NIM Nuremberg Institute for Market Decisions

What Drives the Acceptance of Algorithms in Decision Situations?

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RESEARCH REPORT

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1 Algorithms have found their way into our daily decisions

We live in the age of digitalization. Due to technological advances in information technology and mobile communications, more people and organizations have greater access to data and information than ever before (George et al., 2014; Hilbert & López, 2011). Just over a century ago, few people had read more than 100 books in their lifetime (van Knippenberg et al., 2015). But today, almost every person is just a click away from information about the latest stock prices, tests and user ratings of products, patent applications, and the latest news from business and science. Algorithms can help us to structure this amount of data and make decisions based on them. While not universally the better decision-maker in every situation, an algorithm can be a useful and effective tool in many market decision situations (Leyer & Schneider, 2021). But do people use the algorithms?

With the advent of algorithm-based decision-making, new challenges have emerged (Leyer & Schneider, 2021). For example, it has been shown that decision-makers reject superior but imperfect algorithms (Dietvorst et al., 2015;2018). This phenomenon - referred to as human algorithm aversion - can pose major challenges to businesses, namely when bad decisions are made due to algorithm aversion. Current research therefore seeks to better understand the background and influencing factors of algorithm aversion.

The reasons for rejecting algorithms are manifold

Overconfidence	Grove & Meehl, 1996; Highhouse, 2008
Lack of connection	Broadbent, 2017; Gray, 2017
AI lacks vulnerability	Broadbent, 2017; Gray, 2017
Incorrect expectations	Burton et al., 2019
No incentives	Burton et al., 2019
No control	Burton et al., 2019

2 What determines the acceptance of algorithms and which factors can influence their acceptance?

In order to answer the research question above, we developed an experimental research design in which about 1,000 participants took part. In our study, participants had to predict the success of crowdfunding campaigns based on several pieces of information.

Crowdfunding platforms are often used to finance new products or identify unaddressed needs. Predicting the success of crowdfunding campaigns - or more generally of product innovations - is therefore quite relevant for consumers and companies alike. Consumers, especially early adopters, must decide which crowdfunding campaign is promising so that their investment does not "fizzle out." Product managers in companies and investors must invest in innovations or innovative product ideas at an early stage, without the market success already being clearly recognizable.

In our study, participants could choose whether to let a prediction algorithm (developed by us) make the decision or to decide for themselves based on the data. The probability of success of the algorithm was 80%, but

this was only known to one group of participants. An additional incentive was a monetary reward, the amount of which depended on the number of successfully predicted projects.

The experiment

To test which measures can influence the acceptance of an algorithm in decision situations, we randomly assigned the participants to different groups. While the decision situation and the algorithm were the same in all groups, we provided each experimental group with different information about the algorithm. In this way, we were able to test which measures influenced acceptance. As a basis for comparison, we used a control group whose participants started directly into the prediction task without any additional information.

The groups

Result of the algorithm can be changed slightly (group "Intervention")

In this group, the participants could slightly adjust the decision of the algorithm. There are already findings from the literature in this regard. Dietvorst et al. (2018) have shown that people are significantly more likely to decide to use an imperfect algorithm if they are able to modify its predictions, even if this modification is marginal. **Hypothesis**: A possible influence on the algorithm's decision increases people's willingness to use it.

Transparent description of the algorithm (group "Transparency")

In various strands of literature, it has been shown that providing detailed information and targeted education can influence usage and decision-making behavior (cf. Goodyear et al., 2016). Therefore, in our study, participants in this group received more detailed information about the algorithm. For example, participants were explicitly informed that the algorithm predicts correctly with a probability of 80%. **Hypothesis:** Accordingly, higher use of the algorithm was also expected for this group.

Participants had to pay a fee for using the algorithm (group "Fee")

The effort (in terms of time, money, or cognition) that a person has to expend in order to carry out a particular transaction is also referred to as transaction cost. If transaction costs for the use of the algorithm are introduced, the use of the algorithm should decrease. Conversely, if transaction costs are reduced, usage should increase. In our study design, transaction costs - more precisely, information acquisition costs - are introduced by a small monetary fee. **Hypothesis:** People's willingness to use the algorithm in this group is lower than in the control group.

Participants received a reward for using the algorithm (group "Reward")

A (monetary) reward for using an algorithm can mitigate and counteract transaction costs or even represent negative transaction costs. With a reward, therefore, the willingness to use the algorithm should increase (Burton, 2020). Similar to the transaction cost group, in this group the reward is slightly varied when the algorithm is used. **Hypothesis:** A bonus for using the algorithm increases people's willingness to use it.

