerastase Paris	
Bonprix	Pullovers and sweaters	Bavlněný svetr se stojáčkem vetr z jemného úpletu s výstřihem do V T-shirts and tops Triko s dlouhým rukávem Rainbow Dlouhé boxy triko s krátkými rukávy bpc	YES	Notino		Loreal professionnel	YES
					Washing machine	LG F4WT Bosh Serie 6	
					Coffee maker	Espresso Krups Essential Espresso Bosch Tassimo	
Conrad	Acoustic components	Visaton 2913 miniaturní reproduktor Visaton 2912 miniaturní reproduktor Smoke detectors Cordes Haussicherheit CC-80-1 bezdrátový detektor kouře v dané podkategorii už není žádná recenze	YES	Obchody 24 OBI	Building material	Beton Hobby Portlandský směsný cement Ochranný obal na stůl a židle	YES
Cycology	Bowden, ropes	Alu koncovka na lanko - 2mm Alligator LY-IPA03 Alu koncovka lanka - 1,6mm Alligator LY-IPA01 Handles Kliky ShimYES DEORE FC-M6100 KLIKY SHIMYES ULTEGRA FC-R8000 2X11SP	YES	Ok Hračky		Box na polstry	NO, only the questions section (public)
					Mobile phone	iPhone SE 2020 Samsung Galaxy A12	
					Television	Philips 43PUS Hisense 65U8QF	
CZC.cz	Mobile phone	Samsung Galaxy A52s Apple iPhone SE 2020, 64GB	YES	Okay			Option to add a review exists, but no review is on the site NO
	Tablets	Apple iPad Air 2020 (4. gen.), 10,9", 64GB Samsung Galaxy Tab A7 T500N, 3GB/32GB					
Datart	Television	Televize LG OLED65CX Televize Samsung QE55Q7TTA	YES	ONLINESHOP	Washing machines	AEG ProSteam Beko HDF7 Slim	YES
	Video equipment	Set-top box GoGEN DVB 272 T2 PVR černý Set-top box Tesla TEH-500 PLUS			Food processor	Eta Grattissimo Bravo Bosh Mum	
Decathlon	Women's T-Shirts	DÁMSKÉ BĚŽECKÉ TRIČKO RUN DRY RŮŽOVÉ KALENJI DÁMSKÉ FITNESS TRIČKO ZE 100% BAVLNY BÍLÉ NYAMBA	YES	Originalky	Women's perfume	Enrique Iglesias Deeply Yours Guess Seductive	YES
	Women's hoodies and sweaters	DÁMSKÝ TURISTICKÝ HYBRIDNÍ SVETR NH 100 ŠEDÝ QUECHUA DÁMSKA TURISTICKÁ FLEECOVÁ MIKINA MH 520			Aftershave	Hugo Boss Boss Bottled Giorgio Armani Acqua	
Decodoma	Linen	Ložní rodinná souprava z mikrovlákn HILDY Ložní rodinná souprava z mikrovlákn MEADOW	YES	Elnino Paddy Pekro			NO, only the questions section (public) NO, only the questions section (public) NO
	Tension covers	Antibakteriální bielastické potahy SANITIZED Bielastické potahy BRILLANTE					
Detske Kocarky			Option to add a review exists, but no review is on the site YES	Piilulka	Over-the-counter drugs	Paralen 500 Wobenzym Perlan 45g	YES
	Pre-filled washing machines	Pračka Beko WRE6612CSBSW Pračka Beko WRE6511BHW			Drugstores		
	Tumble dryers	Sušička Beko EDS7434CSRX				Batist vložky porodnické	

		Sušička Beko DPS7405GB5			winter tyres	Barum Polaris 5			
DOMACITECHNIKA.cz			NO, only the questions section (public)			Continental Winter Contact TS 860			
Dr.Max			NO		summer van tyres	Continental Van Contact	YES		
