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Impact of a priori positive information on the results of voting methods

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Abstract. The aim of this paper is to present the results of experiments relating to voting methods based on the bounded rationality theory. The research demonstrated that a positive nudge changes the voting results. The study focused on three methods of voting: the Borda Count method, the Condorcet winner method and the anti-manipulation method. In a laboratory experiment, the subjects were asked to select the best musician. They were to manipulate their voting so that a predetermined winner is chosen. In the first voting, the subjects did not receive any a priori information, while in the second voting, some a priori information was provided, i.e. the true, objective ranking of the musicians. What followed was another voting. It was initially assumed that the participants would manipulate their voting the same way as in the first voting. The results, however, were different. The obtained second ranking of musicians was closest to the true, objective ranking, thus proving that the manipulation effect was neutralised by the a priori positive information about the true, objective order.

Keywords: a priori information, strategic voting, voting methods

JEL: D71, D83, D91

1. Introduction

The idea of bounded rationality was introduced by Herbert Simon in 1955. It concerns limited rationality of individuals when making decisions. These limitations may be caused by the cognitive capacity of the mind. In a perfectly defined world, the agents would be perfect, i.e. economically rational; however, in the real world, the understanding of dilemmas is affected by subjective concepts, not necessarily consistent with the expected value maximisation principle. The most popular examples of situations where bounded rationality occurs is framing and nudge, both of which relate to micro and macroeconomics (Kowalski, 2002). The experiment presented in this paper is connected with the latter, i.e. the nudge concept.

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Framing (Tversky & Kahneman, 1981) occurs when the way problems are formulated affects decision-making. Experiments based on the 'Asian Disease' are very often studied to exemplify the reasoning behind the idea.

'The Asian Disease' assumes that a deadly illness is threatening to the lives of 600 inhabitants of a town. The task is to choose between two alternative rescue programmes: one is certain, while the other is risky. They are described (framed) either positively or negatively, but equal in their expected value. The positively framed subjects were to select between:

(A) saving 200 people for certain or

(B) saving 600 people with a one-third probability and a two-thirds probability that no one will survive.

The negatively framed subjects were to choose between:

(A') a certain death of 400 people and

(B') a one-third probability that nobody will die and a two-thirds probability that all 600 people will die.

The framing effect itself shows the violation of the invariance principle by choosing a risky gamble (B') rather than something certain (A') when the descriptors are negative (78% chose B' in the loss domain), and a certain option (A) rather than a gamble (B) when the descriptors are positive (72% selected A in the gain domain).

The nudge is a kind of indirect suggestion used to affect decision-making. It was introduced by Thaler and Sunstein (2008). Its most popular example refers to children's choice of healthy food. If we want children to decide on healthy food, we place it at the level of their eyes on the store shelves. The nudge theory has many applications in economics, healthcare and politics.

A priori information is a special type of nudge. We will analyse a case involving a priori information in the context of classical music competitions. A jury consisting of a dozen jurors using a given voting method creates a ranking of contestants from the best to the worst. A lot of nudges may be used. For example, information about the contestant, their achievements (halo effect) or the teachers. The order according to which the performances are presented is important. Whether the performance preceding the given contestant was weak or very good proves significant. The information about the contestant and the previous performances is a priori information.

The impact of a priori information has been analysed in many papers. One of them is Chmurzyńska (2015), where she quotes the research conducted by Manturzewska (1970a, 1970b), repeated in Chmurzyńska and Kamińska (2006). Papers by Manturzewska (1970a, 1970b), and Chmurzyńska and Kamińska (2006) are in Polish and are not widely known. Manturzewska presented five performances of one of Chopin's works to a team of experts. The performances ranged from very

poor, through average to very good. One very good performance and one average were presented twice, preceded by performances of different quality. The result depended on the quality of the preceding performance. The same performance received two different scores. Manturzewska's research results were confirmed and generalised in a number of independently written papers: the impact of the halo effect (Duerksen, 1972; Hunter & Russ, 1996; Radocy, 1976), the influence of a position in a sequence (Flôres & Ginsburgh, 1996; Ginsburgh & van Ours, 2003), and differences between various assessments of the same performance (Fiske, 1977, 1979; Wapnick et al., 1993). There are also papers which present investigations in sports competitions: Bertini et al. (2010), Gambarelli (2008), Gambarelli et al. (2012), and Tyszka and Wielochowski (1991).

