Real-World Geopolitical Influences on In-Game Financial Behaviour

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Abstract: This paper explores how real-world geopolitics can influence financial decision-making in virtual environments. The study primarily focuses on trading dynamics in a pandemic simulation game. The players manage resources and trade with each other to save their population. We compared two groups: one playing with made-up country names (control) and another with real country names (test). The players were not permitted to communicate outside of the resources the game provides and were finally ranked based on the number of months survived and trade volume. Our findings reveal two distinct player archetypes, one focusing on maximising trade volume and a second focusing on resource conservation. Real country names compared to color-coded labels seem to delay the perception of competition and reduce overall trade volume, suggesting increased immersion and a more conservative approach towards resource management. Observations from gameplay footage reveal instances of potential bias, with players forming diplomatic ties based on national identities. The data collected suggests that real-world geopolitics can influence financial behaviour in virtual environments as hypothesised. It also explores virtual environments to study how political narratives and dynamics affect human decision-making. The findings offer practical insights for game developers regarding fostering player engagement, mitigating bias, and creating fair economies. While parallels with real-world resource trading and allocation during pandemics were noted, further analysis would be required to explore these connections.

Keywords: Polarisation, Game Design, Pandemic, Trade, Perception, International Affairs

1. Introduction

The convergence of the domains of video games, political polarisation, financial behaviour, pandemics and disasters is initially unexpected. Games themselves encompass a virtual microcosm where players engage in economic transactions and strategic decision-making akin to the mechanisms of real-world financial systems. Simultaneously, games often embed geopolitical elements, mirroring global political scenarios and introducing players to dynamic narratives that simulate real-world sociopolitical landscapes. These virtual economies can also be influenced by real-world events, such as pandemics and disasters, blurring the lines between the virtual and the tangible.

1.1 Political Polarisation and Cooperative Dynamics

The COVID-19 pandemic has revealed a remarkable confluence of global coordination challenges and political balance. During this period, the intersection of politics, media, and public perceptions has become evident (Chen *et al.*, 2020; Bobba and Hubé, 2021). The trading of resources between nations and the opening and closing of borders have become victims of internal strife, with each country adopting its approach to the pandemic. These decisions, often made without a template for collaborative legislation, reflect the paradox of a shared global challenge met with fragmented responses (Allam, 2020), but also underscore the interconnectedness of global economies. Nationalistic policies, supply chain disruptions, and collaborative efforts for resource sharing indicate how geopolitical decisions affect international trade and economic dynamics. Allam (2020) posits that the potential for global coordination could provide a more effective solution, without politicisation. Intriguingly, as markets and trade relations are scrutinised by citizens, they, too, become subjects of societal discourse, influencing public opinions, electoral politics, and mobilisation (Zürn, 2014). Consequently, instrumental questions about problem-solving and effectiveness intertwine with issues of legitimacy, fairness, rationality, and equity (Goggin, 2012; Caplan, 2011; Singer *et al.*, 2019).

Rationality often contends with group dynamics and polarisation (Singer *et al.*, 2019). The ability of rational agents to polarise after sharing evidence highlights the intricate interplay between individual rationality and group-level dynamics. This phenomenon resonates with the potential for player financial behaviours to diverge as real-world geopolitical elements are introduced into virtual game contexts.

Examining the intersection of game theory and financial behaviour within virtual environments provides a lens through which to understand the dynamics of player interactions. In cooperative games, a fundamental implicit assumption prevails - players form coalitions and establish agreements on how to distribute the proceeds of their cooperative efforts (Hart, Chinn and Soroka, 2020). Cooperative games strive to maximise collective profits and promote social welfare through collaborative strategies.

In contrast, non-cooperative games emphasise strategic interactions among players, where each participant makes decisions to optimise their individual outcomes. The pursuit of equilibrium, where no player has an incentive to unilaterally deviate from their chosen strategy, characterises the essence of non-cooperative games (Hart, Chinn and Soroka, 2020). In this context, price setting emerges as a pivotal determinant in the success of trading and the equitable redistribution of profits.