Eberry			NO, only questions section (non-public)	PNEUMATIKY		Nokian cLien Van			
Electronic Star	Fryers	AeroVital Deluxe horkovzdušná fritéza	YES	Profizoo	Dogs	PROFIZOO Ucho vepřové sušené volně 1ks	YES		
		VitAir Turbo horkovzdušná fritéza				BRIT Premium Dog Adult L 15 kg			
	Coffee Machines	Espressionata Gusto espresso kávovar			Cats	Bayer Foresto obojek pro malé psy do 8kg 38cm			
		Passionata 20 kávovar				WHISKAS s hovězím masem 14kg			
Electroworld	Laptops	Apple MacBook Air 13" M1 256 GB (2020) MGN63CZ/A	YES	Prozdřavi	Detoxification of the organism	Aloe Vera gel 1000 ml	YES		
		ASUS VivoBook 14 M415DA-EK341T stříbrný				Mycobaby dračí sirup 200 ml + pastilky ZDARMA			
	Monitors	Philips 243V7QDSB			Acidification of the organism	pH Mineral Balance 60 tablet			
		LG 24TN510S-PZ				pH Minerals na odkyselení organismu 320 g			
Elektroz	Washing machines and dryers	AEG L8WBE68SI	YES	Kola Šilhavý - RAMALA			NO		
		Electrolux EW7W368SI							
	Refrigerators	Bosch KGN39XIDQ			Robotic vacuum cleaners	iRobot Roomba 975 WiFi			
		Bosch KGE36AWCA				iRobot Roomba 676 WiFi			
Elektrospecialista			NO, only questions section (non-public)	roboticky-vysavac.cz	Stick vacuums	BOSCH BBH325S1	YES		
						BOSCH BBHF214G			
	Women's Running Shoes	Boty NIKE - Revolution 5 BQ3207 002 Black/White/Anthracite	YES		Siko	Shower Panels		panel SIKO na stěnu černá/chrom ALUSHOWERC	YES
		Boty MERRELL - Vapor Glove 3 Luna Ltr J003422 Black/Charcoal						SIKO Bamboo Shower BAMBOOSHOWER	
Women's Fitness Shoes	Boty PUMA - St Activate 369122 20 Castlerock/Puma White	Faucets		S-Line Pro termostatická 150 mm chrom SIKOBSLPRO268T					
	Boty SKECHERS - Graceful Moves 128258/BKW Black/White			S-line Pro termostatická 150 mm chrom SIKOBSLPRO222T					
Eoshop			NO, only questions section (non-public)	Smartronix			NO		
EUC Lékárna			NO	Smarty	Apple products	Apple AirPods bezdrátová sluchátka (2019) bílá	YES		
Euronics	Front-loading washing machines	Pračka AEG ProSteam® L7FEE48SC bílá	YES			Apple MacBook Pro 13,3" / M1 / 8GB / 256GB / vesměrné sedý			
		Pračka AEG ProSteam® L7FBE69SCA s funkcí AutoDose bílá			Mobile phone	Xiaomi Redmi Note 10 Pro 6GB/128GB Onyx Gray			
	Top-loading washing machines	Pračka AEG OKOMix® LTX8C373C bílá				Realme 7i DualSIM 4/64GB Glory Silver			
		Pračka AEG ProSteam® LTX7E272C bílá	SpokojenýPes.cz	Dog food	Marp Holistic Lamb Grain Free 2 kg	YES			
EUROPARFÉMY Eva.cz	Perfumed lotions	Lanvin Éclat D'Arpege		YES				Marp Natural Green Mountains Lamb 12 kg	
		Karl Lagerfeld Karl Lagerfeld For Her					Granules for cats	Marp Holistic Chicken Cat 2 kg	
	Eau de Toilette	Calvin Klein CK One						Essential Foods Jaguar 3 kg	
		HUGO BOSS Boss Bottled				T-Shirts	Lotto CHRENIA		
ExaSoft			NO	Sportisimo		Puma INDIVIDUAL RISE JERSEY	YES		
			NO		Shoes	adidas GRAND COURT			
