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Developing future managers through business simulation gaming in the UK and Hong Kong: exploring the interplay between cognitive realism, decision-making and performance

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Developing Future Managers through Business Simulation Gaming in the UK and Hong Kong: Exploring the Interplay between Cognitive Realism, Decision-Making and Performance

Purpose

This paper investigates how individuals' decision-making approach and perceptions of a game's cognitive realism affect the performance of virtual businesses in a web-based simulation game.

Design / Methodology / Approach

Survey data is collected from 274 business simulation game users and is analysed using the fsQCA technique.

Findings

The study identifies three alternative pathways to high and low performance in a business simulation game. Results indicate that a flexible decision-making approach exists in all high performance pathway solutions. Where a game is perceived to be realistic, a more focused decision-making approach is associated with high performance. However, where perceived cognitive realism is absent, a less focused experimental decision-making approach is employed, which increases the chances to achieve low performance. Finally, perceived cognitive realism and an experimental decision-making approach are found to be mutually exclusive for achieving high performance.

Originality

Whilst the learning benefits of web-based simulation games are widely acknowledged, the complex interplay amongst factors affecting performance in games is underresearched. Limited research exists on how perceptions of a game's cognitive realism interact with user decision-making approaches to affect performance.

Keywords: simulation game; cognitive realism; decision-making; performance; fsQCA; management development

1. Introduction

Advances in online gaming technology have enabled web-based simulation games to provide an increasingly accessible, immersive and sociable experience for users (Lee *et al.*, 2013). However, whilst simulation games offer an engaging space for people to learn through play, some have been criticised for a lack of fidelity (Munshi, 2015), verisimilitude, accuracy (Lean *et al.*, 2020) and realism (Schmeller *et al.*, 2021). This is significant because the perceived realism of a game, particularly its cognitive realism, has been found to affect both the behaviours of gamers and the outcomes they achieve. However, whilst the influence of game realism on behaviours and outcomes such as engagement, motivation and learning has been studied previously (Schwarz *et al.*, 2020; Salas *et al.*, 2009), the role of realism in other behaviours and outcomes critical within the context of business is not well understood.

In business education, web-based simulation games are used by universities as a form of experiential learning to help develop future managers (Garber *et al.*, 2017; Parris and McInnis-Bowers, 2017). Through simulating real-world business contexts, they allow users to make business decisions and see how they impact upon business performance outcomes (Lean *et al.*, 2020). As in the real-world, decision-making plays an important role in the performance of virtual businesses. Therefore, business simulation games are a powerful tool for developing future managers who, through their virtual decision-making experience, become better placed to support organisations in achieving performance objectives. For business students seeking a management career, making and reflecting upon decisions in a business game may therefore be a vital ingredient in developing their professional identities and transferring learning to the real-world through their experience in achieving successful performance outcomes (Newbery *et al.*, 2018; Pasin and Giroux, 2011).

For both educators and designers of business simulation games, it is important to understand how cognitive realism affects key outcomes and behaviours. Prior research has shown that certain behaviours and outcomes including engagement, motivation and learning are affected by perceived game realism (Pasin and Giroux, 2011). Debate also exists regarding the benefits of low versus high-fidelity games in relation to such behaviours and outcomes (Ye *et al.*, 2020; Feinstein and Cannon, 2002). However, in a real business context, the key desired outcome for any organisation is *high performance*; an outcome as yet unexplored in the extant literature relating to game realism. For business educators, developing the ability of future managers to achieve high performance, whether measured in terms of financial performance and market share or corporate social responsibility performance (Singh *et al.*, 2015), is therefore an important outcome for business simulation games. As a result, this study uses performance as the key outcome measure; if the aim of educators is to develop effective future managers who can achieve successful business performance, understanding how the level of cognitive realism of a game can affect this outcome is critical. Furthermore, performance can be considered an important measure as it serves as an effective metric of learning and skills development in the context of simulation games (Alstete and Beutell, 2019; Taub *et al.*, 2020; Harteveld and Sutherland, 2015). Through such learning and skills development, future business leaders become better equipped to run successful, high performance businesses (Jiménez-Jiménez and Sanz-Valle, 2011; Siepel *et al.*, 2021).

