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The Presence of Order-Effect Bias in Moscow Administration

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Abstract. This paper studies ‘the order effect’ in decision making based on classification results of 120 000 citizen claims to Moscow Government. We use machine learning methods and derive that with 60% probability the first out of two consequent claims is prioritized. We conclude that this impact must be considered whilst developing artificial intelligence units.

Keywords: Text classification; order effect; cognitive bias; quantum probability theory; machine learning; G2C.

1 Introduction

Existing behavioral models do not encompass all impacts of intuition, emotional reactions and prior interactions on decision-making [1]. Order effects are one of the known variants of cognitive bias that describes that the sequence of the obtained information influences the human-made decisions [4-11], e.g. when sequence of questions influences survey answers [10-11]. Currently, this effect is seen also in public administration bodies, where similar citizen claims might be resolved differently. Discovering why some documents are considered more important than the latter [2, 3] gave as motivation to write this paper. The goal of this work is to *investigate whether there is a dependence of document sequence on classification*. Table 1 describes the identified areas where order effect is manifested.

Table 1. Areas and manifestations of order-effect.

Id	Area	Order Effect	Manifestation	Source
1	Sociology	Survey answer decision-making	the sequence of questions influences indicators, beliefs and survey answers.	[10], [11]
2	Science	Journal ranking decision-making	experts overestimate journals located higher in the list.	[4]
3	Politics	Electoral decision-making	80% of cases of elections depend on the sequence of candidates’ names in a voting bulletin.	[5]
4	Medicine	Patients’ treatment acceptance	if patients were informed about small risks after potential benefits, they were less likely to	[6]

		decision-making	accept the treatment.	
5	Medicine	Diagnosis decision-making	the sequence of clinical information shown to the doctor influenced diagnosis.	[7]
6	Tourism	Vacation decision-making	early introduction of any travel feature increased the importance of it in the eyes of tourists.	[8]
7	Finance	Investment decision-making	not only quality and amount of disclosing financial statements influenced potential investors, but also the order how those statements were sorted.	[9]

In this paper, we extend this research to the area of public administration, when employees classify documents [3] prior to decision-making, whilst the IT-enabled topic predictors are not used [12]. We analyze a data set of claims to public authority that has (a) unpredictable topic of incoming claims; (b) weakly-structured character of handling process; (c) employees' overload. Consequently, our research question is:

RQ: Does argument order in citizen claims affect its thematic classification?

2 Methods

We analyze 120 000 incoming claims from electronic services supporting Moscow Government¹ in 2014-2015. In this process 8 -12 people classify messages using the universal range of thematic categories, such as "Municipal development", "Healthcare", "Transport", "Education", "Housing and communal services". We knew which category was chosen by an employee. Thus, we reproduce the mode of human decision-making whilst processing of unstructured text. We consider a text message received by a government body not as a single phrase, but as a sequence of words. We use Latent Dirichlet Allocation and Naive Bayes Classifier methods to attach weights to text, depending on its significance and revealing topics which are most presented in it. Classical machine learning methods use simple model of "a bag of words", being limited only to the morphological analysis and not carrying out syntactic analysis and the semantic analysis of offers.

3 Findings

The 'order effect' was tested on arrays 'Dataset 1' and 'Dataset 2' (Table 2). Commonly, several topics exist in a message – more than in one third of all messages where parts were different from each other. However, in the first part subject X indicated, and in the another – subject Y, then in 60% of cases an employee decides to apply the category of the first part (X) to whole message. That characterizes all dataset of claims and gives a positive answer to RQ.

Table 2. Parameters and datasets.