These game-theoretic principles resonate within virtual economies as players engage in financial transactions and decisions that mirror real-world economic behaviour. The interplay between cooperative and non-cooperative dynamics, and the significance of achieving equilibrium, underscores the intricacies of player financial behaviour within virtual worlds.

1.2 Game Design, Social Interaction, and Player Financial Choices

Studies on player experiences in multiplayer games reveal that higher player interdependence fosters more communication, leading to understanding the social dynamics, social well-being, and strategy discussions among players (Balicer, 2007; Emmerich and Masuch, 2017; Lofgren and Fefferman, 2007; Szell and Thurner, 2010; Martončik and Lokša, 2016; Zhang and Kaufman, 2017; Belaza *et al.*, 2020). Augmentation effects (Qin, Cho and Zhang, 2021) emphasise how players' social interactions impact their gaming experiences. This suggests that real-world geopolitical elements might lead to financial decisions shaped by players' social contexts.

Exploring finance within gaming through classroom simulations (Holt, 1996) underscores the relevance of supply and demand models in understanding virtual economies. Dynamic bilateral trading games (Athey and Segal, 2007) highlight the role of serial correlation and buyer incentives, which can be interconnected with game design elements to shape financial decision-making. The financialisation of everyday life, observed in virtual economies (Zürn, Binder and Ecker-Ehrhardt, 2012), emphasises the blending of real and playful economies, potentially affecting player perceptions of in-game financial choices (Snow *et al.*, 2015).

1.3 Research Significance and Implications

Using games, we seek to unearth whether the virtual worlds reflect real-world financial behaviours and political dynamics. Such a setup offers a novel perspective on how virtual environments can serve as laboratories to understand human behaviour, financial decision-making, and political polarisation. A game designed with a theme of the evolving dynamics of the world’s response to the pandemic would capture accurate sentiments and behavioural responses to such an event.

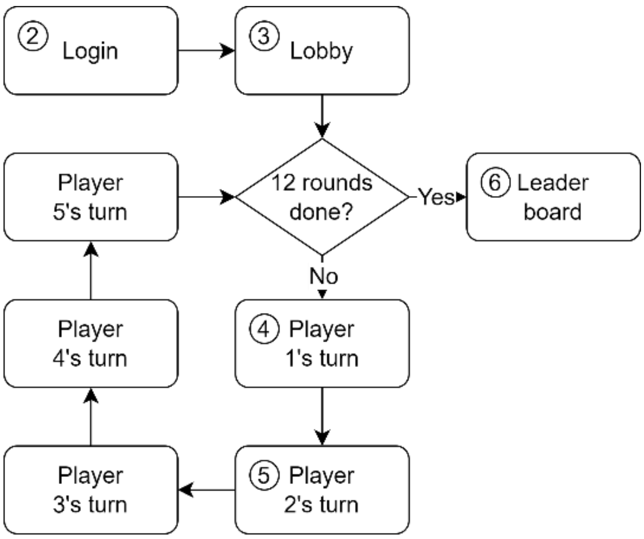


Figure 1: Flow of the game

In this paper, from the player behaviour data collected using an in-house developed unique game, we study decision-making under uncertainty (infection rates), understanding or awareness of real-world geopolitical relations and personal bias that manifests in-game behaviour. The game designed, developed, and play-tested during the pandemic (2020-2021), reflects the struggle for commodities and resources required by each country to save the population. The findings contribute to understanding the role of possible bias (personal and geopolitics) in trade partnerships and strategies applied to cooperate and save lives.

2. Methodology

2.1 Hypothesis

This study aims to investigate how real-world geopolitical contexts influence financial decision-making within a virtual environment. The methodology involves detailed observation of players' trading patterns, leaderboard performance, and qualitative insights gathered from game sessions. This multifaceted approach can provide insight into geopolitical biases and the manifestation of perceptions in virtual game economies.