The observed results may be found not only in classical music competitions but also in sports competitions, evaluation projects by experts, and other.

In this paper, we attempt to determine whether positive a priori information is likely to reduce the differences in the voting results where strategic voting is applied. By 'positive' we mean that information is provided about which particular alternatives might be highly evaluated.

The source of the experiment presented in this paper is a scenario featuring a university board. In Poland, students are members of such boards. The board has to select its chairperson. There are two main candidates: A and B. The students are divided into two groups. The first group supports candidate A, while the second group supports candidate B. Candidate A promises more funds allocated to sports, while candidate B promises the renovation of student housing. The students want to vote in such a way as to mark their favorite as the best candidate and the opponent as the worst. Before voting, they receive some additional information from the school graduates that C is the best candidate. The students are sure that the graduates correctly evaluate candidates and do not ignore their opinions, but they promise to support their favorite. The experiment described in this paper aims to answer the question of how would the students vote in the presented circumstances. In this scenario, the students receive objective, positive a priori information about the best candidate. It is a positive nudge. Therefore, a situation is created where a bounded rationality effect may occur. We attempt to answer the question above by conducting an experiment in the area of music competitions. Such a scenario was chosen as it has a relatively simple construction. Similar methods may be used in cases where expert opinions relate to sports, science and economic issues.

The paper is constructed as follows: Section 2 presents the used voting methods, while Section 3 introduces the formulated hypotheses. Section 4 describes the whole experiment and Section 5 its results. The conclusions are discussed in Section 6.

2. Voting methods

Three voting methods are used in this paper: the Borda Count method, the Condorcet winner method and the anti-manipulation method.

2.1. The Borda Count

This method was introduced by Jean-Charles de Borda in the 18th century. There are n alternatives. Each voter neutrally ranks the alternatives from the best to the worst. The best alternative is granted n points, the next one n–1 points, then n–2 points, etc. The worst alternative scores 1 point. Each alternative receives the sum of points obtained from all the voters. The alternative with the highest score wins. Let us consider the following example.

Example 1

The example relates to the voting in the final of the 15th International Henryk Wieniawski Violin Competition, presented in Table 1. The competition was held in Poznań, Poland in 2016. There were seven violinists (A…, G) and 11 jurors (J1…, J11). The Borda Count was used. Violinist A won, while violinist B came second. In fact, the inverted Borda Count was used. The best alternative obtained one point, the worst seven and the alternative with the lowest score won. The methods are isomorphic and lead to the same results.

Table 1. The final of the 15th International Henryk Wieniawski Violin Competition

Jurors → Contestants ↓	J1	J2	J3	J4	J5	J6	J7	J8	J9	J10	J11
A	7	3	2	7	7	4	3	7	7	7	7
B	4	7	7	2	2	7	7	2	5	6	5
C	5	5	5	3	6	6	5	5	6	1	6
D	3	6	4	5	1	5	4	4	3	5	1
E	1	4	6	1	3	3	6	3	4	3	4
F	6	2	1	6	4	2	1	6	1	2	2
G	2	1	3	4	5	1	2	1	2	4	3

Source: Kontek and Sosnowska (2020).