A further underexplored aspect of the extant literature is the role of game cognitive realism in participant decision making. In the real world of business, managers respond to the reality of the business environment to make decisions on aspects such as investments, new product development and marketing. These decisions in turn give rise to performance outcomes for the business, for example an increase in turnover or profit. For educators and game designers, a key aim is to accurately simulate the real-world business environment to maximise the effectiveness of simulation games as a platform for developing effective decision-making among future managers (Poisson-de Haro and Turgut, 2012). By using realistic simulations, students may experience the processes that a manager goes through when analysing their business environment and making decisions. Research from real-world contexts has shown the importance of decision-making behaviour in achieving strong business performance (Smolka *et al.*, 2018). However, no significant research exists that links cognitive realism with the behaviour of decision-making and the outcome of high performance in business simulation games. Given the criticality of both decision-making and performance in the real-world of business that business simulation games seek to mirror, this represents a substantial gap in current understanding.

In addressing the above knowledge gap, it must be noted that decision-making approaches are nuanced and complex. Sarasvathy's (2001) work on effectuation and causation showed how it is underpinned by different approaches to reasoning. Further, rather than there existing a dichotomy of causative or effectual styles, decision-making approaches intersect and co-exist (Harms *et al.*, 2021; Stroe *et al.*, 2018). This complex interplay amongst factors necessitates an analytical method that enables us to understand how different configurations of decision-making approaches and user perceptions of cognitive realism combine to produce superior performance. This paper therefore adopts a configuration approach using set-theoretic modelling (specifically Fuzzy-Set Qualitative Comparative Analysis, fsQCA) to provide a holistic understanding of these interrelationships. In so doing, the study contributes to theoretical understanding of the hitherto unexplored associations between game cognitive realism, decision-making approach and performance and draws out implications for simulation game designers and educators employing games to support the development of future managers.

This paper is structured as follows. First, literature pertaining to simulation games, cognitive realism, decision-making and performance is reviewed, leading to the development of two propositions. The methodology is then outlined followed by the presentation of results and a discussion of key findings. Finally, conclusions and implications of the study are considered.

2. Simulation Games in Business Education

With the growth in online learning, web-based simulation games have become an increasingly common learning approach for educators (Hainey *et al.*, 2011; Ibrahim *et al.*, 2017). An important feature is their purpose to support learning and development, educating users as well as entertaining them through play (Tao, 2009). They develop users' knowledge and skills and may also lead to behavioural and attitudinal change (Buil *et al.*, 2018; Anderson and Lawton, 2009).

In business education, simulation games represent an important form of experiential learning (Kolb, 2014), holding particular relevance for the development of future managers' capability to make decisions aimed at improving business performance. Their constructivist-based 'learning-by-doing' approach (Tao *et al.*, 2012) enables novice nascent entrepreneurs and business managers to experience running a business and to develop a range of important management skills including information processing, dealing with uncertainty and decision-making (Goi, 2019; Hernández-Lara and Serradell-López, 2018). A key benefit of business games is that they allow users to practice making critical decisions relating to finance, operations and marketing