The primary hypothesis of this paper is that in-game financial behaviour alters when the player represents a real country as opposed to a fictitious one. This hypothesis subsumes the premise of bias due to political polarisation that influences financial decision-making even in times of crisis.

2.2 Game Description

Figure 1 shows the block diagram for all screens of the game. It is a digital competitive multiplayer game that five people play simultaneously. The player assumes the role of the leader or policy decision-maker of the country being represented. Each game goes on for twelve rounds, each round being titled as a month in-game. Each round is turn-based, with players taking their turns in a fixed decided sequence. Once twelve months (sixty turns) have passed, the game ends, and the players are displayed on a leaderboard. Each turn is clocked to a one-minute maximum.

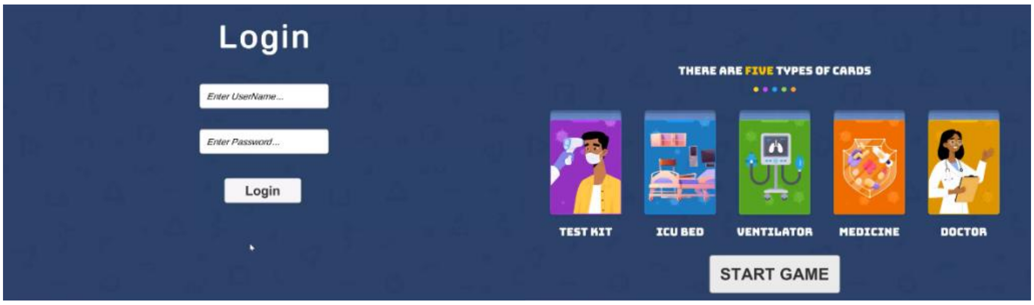


Figure 2: The login screen (left panel) where players enter their credentials. The screenshot of the lobby on the right displays the assets the players can trade.

Each player enters credentials to the login screen (Figure 2) to access the game lobby. Once logged in, the player is randomly assigned one colour-coded country (in the control case) or a real-world country (in the test case) to represent the game's duration. The countries chosen are the USA, Russia, China, India, and Brazil. The player enters the lobby where a screen (Figure 2 right) is displayed till all five players are logged in and choose to start the game. The lobby displays the five resources that the player can trade with other players: test kits, ICU beds, ventilators, medicine, and doctors.

Figure 3: left: Player's dashboard during their own turn, right: pop-up when another player offers to sell a requested resource.

Figure 3 presents the main dashboard of the game. The bottom panel, in the colour of the player, displays the player's current available resources and current in-game money. The countries that each player represents have in-game starting money closely based on their real-world foreign exchange reserves, modified with the intent to balance the game. The number of infections each country will face is also based on the predictions hosted on the world COVID-19 tracker (Worldometer, 2020) to provide a more realistic simulation. The game was designed in 2020 and hence uses predictions of infection rates till February 2021.

The panel on the top has on the left the number of infections that the player has on the centre of the current month, and on the right the clock displays the time left in the current turn. There are four tabs, two on each side of the screen, representing the other four players.