This method is used in sports or music competitions and in the assessment of projects. It should be noted that this approach is sensitive to manipulation. The highest number of points is granted to the favorite and the lowest to the opponent. Such manipulation can be observed during classical music competitions (see Table 1). If A has the best note of seven, then some jurors award B only two points. And conversely, if B is allotted seven points, then some jurors give two or three to A. This situation may result from a significant difference in music tastes, but it may also

be the effect of manipulation. Borda said that his method is designed for honest people. The application of voting methods in the context of music competitions is possible since the data are widely available. More about the Borda Count can be found in Gaertner (2013).

2.2. The Condorcet winner

The concept of the Condorcet winner was introduced by Nicolas de Condorcet in the 18th century. It is assumed that each voter has a preference relation which they use to compare alternatives. Let us consider alternatives A and B. Alternative A wins in comparison with B if more than 50% of voters (the majority) prefer A to B. All alternatives are compared. Alternative A is the Condorcet winner if it wins in comparison with each alternative. The Condorcet winner does not always exist. Let us consider the following example.

Example 2

The example is presented in Table 2. There are three voters: J1, J2, J3 and three alternatives: A, B, C. Voter 1 ranks alternatives A, B, C. Voter 2 – B, C, A. Voter 3 – C, A, B. The first alternative is the best, the third is the worst.

Table 2. The Condorcet paradox

Voters → Alternatives ↓	J1	J2	J3
A	3	1	2
B	2	3	1
C	1	2	3

Source: authors' work.

It should be noted that alternative X is before alternative Y in someone's order when X gets a higher score than Y in this order. Table 2 shows that A is twice before B, so A wins in comparison with B. C, on the other hand, is twice before A, so it wins in comparison with A. Therefore, C wins in comparison with A. A does not win in comparison with any alternative, so it is not the Condorcet winner. C loses in comparison with B, thus C is not the Condorcet winner. B loses in comparison with A, so B is not the Condorcet winner. Therefore, for these preferences, the Condorcet winner does not exist. These preferences are called the Condorcet paradox. The preferences are scattered. If the Condorcet winner exists, we deal with preferences that may lead directly to a common decision. In the case of the final of the 15th International Henryk Wieniawski Violin Competition, the Condorcet winner is A. More about the Condorcet winner can be found in Gaertner (2013).

2.3. The anti-manipulation method

No voting method is immune to manipulation except for the dictatorship method (Gibbard, 1974; Satherwaitte, 1975). Dictatorship is the only method which fulfils the conditions of the Arrow Impossibility Theorem (Arrow, 1951), while others meet these conditions only partly. Thus, there is no universally effective method, but we can choose a method with special properties. Kontek and Sosnowska (2020) proposed an approach that may reduce the possibility of manipulation. This method was devised on the basis of the observation of the final of the 15th International Henryk Wieniawski Violin Competition. It involves n voters and is constructed as follows:

- all voters use the Borda Count. Each voter has his or her vector of scores;
- the mean of the obtained scores is computed for every alternative. The vector of means is formed;
- there is a computed distance between each vector of the scores and each vector of the means;
- the whole part of $n/5$, $[n/5]$ is computed: $[n/5]=r$;
- the r voters with the highest distance from the mean are removed. If the distance of more than one voter who is in the r place is the same, the relevant parts are computed. For example, if there are two such voters, their scores are computed with a weight of 1/2;
- the Borda Count is applied to the rest of the voters.

It is assumed that a juror will consider carefully whether to apply manipulation in fear of obtaining extreme results and being removed from the group of jurors whose evaluations are taken into account. According to the anti-manipulation method, violinist B is the winner of the 15th International Henryk Wieniawski Violin Competition. This violinist is different from the Borda winner. Let us note that we indicated that the Condorcet winner might be different from the anti-manipulation method winner.

Some versions of the anti-manipulation method were used for the 5th International Fryderyk Chopin Competition for Amateur Pianists in Warsaw in 2021. The method was mentioned in the special edition of the main Polish classical music journal 'Ruch Muzyczny' devoted to the 18th International Fryderyk Chopin Piano Competition, which was held in Warsaw in October 2021 (Miklaszewski, 2021). In the case of many voters and many alternatives, the calculation of the anti-manipulation method determining the winner is complicated. The computer program may be found in Ramsza and Sosnowska (2020).