(Ben-Zvi, 2010) over successive decision and performance periods. They show students how business decisions made in response to influences in the simulated business environment result in performance outcomes measured, for example, by turnover, profit and market share (Moizer *et al.*, 2006). Hence, they provide a powerful platform for double-loop learning as learners' mental models of how businesses are run are modified through game play (Argyris, 2002; Bartunek, 2014). As online simulation games provide continuous in-game performance-based feedback, users can trace through the patterns of cause and effect, reflect upon how decisions impact business performance and make changes to their gaming approach accordingly (Tao *et al.*, 2015). Hence, reflecting Kolb's learning cycle (Kolb, 2014), the various cyclical performance outcomes achieved through gameplay both demonstrate prior 'in-game' learning and facilitate forward learning through reflection. Importantly, business students are able to practice decision-making in a 'risk-free' environment. With no 'real-world' consequences in terms of actual financial loss or business failure (Lean *et al.*, 2020), participants can implement their business ideas and make decisions in the knowledge that the only impact on them may be the grade that they receive (Morin, *et al.*, 2020). Users can learn from mistakes made and consequently improve their decision-making skills (Pasin and Giroux, 2011; Newbery *et al.*, 2016). Hence business simulation games facilitate active and reflective learning in a way that would be challenging in the real-world due to the associated risks of business failure (Zulfiqar *et al.*, 2019), enabling students to achieve improved performance outcomes for their virtual business. Business games also provide advantages related to design flexibility. First, game instructors can change parameters or introduce critical incidents during game play (Lean *et al.*, 2014). For instance, a change to interest rates may be introduced. A second important area of flexibility relates to timescale. Temporal compression is a common feature in games (Zagal and Mateas, 2010) meaning decisions and outcomes that may play out across several years in the real-world can occur over days or even hours. Thus, rich experiences that may be confronted rarely in a real business can be encountered in a much shorter timeframe.

3. Cognitive Realism, Decision-making and Performance in Simulation Games

Business simulation games attempt to create a learning environment that is cognitively authentic and meaningful, to reflect the reality of running a business (Huebscher and Lendner, 2010); that is, they seek to achieve a high level of cognitive realism. However, the inherent features discussed above, such as low risk, design and temporal flexibility, may detract from cognitive realism, making simulation games feel less real. Hence, a trade-off typically exists between the benefits of learning design and educator control within games (Carvalho *et al.*, 2015) and their level of cognitive realism. Regarding design flexibility, the parameters set and critical incidents introduced by instructors may or may not reflect current conditions in the real business environment. Further, the compressed timescales and decision cycles in business games inevitably do not reflect those experienced by real businesses. Regarding risks, these do not equate to the financial and personal consequences of failure faced by real-world managers (Mason *et al.*, 2009), although some risk can be retained through performance-based summative assessment. Thus, users of simulation games are likely to have differing perceptions of their cognitive realism. Of particular interest in this study is how these varying perceptions of cognitive realism may combine with user decision-making approaches to affect performance.

3.1 Realism in Simulation Games: Physical and Cognitive Realism

Faizan *et al.* (2019, p.20) defined game realism as "the game-users' perception about the extent to which a simulation game reflects real life situations". It may relate to physical aspects (visual elements and aesthetics) or cognitive aspects (how the game represents the real-world). Prior research indicates that perceptions of game realism, both physical and cognitive, are linked to the attitudes and behaviour of game participants, with most studies focusing on the role of perceived realism in user engagement, motivation and learning. In their review of factors associated with engagement in health-related games, Schwarz *et al.* (2020) identified various elements of realism that are important. These included relatable characters (Park and Ko, 2022), a realistic narrative storyline and high-quality graphics. Adobor and Daneshfar (2006) concurred, finding that unrealistic games reduce user motivation to play management games whilst Beckem and Watkins (2012) stressed the importance of an immersive environment that closely represents the complexity of the working context. Lee *et al.* (2020) went further, concluding that realism and authenticity can be the most important factors in the effectiveness of games. Notably, they found that practitioners undertaking professional development place particular importance on a realistic gaming context and an authentic game theme, underlining the importance of cognitive realism for games focused on vocational development. Yet the role of realism in engagement is not clear cut. Laine and Lindberg (2020), in their systematic review of game motivators, found that the seemingly contrasting factors of '*real-world relation'* and '*fantasy'* can both be drivers of engagement.

Regarding the impact of realism on learning, both Herrington *et al.* (2003) and Salas *et al.* (2009) argued that the cognitive realism of games plays a greater role than physical realism. In other words, the effective representation of the real-world context is more important than cosmetic aspects of the simulated environment. The particular significance of cognitive realism is recognised in prior studies that stress the importance of a carefully considered game design process, where educators and specialists take account of the educational context of a game (Aslan and Balci, 2015). Good design is considered important to the promotion of active engagement, motivation and learning and several authors identify cognitive realism as a significant design feature in game-based learning (Qian and Clark, 2016; Pasin and Giroux, 2011). Dicheva *et al.* (2016) stressed the importance of realistic problem-solving processes and storylines in achieving cognitive realism whilst Herrington *et al.* (2007) argued for placing greater emphasis on the cognitive realism of games.