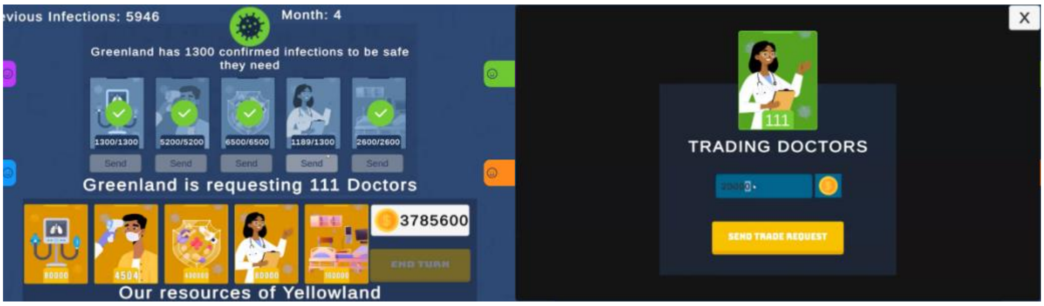
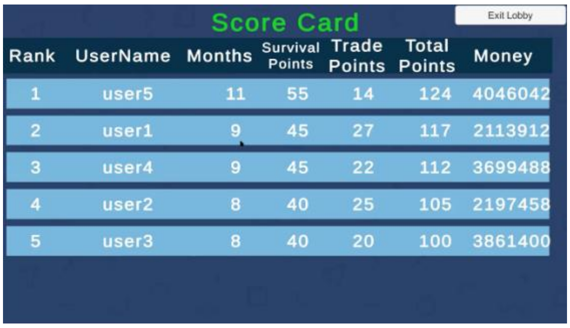


Figure 4: Left: Player's dashboard during another player's turn, right: modal to enter amount or sale price when offering resources to another player.

The centre of the screen is occupied by request buttons for the player to procure resources. Once the player requests a resource, the other four players can view the request and the number of infections in the land requesting the resources (middle area in Figure 4 left). If one of the other players decides to sell to the current player, they are displayed the modal (Figure 4 right) to enter the price for which they wish to sell the respective resource. When an offer is made by another player, it is displayed as a pop-up box next to the player who made the offer (Figure 3 right). The current player can choose to accept any of the offers.



Rank	UserName	Months	Survival Points	Trade Points	Total Points	Money
1	user5	11	55	14	124	4046042
2	user1	9	45	27	117	2113912
3	user4	9	45	22	112	3699488
4	user2	8	40	25	105	2197458
5	user3	8	40	20	100	3861400

Figure 5: Leaderboard shown at the end of 12 rounds.

Once a trade is accepted and the player's resources reach the sufficient minimum amount required to deal with the player's current infections, the player is said to have 'survived' the month. At the end of the game, the leaderboard (Figure 5) displays the number of months survived, followed by the number of trades done by the country. This is briefed to the players prior to beginning the game. The ranks are provided based on the months survived and then trade points, and intentionally not based on the money left with a player. The players are made aware of this information before playing the game.

2.3 Tools Used

The game was developed in the Unity game engine and targeted for Windows. It uses a GameSparks cloud back-end. All participants logged in via Zoom meetings in their isolated environments. To record all data and ensure no verbal communication between participants, all participants were placed in their own breakout rooms, with screen recording.

2.4 Participants of the Study

The participants of the study were undergraduate computer science students between the ages of eighteen and twenty-two, who all speak English fluently and had proficiency in digital games. Of the 30 participants, fifteen were assigned the control group, and fifteen were assigned the test group. Each game requires five participants, and hence this caused a total of six successful runs of the game. The control groups played a version of the game that did not mention real country names. The names 'Orangeland', 'Yellowland', ‘Greenland’, ‘Purpleland’, and 'Blueland' were used. Real country names - India, Russia, China, Brazil, and the USA - were used with the test groups.

The participants were briefed for thirty minutes about the game before playing it, including a discussion segment. For the duration of the game, the participants were not allowed to communicate with each other. Once the leaderboard was displayed at the end of the game, the participants engaged in a second discussion segment.

2.5 Data Collection and Analysis Methods

Three types of data analysis have been conducted, the first being qualitative, the second being quantitative, and the third being anecdotal.

The first analysis is on the turn-by-turn log data. All the players’ trade offers and acceptances are recorded in a table. The data entered is each trade offer given, received, and accepted. All these data points are then line plotted. Since it is a five-player multiplayer game, each player interacts with four other players. This means that four graphs for twelve rounds, those of the interactions of a single player with four others, can be plotted as overlapping. These graphs are noted to be similar to quadratic graphs. When a best-fit quadratic curve is applied to the line graphs, the quadratic curve can be classified as either an upward or downward parabola, and the peak of the parabola (maximum for downward, minimum for upward) is noted. The peak’s averages and variances are then calculated for all control and test groups separately. This allows us to observe typical player archetypes.