Parameter name	Dataset 1	Dataset 2
Total number of addresses in selection	6116	33393
N_{AB} is the number of the messages having various categories at the 1st and 2nd part	828	12648
$N_{AB \rightarrow A}$ is the number of messages with the choice of total category for the 1st part	348	4900
$N_{AB \rightarrow B}$ is the number of messages with the choice of total category for the 2nd part	475	3403
$\Pr(AB \rightarrow A)$ – choice probability for all address of category of the	61,42	59,01

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To check order effect dependence on the claim probabilities $\Pr(A_i B \rightarrow A_i)$ and $\Pr(B A_i \rightarrow A_i)$ were estimated, where A_i an exact category from the general list from 53 categories. At the same time the number of messages in which the category A_i occurred in the first and in the second part was separately considered. The received results are reflected in Fig. 1.

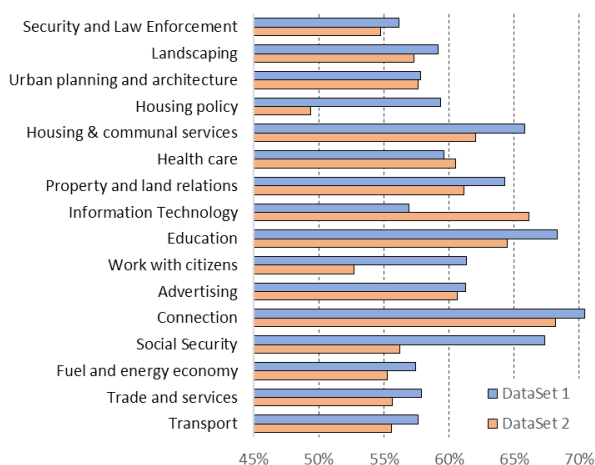
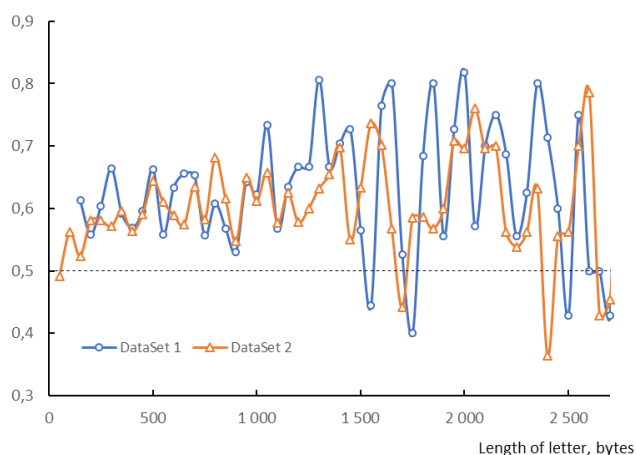


Fig. 1. Order effect for different categories, where blue color represents the choice of the first topic in classification

In the 'Dataset 1' all categories show such 'order effect' with the higher probability of applying the first topic to the whole citizen's claim. The most categories "Dataset 2" are characterized by reduction of observed order effect by 1-2%. However, for some thematic categories the order effect is changed strongly: drastic reduction of order effect is observed with topics 'Housing Policy' and 'Social security' and drastic growth (attention to 15%) with the topic 'Information Technologies'.

Fig. 2 reveals that the asymmetry exists in all texts which size exceeds ~ 100 -200 bytes (about one-two lines of the text). An Average value of an order effect - 60%, but at the same time quasiperiodic fluctuations are observed – the effect of an order changes in quite wide limits from 50% to 80%, and at some values of length of the text even "changes the sign" (decrease in probability of the choice of the first part lower than 50% means that the choice of category of the second part of the message becomes more probable). The period of such fluctuations is ~ 150 -250 bytes. Also, the correlation between schedules for two data arrays with lengths of text from 300 to 1200 bytes attracts attention. Such messages make the majority in the studied datasets and the received values of probabilities are more exact.



4 Conclusion

Our findings confirm the existence of cognitive bias in public administration using the example of Moscow Government. We develop the machine learning method to reveal order effect. There are certain limitations of this paper as we studied only one weakly-structured process. Future research will analyse other processes where decisions are made based on the manual analysis of documents – appeals to technical support, coordination of documents and consideration of credit card in banking.

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