Whilst the role of cognitive realism in game design and its impact on the attitudes and behaviours of users is recognised in prior research, a debate exists regarding the level of realism that is most appropriate. Although high levels of realism may stimulate engagement and enjoyment amongst game users, some have argued that lower fidelity games that are simplified and less complex can better support learning (Feinstein and Cannon, 2001; Wright-Maley, 2015). Reduced complexity and fewer visual distractions can ensure focus on key variables and help achieve learning objectives. Although the visual appeal of high-fidelity games is important to how a game is received by users and the level of immersion attained (Scholtz *et al.*, 2016; Chen *et al.*, 2011), Jarvis and de Freitas (2009) suggested that too much emphasis on visual fidelity may detract from learning. Meanwhile, Ye *et al.* (2020) identified contrasting findings on the relationship between fidelity and learning in games, concluding that the association is both complex and non-linear. Drawing similar conclusions, Kyaw Tun *et al.* (2015) argued that the key issue of importance is users' perceived realism within a specific learning context.

Overall, research exploring the association of simulation game realism with different behaviours and outcomes has given rise to mixed results. Nevertheless, despite different views on the appropriate level of realism, the significance of user perceptions of cognitive realism as a key design consideration is clear, with most studies emphasising the importance of cognitive over physical dimensions. Yet critically, whilst prior research has focused on motivation, engagement and learning, a significant research gap exists concerning other key behaviours and outcomes. Most notably, in the context of business games, the role of cognitive realism in decision-making and performance remains underexplored.

3.2 Decision-making Approaches and their Impact on Simulation Game Performance

Whilst prior research has focused on the complex interrelationships between game realism, engagement and learning, there is little evidence on how cognitive realism is associated with decision-making approaches in a simulation game. Only studies by Rumeser and Emsley (2019) and Gopinath and Sawyer (1999) hinted at possible associations. Rumeser and Emsley's (2019) study of a project management game provided some evidence that a higher level of game realism (measured here in terms of complexity) is associated with better decision-making performance. Meanwhile, Gopinath and Sawyer (1999), who found a relationship between perceived realism and game performance, also identified links to long-term orientation in strategic decision-making. Understanding the interplay amongst these factors is important because of the critical relationship between decision-making and performance outcomes in businesses; a relationship that business simulation games seek to replicate in order to mirror the key management processes and outcomes essential in the real-world of business (Faria and Wellington, 2005; Feinstein and Cannon, 2002). Given that an aim of employing a simulation game is to enable users to attain good performance outcomes, there is a need to understand the role played by cognitive realism in the decision-making of game users that subsequently gives rise to such outcomes.

Few studies have explored the link between decision-making approaches and simulation game performance, with some considering decision-making only as an outcome. Wellington *et al.* (2010) observed that students performing well in a marketing game reported improved perceived decision-making. A further study identified that during a business game, better performing students were also those that had become more analytical during the game, while poor performers had become more intuitive and indecisive (Wellington *et al.*, 2012). Examining the relationship between time spent on decision-making and game performance, both Wellington *et al.* (2012) and Treen *et al.* (2016) found that performance at first increases with time spent on decision-making, before eventually decreasing with additional time spent. Whilst these studies add to our understanding of the association between decision-making and performance, they reveal little about the performance effects of specific decision-making approaches. Only Wellington *et al.*'s 2012 study hinted at a link between an analytical approach and high performance.