The second analysis is on the final leaderboards of all six games and thirty players. Variances and means are plotted. This data is presented as aggregate and not individual. Since the game is granular, with only five players at a time trading five resources, it is challenging to balance the game. Therefore, it is only appropriate to study the difference generated between the control and test groups and not the difference generated between countries ignoring the control and test groups.

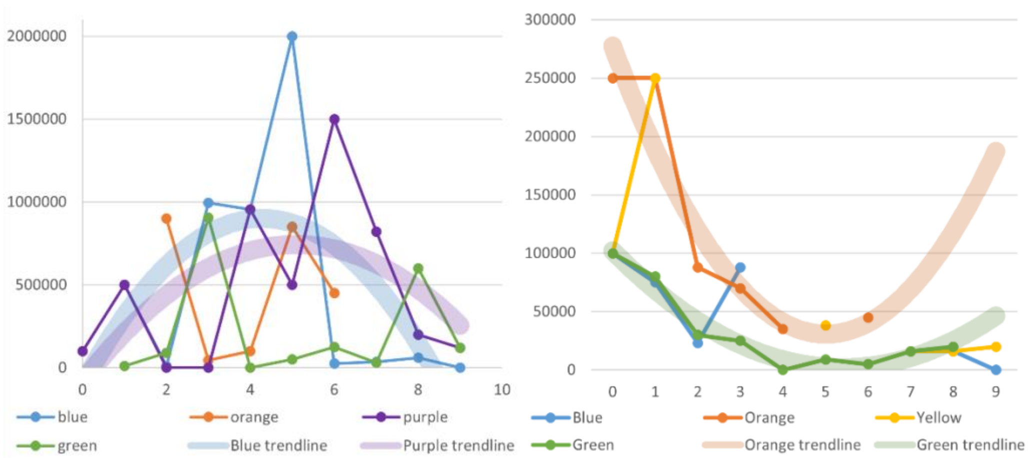


Figure 6: Representation of the two typical archetypes players show - upward and downward parabolas. The first graph (left) is for a player representing ‘Yellowland’, and the second graph (right) is for a player representing ‘Purpleland’. The X-axis represents months passed, the Y-axis represents in-game money traded, and the colours represent all other players.

The third analysis is on the footage captured during a few game sessions. It consists of audio quotes of players if they remark on other players while in the game or oral musings during decisions. It also goes through parts of the gameplay footage when an ’irrational’ decision has been made.

3. Results

The final leaderboard results are available from all thirty participants, while anecdotal evidence is available from only twenty participants. Complete turn-by-turn data is also available from twenty of the participants. The first two rounds are typically rounds with zero infections across populations, effectively the data is from ten of the twelve rounds.

3.1 Observed Player Archetypes and Shifts

Turn-by-turn trading data was recorded for twenty of the thirty participants of the study. There are two common archetypes observed from the players. One type of player's trading pattern trendline follows an upward parabola, while the other type follows a downward parabola (Figure 6). Fifteen of them, that is 75% of the player trajectories have been upward parabolas. It is reasonable to assume that if the number of players and rounds in the game is increased then the data will begin to look increasingly like its trend line. While most players follow an upward parabola, the downward parabola following players is not negligible.

The rationale behind following an upward parabola is that the player might care more for the trade volume aspect of the game rather than wealth accumulation initially, an expected but recognisable distinction. The prices continue to drop and trade volume continually increases (minima of the trendline), when the player realises that the increase in cases demands a more conservative approach to trading. Since the scarcity of resources is more abundant towards the end of the game, trade volume is typically reduced. Therefore, demand is less, and prices begin to increase.