3. Hypotheses

In the following parts of the paper, the voting methods presented in Section 2 are discussed. The aim of the paper is to determine how the results of voting change when positive a priori information about the objective ranking is provided. A voting is considered where there is no common favourite for the whole group of voters. Voters are divided into two subgroups, which manipulate voting to get their favourite winner. The hypothesis is formulated as follows:

H.1. The voting result preceded by positive a priori information about the objective ranking is highly positively correlated with this objective ranking when two subgroups of voters are involved, each with a favorite. Favorites do not coincide.

In some experiments, alternatives are labelled with letters, starting with A. In this situation, we can consider the alphabetical order A, B, C... The alphabetical ranking, as the most popular kind, holds a special place in the minds of voters, which implies specific results of the voting. The following hypothesis is formulated:

H.2. When no nudges or common favorites of subgroups occur and alternatives are presented alphabetically, the results of the voting are positively correlated with the alphabetical order.

4. Experiment

The experiment was conducted in May 2021 on a group of undergraduate students of the SGH Warsaw School of Economics, majoring in quantitative methods in economics. The group consisted of 20 students and was divided into two 10-person subgroups. Each subgroup was to select the best musician among musicians A, B, C, D, E, F, G, H. They did not listen to the music, but relied on the provided information only. Each subgroup had its favorite and was told to manipulate the voting so that this person wins. Musician D was the favorite of the first subgroup, while E of the second. Both subgroups knew that the other subgroup was also manipulating the voting. Moreover, they were aware of who the opponent's favorite was. They were also informed that the anti-manipulation method would be used. Each subgroup's voting results were established. Moreover, the votes of the members of both subgroups were combined and a data simulation was performed which determined the voting results of the whole group involved in the research.

The anti-manipulation method based on the Borda Count was used. Therefore, we obtained results for the Borda Count and by applying profiles of preferences for the Borda Count, we were also able to determine the Condorcet winner. Voting based on these three methods was thus analysed.

There were two votings. The first one was conducted using the above knowledge about favorites and manipulation. Before the second vote, some additional a priori information was provided: that the true, objective ranking of musicians was B, C, F, E, D, G, A, H. Then, both subgroups voted for the second time taking into account the same information as in the first voting and the additional information about the true, objective ranking. Again, the anti-manipulation method was used. The anti-manipulation method winner, the Borda winner, as well as the Condorcet winner were determined for both subgroups. The results of the voting in both subgroups were established. Using these data, the voting of the whole group was determined, combing the individual preferences of both subgroups and computing the result of the voting for the group formed in this way. It should be noted that this group had no common favorite as the two subgroups had different favorites.

To summarise, it can be said that the experiment is based on a 3×2 plan. There are 3 voting methods (Borda, Condorcet and anti-manipulation) and 2 votings (without a priori information and with a priori information). The manipulation involving a priori information is a within-subject study (in the first voting each participant is not provided with a priori information and in the second voting each participant receives a priori information), while manipulation by information about favorites is a between-subject study design (each participant receives information only about the favorite of his or her subgroup).

5. Results

The results of both votings in each subgroup and the whole group are presented in Table 3.

Table 3. Winners of the voting determined on the basis of the experiment

Number	Group or subgroup (favorite)	Borda Count	Anti-manipulation method	Condorcet winner
1.	Subgroup 1 (D) without a priori information	D	D	D
2.	Subgroup 2 (E) without a priori information	E	E	E
3.	The whole group without a priori information	A	A	does not exist
4.	Subgroup 1 (D) with a priori information	D	B	D
5.	Subgroup 2 (E) with a priori information	E	E	E
6.	The whole group with a priori information	B	B	B

Source: authors' calculations.