One way in which business decision-making approaches can be considered is in terms of effectual versus causal reasoning (Sarasvathy, 2001). Effectual reasoning (or effectuation) is an approach based on how available means (or resources) may be used to form possible ends (or business ideas / outcomes). Decision-making is not driven by pre-determined goals but is instead based on trying different strategies and adapting them in response to outcomes (Chandler *et al.*, 2011; Dew *et al.*, 2009), with the final end-point being uncertain. Key dimensions of effectual reasoning are experimentation (where alternative options are tried), affordable loss (where investment decisions are based on the level of loss that can be afforded in the worst-case), pre-commitments and strategic alliances (where contacts and networks are leveraged to bring additional means) and flexibility (where reflection on opportunities arising from change shape decision-making). In contrast, causal reasoning (or causation) is driven by the aim of achieving a pre-determined goal. Existing or new means are used to achieve this goal in a way that is carefully planned in advance, based on rational processes of analysis and decision-making (Shirokova *et al.*, 2020; Reymen *et al.*, 2015). Here, there is little room for experimentation that may deviate from pre-determined business plans. Further, investment decisions are based on forecast returns rather than affordable loss.

Research in real-world settings has shown mixed results regarding the effects of effectual and causal approaches on performance (Peng *et al.*, 2020; Futterer *et al.*, 2018). Shirokova *et al.* (2021) argued that contextual variations may explain these mixed findings. Simulated environments such as business games, whilst seeking to replicate the real-world, represent a contextually very different environment for decision-making. Whilst game designers aim to ensure that decision-making will affect performance in a similar way to the real-world, the differences between game and real-world environments may have behavioural and attitudinal effects associated with the decision-making approaches adopted by users. Hence, by examining the interplay between perceived game realism, decision-making approach and performance, this study seeks to understand the nature of these interactions. Use of a configuration approach is considered particularly appropriate to this study as, by examining the complex interplay amongst variables, the method is often used to understand issues where prior research has resulted in mixed or inconclusive findings.

3.3. Causation, Effectuation, Cognitive Realism and Simulation Game Performance: A Configuration Approach

The above review of the roles of both cognitive realism and decision-making approaches in simulation game performance indicates that a holistic approach to analysing the interplay amongst causalities is required. Significant complexity exists due to the likely associations between causalities and their associated impacts on performance. In particular, prior studies have indicated that certain behaviours, such as game engagement, are associated with perceptions of game realism (Schwarz *et al.*, 2020; Lee *et al.*, 2020). Therefore, it may be expected that other business relevant behaviours and approaches adopted by simulation game users, such as decision-making tactics, may also share such an association. Yet the exact nature of the associations explored in prior research remains unclear (Laine and Lindberg, 2020) and there is debate around the level of cognitive realism that is most appropriate in simulation games (Ye *et al.*, 2020; Kyaw Tun, 2015). Further, additional uncertainty exists in relation to the association between decision-making approach and business performance (Shirokova, 2021). This uncertainty is magnified by the complex interplay between causation and effectuation observed in prior studies (Harms *et al.*, 2021; Stroe *et al.*, 2018). What is more, the association between decision-making approach and business performance remains unexplored in the context of business simulation gaming. Hence, this study aims to investigate the combinations of cognitive realism perceptions and decision-making approaches that give rise to high performance in a business simulation game. In line with a configuration approach (Kent, 2015), the analysis proceeds via a data-driven process that uses fsQCA analysis to explore the following propositions:

> **Proposition 1**: Specific combinations of causalities related to (i) perceived cognitive realism and (ii) decision-making approach, will result in high simulation game performance.
>
> **Proposition 2**: The existence of high perceived cognitive realism is necessary for good performance.

4. Data and Methodology

The study is based upon survey data collected from undergraduate business students in combination with game-generated business performance data. For the survey, post-game questionnaire responses relating to perceived cognitive realism were collected along with data on participants' decision-making approach. Survey respondents were selected based on their participation in a web-based simulation game called Glo-Bus. All were studying the same international module on Strategic Management delivered to a diverse cohort of students in two locations (UK and Hong Kong) as part of a degree awarded by a UK institution. The game was delivered in the same way by the same academic staff to all students on the module. Whilst the binational nature of the module cohort strengthens the representativeness of the research findings, cross-cultural comparisons were not an objective of this study.