The hypothesised rationale behind following a downward parabola is that the player keeps increasing prices for resources since they are in more demand initially. An increasing price however is more prone to rejection, as competition is still present within the game. At the maxima of the trendline, the player has accumulated enough rejections of trades to realise that more competitive pricing would be an optimal strategy. Beyond the maxima, trade volume has reduced since the typical player is in resource conservation mode. This causes rejection of trade at falling prices, further causing the trendline to fall.

Table 1: Average difference in peaks of all trade graphs

Scenario	Colours		Countries		Difference of means
	Mean	Variance	Mean	Variance	
Selling	4.2	0.8	4.7	1.2	0.5
Buying	3.8	1.6	4.4	0.8	0.6

Table 2: Average difference in peaks of upward parabola trade graphs

Scenario	Colours		Countries		Difference of means
	Mean	Variance	Mean	Variance	
Selling	4.3	0.8	5.0	1.0	0.7
Buying	3.3	0.5	4.5	0.8	1.2

In the control experiment where country names were hidden, the average peak (between 0 and 9) for selling by ten players was 4.2 with a 0.8 variance, while for buying it was 3.8 (with a 1.6 variance). In the test condition (country names displayed), the average peak for selling resources shifted forward to 4.7 with a 1.2 variance, while for buying it shifted forward to 4.4 with a 0.8 variance (Table 1). If the downward parabola graph interference is removed from this (considering that only 25% of the players generated a downward parabola graph), in the control condition the average peak for selling resources was 4.3 with a 0.8 variance, while for buying it was 3.3 with a 0.5 variance. In the test condition, the average peak for selling resources shifted forward to 5.0 with a 1.0 variance, while for buying it shifted to 4.5 with a 0.8 variance (Table 2).

3.2 Shifted Means and Variances in the Final Scores

From Figure 7, illustrating the difference in ranks between control and test groups, it is evident that players representing India received the most significant leaderboard rank boost as expected since the players were all from India. In the cases of Russia and China, there is an increase in the standard deviation of the data, reflecting that the participants possibly hold possible higher bias regarding them, causing a larger variance in gameplay outcomes. Brazil loses their leaderboard rank the most while maintaining consistency in deviation. The United States performs consistently poorly in both control and test cases but with no significant difference in trade volume.