Let us determine whether the winner in the case with no a priori information is A considering the voting of the whole group. The fact that the alphabetical ranking: A, B, C, D, E, F, G, H is the one that comes to people's minds first is no surprise.

When the group is provided with additional a priori information about the objective ranking, the winner changes to B. Thus, B is the best alternative in this objective ranking and additional information changes the winner. Moreover, B, who is the winner, is the best alternative in the ranking obtained due to this information. The results hold for all the considered voting methods. Let us compare the alphabetical ranking and the objective ranking by Kendall Tau. The Kendall Tau (τ) rank correlation coefficient is used to measure the ordinal association between measured quantities (Kendall, 1938). Kendall Tau for these two rankings is equal to 0.35, thus, there is no high or medium correlation between these two rankings. In addition, in one of the subgroups, B (the first one in the voting with additional information) is the winner in the anti-manipulation method. Therefore, the additional information about the objective ranking neutralises the manipulation effect and allows the true, best alternative to win.

Now, let us compare the obtained rankings: the true, objective ranking and the alphabetical ranking using the Kendall Tau. The following notation will be used: r_1 – ranking obtained in voting without additional a priori information, r_2 – ranking obtained in voting with additional a priori information, r_3 – objective ranking, and r_4 – alphabetical ranking. The Kendall Tau correlations are presented in Table 4.

Table 4. Kendall Tau correlations between rankings

Number	Group	Voting method	$\tau(r_1, r_2)$	$\tau(r_1, r_3)$	$\tau(r_1, r_4)$	$\tau(r_2. r_3)$
1.	Whole group	Borda	0.50	0.28	0.92	0.78
2.	Whole group	Anti-manipulation	0.33	0.28	0.92	0.92
3.	Subgroup 1	Borda	0.63	0.21	0.57	0.57
4.	Subgroup 1	Anti-manipulation	0.50	0.21	0.42	0.71
5.	Subgroup 2	Borda	0.50	0.14	0.35	0.64
6.	Subgroup 2	Anti-manipulation	0.35	0.07	0.28	0.71

Source: authors' calculations.

It is worth noting that for all the groups and both methods, the obtained ranking where voters had additional information r_2 was highly correlated with objective ranking r_3. This correlation was especially high for the voting of the whole group. Hypothesis H.1 has therefore been confirmed. The ranking where voters had no additional information r_1 was correlated with alphabetical ranking r_4, especially for the whole group. This indicates that the alphabetical ranking, where the alternatives were listed alphabetically, is a kind of natural ranking. Hypothesis H.2 is thus confirmed. The correlation between ranking r_1 with no additional information for the voters and ranking r_2, i.e. the one with the a priori information provided, is low or medium. There is a low correlation between r_1, where voters have no additional information, and true, objective ranking r_3. Therefore, the result of the voting with

the additional information given is the closest to the true, objective ranking. The additional information about the true, objective ranking makes the voters vote in such a way that the results are very close to those presented by this ranking.

6. Conclusions

It was shown that the anti-manipulation method, the Borda Count and the Condorcet winner methods are sensitive to positive a priori information, thus proving that reducing manipulation is possible. We can use a positive nudge as a weak suggestion, not an evaluation.

During the 18th International Chopin Piano Competition, the jurors did not know how the others voted. On the one hand, it is a positive feature, as it may be assumed that jurors did not influence each other. On the other hand, however, jurors are not the same and some of them may be recognised authorities for others. The knowledge of how these authorities vote may form a positive nudge and reduce manipulation. The knowledge which jurors have about students is another issue – the jurors do not participate in the voting concerning their own learners, but it is common knowledge which jurors taught which students. If there is a student of a juror who is an authority and teaches only very good students, this knowledge may act as positive a priori information and contribute to a higher score than in the case of someone not taught by a recognised authority. Thus, there are many practical questions connected with positive frames or nudges caused by the sensitivities of the voting methods.

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