Expert			NO (individual reviews cannot be displayed, only the overall star rating)					Lotto SET MATCH AMF INF SL	
Fepro			NO (individual reviews cannot be displayed, only the overall star rating)	SportObchod	Cycling	Střešní nosič kol Thule FreeRide 532	YES		
Fitham			NO, only the questions section (public)			Střešní nosič kol Thule ProRide 598			
	Washbasins	Umývadlo Cersanit MITO 60x45 cm	YES		Tennis	Tenisové míče Head Tour (4 ks)			
		Umývatko Tarn přírodní kámen 40x23x11 cm				Tenisové míče Wilson US Open (4ks)			
Hornbach	TOILETS	WC kombi Grand s úspornou armaturou	Suntech				NO		
		WC kombi Grand MK43894	Svářečky-Obchod.cz	CO2 WELDERS (MIG-MAG)	KOWAX GENIMIG 220 MIG/MAG,MMA + HOŘÁK + KABELY + VENTIL + KUKLA	YES			
Imobily		Option to add a review exists, but no review is on the site			KOWAX GENIMIG 220 + HOŘÁK 4M, KABELY 3M, VENTIL, KUKLA, SVAŘOVACÍ DRÁT, SPREJ, PODVOZEK, LÁHEV CO2 PLNÁ				
Insportline				NO	Plasma cutters		SCHEPPACH PLC 40 PLAZMOVÁ REZAČKA		
iStage				NO			VECTOR PARIS 700 PLASMA PILOT + HOŘÁK PLASMA		
Jysk K24	Bedrooms - wardrobes	Skříň DAMHUS 60x150 tmavě šedá	YES	Tchibo	Home food preparation	Souprava pro kvašení TESCOMA DELLA CASA 5000 ml	YES		
		Skříň HAGENDRUP 96x176 kombi buk				Závaží pro kvašení TESCOMA DELLA CASA, 3 ks			
	Bathroom - bathroom equipment	Dávkovač mýdla ROSENLUND			Knives	Nůž univerzální AZZA 13 cm			
		Miska na mýdlo MALA šedá plast 2400 g (122483) 1015643				Nůž univerzální AZZA 9 cm			
Kamody	Top Selling Products 2020 by Consumer	VILEDA TURBO mop 151153	YES	Teshop			NO		
		GARDENA Pipeline vodní záruška, 3/4" 8250-20		Tipa			NO		
		Den Braven Mamut Glue, High Tack lepidlo 290 ml, bílá, 0411RL 1173		T.S.Bohemia			NO		
		Fiskars X25 - XL Sekera štípací 72 cm, 2400 g (122483) 1015643		Velko Pneu			NO		

Kasa	Large household appliances	Sušička prádla Bosch WTW87467CS bílá	YES	Vestavné spotřebiče.cz	Built-in ovens	WHIRLPOOL AKP 244/IX	YES	
		Pračka AEG ProSteam® L7FEE48SC bílá				WHIRLPOOL AKP 449/IX		
	Small Home Appliances	Espresso Krups Arabica EA811010 černé				SIEMENS EH645FFB1E		
		Tyčový vysavač Rowenta DUAL FORCE 2 V 1 RH6751WO modrý				SIEMENS EH651FFC1E		
Knihy Dobrovský	Bestsellers	Má cesta za štěstím - Karel Gott	YES	Zoot			NO	
		Šikmý kostel		Kytary			Option to add a review exists, but no review is on the site	
		Pozvání		L-E			Option to add a review exists, but no review is on the site	
		Listopád			Dietary supplements and vitamins	GS Vitamin C 1000 se šípky 120 tablet	YES	
Kobras			NO		GS Vápník Hořčík Zinek PREMIUM s vitaminem D 100+30 tablet			
Kosmas	Readers recommend	Zuzanin dech	YES	Lekarna (Lékárna.cz)	Over-the-counter medicines	PARALEN 500 mg 24 tablet		
		0 Tu, svazek první				IBALGIN 400 mg 100 potahovaných tablet		
		Dlouhá trať		Kuma			NO	
		Šikmý kostel						