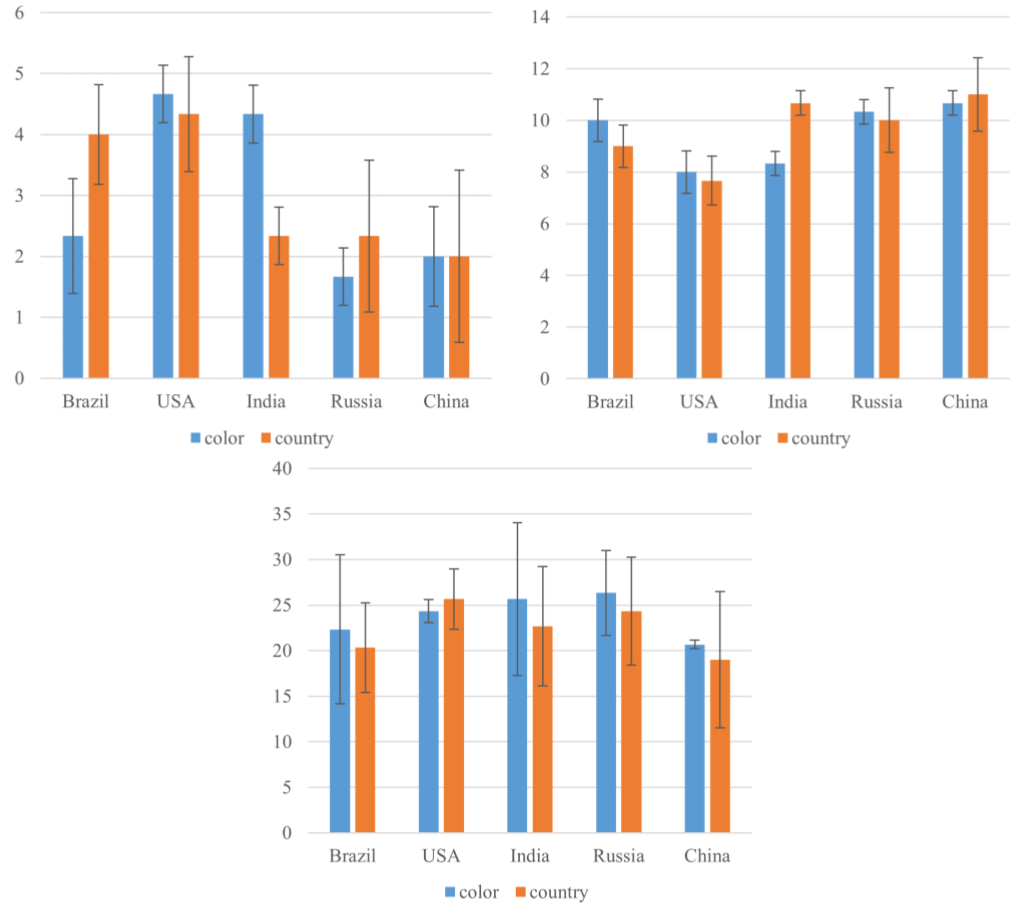


Figure 7: (clockwise from top left) Average leaderboard rank (lower is better) with standard deviation, average months survived (higher is better) with standard deviation and average number of successful trades with standard deviation.

3.3 Anecdotal Findings

Going through the footage of the game reveals the thought process behind a few of the choices that players have made.

In the eighth month of a game in the test group, the player of India, while requesting resources, chooses to trade with China for 8000 coins over the USA for 5000 coins, stating, “Let me give China the business for this round”. In the ninth month, the player repeats this ‘irrational’ purchase but with Russia for 1000 coins, over the 300 coins offered by the USA as well as China, stating almost the same thing, “Let's give Russia the business for this round”. It appears that the player wants to start building diplomatic ties with other players amidst the resource-deprived part of the game. This strategy, however, is not optimal, since the other players cannot see the options this player has, or access the player’s thought process, making the gesture useless. It is more reasonable and supported by this anecdote, for the players whose trades have been accepted to simply assume that they have made the lowest offer, which is why their trades have been accepted. The latter now becomes a mistaken assumption, offsetting the trendlines for the rest of the players.

In the twelfth month, the last round, the same player of India while trading, states, "USA, you were playing so good, but you screwed up in the end; I could try to help; I'm sorry." The player says this while not having offered any trade to the USA for months eight, ten, eleven and twelve. This statement might not reveal any non-optimum behaviour by the player; however, it does reveal the player's tendency to cognitively believe that they are playing not with other players like them, but rather with other countries. For months five to ten, the player of China ensures to accept the trade with Russia every time, either exclusively, or while accepting other trades as well. Three of these trades are not optimal trades, as better offers are available at the same time.

In month seven, the player from Brazil recognises that the player from China is playing well, based on their infection count. In month eleven, when prompted, the Brazilian player ranks the other competitors as "USA, then India, then Russia, then China" from best to worst. When the actual leaderboard is revealed, the order is China, then Russia, then India, and then USA for the round. Essentially the player initially correctly actively remarks that China is doing well, however still has an inherent bias towards India and the USA, which reveals itself when the player is asked to compare all their competitors to one another. This causes an inversion in a more accurate assumption about the situation.