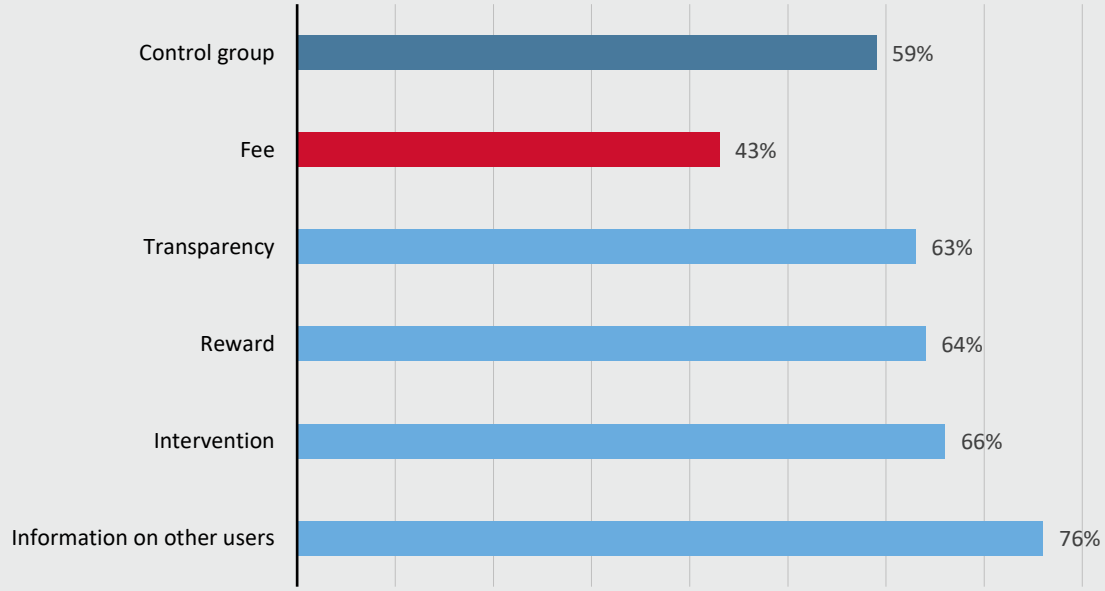
Information about usage and success rate of other participants (group "Information on other users")

Finally, one group was provided with information about the willingness of other participants to use the algorithm and their success rate. This method of "behavioral design" uses information about a comparison group as a reference point (Burton, 2020). **Hypothesis:** A higher level of willingness to use the algorithm is also expected for this group.

3 Information and control increase the acceptance of algorithms

The highest usage rate, i.e., the lowest aversion, was shown by the group that received information about the success rate (monetary payoff of participants with and without using the algorithm) from other participants in advance.

Figure 1: Average usage rate in percent



Also, the group with monetary incentives, the group with the possibility of changing the algorithm's result, and the group that received information about the algorithm's calculation logic chose the algorithm more often compared to the control group, right from the beginning. The group that had to pay a fee for using the algorithm showed the greatest aversion.

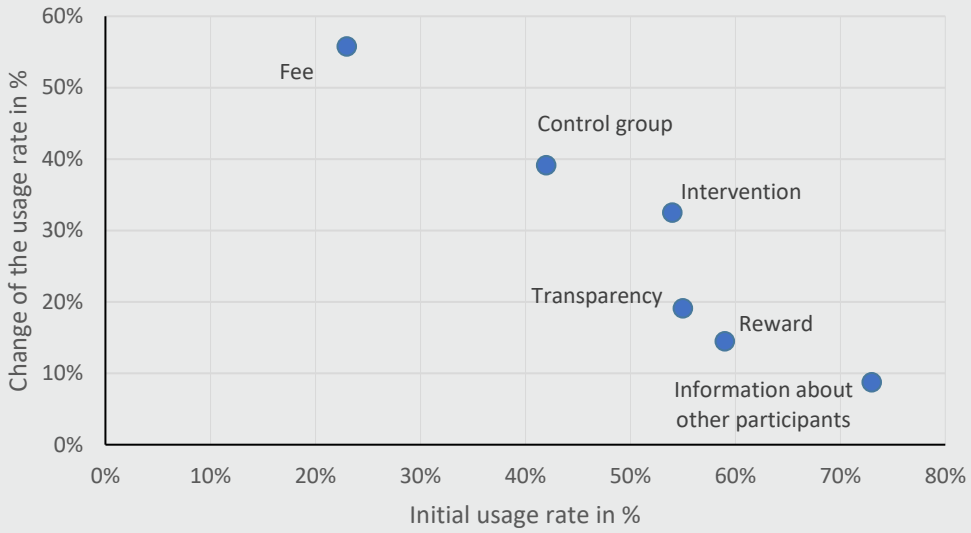
Over time, all groups showed higher acceptance of the algorithm the more frequently they used it. After seven rounds, willingness to use the algorithm was significantly higher in all groups than at the beginning. This effect suggests that a learning effect or habituation effect is setting in.

Figure 2 shows the initial usage rate (x-axis) and the change of usage after seven rounds (y-axis) in percent. In all groups, the algorithm was chosen more often after seven rounds, and algorithm aversion decreased.

The largest change over time of more than 50% was shown by the group that had to pay a fee for using the algorithm. However, only slightly more than 20% of the participants used the algorithm in the first round.

The usage rate of the group that received information about the usage behavior and success rate of other participants still increased slightly over time, even though the initial usage of this group was already very high at over 70%.

Figure 2: Initial usage rate and change over time



4 Conclusion of the study

Our study showed that initially, there is a relatively high level of skepticism towards algorithms. Although our algorithm has a success rate of "only" 80%, its forecasting success was significantly higher than that of human decision-makers. Therefore, it would have been optimal to always use the algorithm. Nevertheless, many participants decided against it. With our experiment, however, we showed that in some cases, acceptance can be increased and aversion reduced.

If the acceptance of algorithms is to be increased, e.g., in companies, but also in private consumption and investment decisions, we see the following possibilities:

> The algorithm should first be tested by interested parties and the experience and results shared with user groups.

> The user should be given the possibility to slightly modify the result of the algorithm.

> Transaction costs should be reduced. To discover which measures are best suited for this purpose, e.g., training courses that reduce the time and cognitive effort required for use, tests would have to be conducted in separate studies; this certainly depends on the specific use case.

Basically, one should not immediately abandon algorithms in the decision environment if the initial aversion is great. Over time, the participants showed increased familiarity and frequency of use.

The opportunities for future research

Interestingly, female participants adopted the algorithm much more frequently than their male counterparts. One reason could be greater self-confidence or even contextual overconfidence (illusion of explanatory depth) on the part of the male participants in their own abilities. This is an interesting research gap that we would like to investigate in more detail in new studies.

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