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Full Research Paper

The Impacts of Machines on the Prediction Accuracy of Human-machine Hybrid Information Market

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Abstract: Incorporating machines into the traditional prediction market can create hybrid intelligence. To leverage the potentials of the human-machine hybrid information market, this study investigates the impacts of two elements of human-machine interaction design, machine participation, and machine disclosure, on prediction performance. The results of the experiment in this study reveal that simply disclosing machines will harm the prediction performance, as it may decrease humans' deliberation effort. The findings also suggested two competing effects of machines participation on prediction accuracy. The positive influence comes from the intensive competition context brought by machines which enable humans to have desires to win and motivates them to put more deliberate efforts into decision-making. However, in the condition of intensive competition, humans tend to trade in large magnitude, which will lower the prediction performance. These findings provide implications for human-machine hybrid market design.

Keywords: Hybrid prediction market, Human-computer interaction, Prediction accuracy

1. INTRODUCTION

The information market, also termed the prediction market, is an effective tool to synthesize heterogeneous opinions to predict future events, such as political election prediction, geopolitical events, sports, and economic indicator movement [1]. The research gaps in the information market, the mixed findings in finance experiments, and the practice requirements of AI motivate us to study the research question: ***How do the introduction of machines and disclosure of their presence affect the prediction accuracy of information markets?***

According to decision theory, competitive arousal model and cognitive load theory, we construct the research model based on literature on collective intelligence and human-machine interaction.

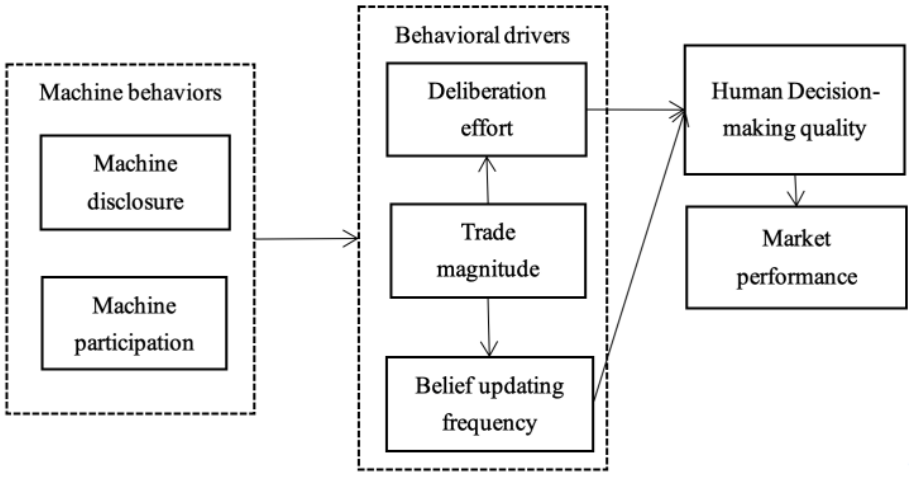

Figure 1. Research model

2. RESEARCH METHODOLOGY AND RESULTS

To conduct the experiment, we designed an information market (https://m.imzhuge.com/). we adopt the second method and develop a logarithmic market scoring rules (LMSR) market which has been widely applied in the area of information market [2, 3]. The tasks in our experiment are one-day ahead predictions of stock price up-down in China. Four well-known listing companies, Kweichow Moutai (stock code: sh600519), Eastmoney (stock code: sz300059), Industrial & Commercial Bank of China (stock code: sh601398), and Contemporary Amperex Technology (stock code: sz300750), were selected as the prediction targets.

Participants were randomly assigned to one of the three scenarios: (1) no machines are introduced and no disclosure of machine presence (*no_introduce_no_disclose,* H), (2) machines are introduced but their presence is not disclosed (*yes_introduce_no_disclose,* No), (3) machines are introduced, and their presence is disclosed to humans (*yes_introduce_yes_disclose,* Yes). We did not create a condition of *no_introduce_yes_disclose,* which does not have machines but disclosed their presence, since it is also not legal and ethical to do so in the field of real-world AI applications. The results of hypotheses testing are shown in Table 1.

Table1. Hypotheses Testing

Hypotheses	Path Coefficients	T value
introducing machines -> deliberation effort (H1a was supported)	**1.058**	**9.965*** **
introducing machines -> belief update frequency (H1b was not supported)	-0.228	0.160$^{n.s.}$
introducing machines -> trade magnitude (H1c was supported)	**0.810**	**11.59*** **
introducing machines -> prediction performance (H2 was not supported)	-0.169	1.292$^{n.s.}$
machine disclosure -> deliberation effort (H3a was supported)	**-0.616**	**5.90*** **
machine disclosure -> belief update frequency (H3b was supported)	**-0.269**	1.22*
machine disclosure -> trade magnitude (H3c was supported)	**-0.163**	**1.70$^{\#}$**
deliberation effort -> human decision quality (H4 was supported)	**0.350**	**2.417***
belief update frequency -> human decision quality (H5 was supported)	**0.093**	**3.38$^{\#}$**
human decision quality -> prediction performance (H6 was supported)	**-0.298**	**2.708****
trading magnitude -> deliberation effort (H7a was supported)	**-0.462**	**3.532*** **
trading magnitude -> belief update frequency (H7b was not supported)	-0.183	1.011$^{n.s.}$

Note: n.s. Non - significant. *P <.05. **P <.01. ***P <.001. #P <.1. Coefficient values with p<0.1, p<0.01, p<0.05, and p<0.001 are in bold.

3. CONCLUSION AND DISCUSSIONS

This study investigates how the introduction of machines and the disclosure of their presence affects humans' decision-making quality and prediction performance. First, to the best of our knowledge, we are one of the first to introduce human behaviors as drivers for prediction performance in a human–machine hybrid information market. Second, the results revealed two competing influences of introducing machines on human behaviors. Third, the results verified that simply disclosing machine presence will harm the performance of the hybrid information market, as it will decrease humans' deliberation effort. All of these findings are of great significance both in theory and in practice. Future studies could investigate the factors influencing human trade frequency. It is also valuable for future studies to assess the validity of our results for larger populations with more financial experience. Additionally, we could also run a long-term hybrid information market to check whether machines' negative effects diminish as humans adapt to machines.

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