4. Discussion

4.1 Interpretation of Findings

In terms of player archetypes, meeting the peak of the parabola has been delayed in trials where real country names were used. This can either be attributed to the presence of country names and involvement of prior perceptions of international relations, a distraction bias in the game strategies, or to recognition of the competition within the game as lesser than it actually is, since there is a greater self-identity when identifying as a real-world country as opposed to representing a colour-coded country. It is also important to note that, unlike the sense of uniformity perceived by colour-coding, identifying by countries makes the players consider factual data, such as perhaps the size of the economy, political stance, manufacturing prowess, etc. Hence, it is believable that there is a more non-uniform sense of competition perceived by the participants in the gameplay with country names, further delaying the perception of competition.

From the total volume of trades in the games, it is observed that, in general, trade between countries decreases in the test condition as opposed to the control condition. It can be hypothesised that there is a higher degree of immersion involved in the game once real-world country names are used. This makes the players more conservative since resource stockpiling seems to be felt as a more secure mechanism for dealing with the pandemic. The players are less dissociated with the identity of the countries they represent, making the consideration of more abstract ideas such as trading away resources slightly more discouraging. This could also be why the peaks of the round-wise trade data trendlines arrive later than they should in the test groups.

As per Figure 7, India has performed better in the test cases than in control cases. This can be attributed to the fact that all participants of the study have been citizens of India and therefore hold an implicit bias towards India. Brazil's poorer performance in the test case could stem from the fact that politics or trade with Brazil is far less covered in Indian media. USA's deficient performance across all participants while maintaining trade volume needs to be further analysed with respect to survey findings (Purushothaman, 2022; Fuchs and Thurner, 2014).

4.2 Theoretical Implications

The literature review highlights the parallels between the politicisation and polarisation observed in real-world geopolitics during pandemics and disasters and the potential for similar patterns to emerge within virtual environments. The findings from this study support the idea that introducing real-world geopolitical elements into virtual games can delay the perception of competition and influence player behaviour. This suggests that virtual environments can serve as a valuable testing ground for understanding how political narratives and dynamics impact human decision-making, both individually and collectively, supporting the findings from Belaza *et al.*, 2020.

4.3 Practical Implications

4.3.1 Game Design for Enhanced Engagement

Game developers can use these findings to design virtual environments that encourage player engagement and immersion. Incorporating real-world geopolitical elements while maintaining a balance to prevent bias or distortion can create more captivating and thought-provoking gaming experiences.

4.3.2 Mitigating Implicit Bias

The findings indicate that players may exhibit biases in favour of their real-world countries. Game developers should be aware of these biases and take steps to balance gameplay. Virtual games with economic components should prioritise fairness and transparency in their in-game financial systems.

4.3.3 Incorporating Real-World Relevance

Educational and serious games can benefit from incorporating real-world political and economic elements to provide players with valuable insights into the complexities of global issues. Educational institutions and policymakers can consider integrating virtual economic simulations into curricula to enhance students' understanding of economic principles, decision-making, and the impact of real-world events on financial choices.

4.4 Limitations of the Study

The primary methodological constraint of the study is the number of teams considered for the analysis and the lack of diversity among the participants. The generalisability of the findings is restricted to the age group and country of origin of the participants in the study. All participants were from India, the advantage of this being that the five countries within the game could be selected to maximise variance in perception and response as tailored to an Indian audience. The disadvantage here is that it makes inferences strong only for the Indian population. The same disadvantage goes for age restriction. The experimental data was captured entirely during the COVID-19 pandemic when a controlled lab testing environment to ensure physical uniformity was inaccessible.

5. Conclusion

The findings of this study provide intriguing insights into player archetypes and the impact of real-world country names on in-game decision-making. The presence of real-world country names appeared to delay the peak of resource trading patterns, potentially due to players' immersion in the geopolitical context and their consideration of factors like the size of the economy and political stances. This study sheds light on the complex relationship between real-world geopolitics and player financial behaviour in digital games. The methodology can be expanded to detect a difference in political polarisation across various ranges of people. One of the focuses in the future of this study is to detect a perceivable difference in political polarisation across age ranges, through children, young adults, as well as senior citizens.

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