Glo-Bus is a total enterprise game which requires students to run a company that sells wearable cameras and camera drones to the global market. Karriker and Aaron (2014, p.773) described the game as providing "rich contexts for student application of capstone constructs through complex, yet enjoyable, competitive frameworks". In the game, company managers are responsible for assessing the competitive environment for the two products and making strategic decisions in response to the actions of competitors to try to achieve superior performance. Following two trial gaming periods during which strategic plans are developed, companies commence trading and participants make multiple yearly decisions across several simulated trading years. They are scored on the performance of their company against a set of metrics both in each trading year and cumulatively via a game-to-date score.

Paper-based surveys were distributed to all students studying the module to collect data on decision-making approach and perceived cognitive realism (post gaming). The population for the study consisted of 387 undergraduate students studying the international module on Strategic Management. The number of usable responses was 274, giving a 71% response rate. Table I provides an overview of the survey population's characteristics.

[Table I: Survey Population's Characteristics – ABOUT HERE]

Various measures were used to collect the required data. Decision-making approach was measured with a 5-point Likert scale using items developed by Chandler *et al.* (2011) to capture participants adoption of effectuation and causation approaches. In the case of effectuation, sub-measures relating to affordable loss, experimentation and flexibility were used. Cognitive realism was measured using four items on a 5-point Likert scale. Finally, reflecting its criticality as a business outcome in the real-world, performance data was required. Each company's performance was evaluated using five metrics generated by the simulation game: earnings per share, return on equity investment, stock price, credit rating and brand image rating which collectively contribute to an overall game-to-date score (GTD). Hence the performance score used as a measure in this study reflects common performance measures used in real-world business contexts. Further, prior research has indicated close alignment between performance score outcomes achieved in business simulation games and performance outcomes observed in real businesses (Faria and Wellington, 2005).

To analyse the results, a novel fsQCA technique is used. The approach allows for the combined influence of the various factors predicting a given sought outcome to be identified. In the case of the current study, the combined influence of game users' perceptions of cognitive realism and decision-making approach (i.e. causation or effectuation) that lead to high performance in the game was examined. The process adopted in applying fsQCA, along with the study results, are reported below.

5. Results

5.1 Scales' reliability and validity

The reliability and validity of constructs were initially assessed to ensure the quality of the measurement items. We conducted a confirmatory factor analysis using a structural equation modelling approach, a common approach when validity needs to be tested prior to an fsQCA analysis (Knight *et al.*, 2022; Haddoud *et al.*, 2022). Table II presents scores for Composite Reliability, Cronbach's Alpha (α) and Average Variance Extracted. After removing three items (see Appendix for final retained items), acceptable levels of reliability and validity were obtained. Descriptive statistics for both conditions and outcome are also depicted in the Appendix. Lastly, a post hoc Harman's one-factor test was performed (Lings *et al.*, 2014) to check for common method bias. Here, the single factor accounted for less than 50% of total variance, suggesting no major issues. Likewise, from the full Variation Inflation Factor scores in Table II, no serious issues of common method bias exist, as per Kock and Lynn's (2012) guidance.

[Table II: Constructs' Reliability and Validity – ABOUT HERE]

5.2 Configurational analysis (fsQCA)

The fsQCA[1] technique was developed based on a Boolean algebra system to capture the set of conditions (usually in combinations) sufficient to predict an outcome (Ordanini *et al.*, 2014). By including contrarian cases that deviate from the general trend of the data (Woodside, 2014), fsQCA provides a holistic insight of the relationships in a given sample and minimises unobserved heterogeneity issues (Schneider and Wagemann, 2010).

The first step of fsQCA analysis involves the calibration of variables. Here, the average scores of each construct are computed[2], which is then followed by the transformation phase of the Likert scale scores into fuzzy membership scores. For this, researchers identify three values that reflect the three qualitative thresholds signifying fuzzy-set scores: 1 for full membership, 0.5 for cross-over point and 0 for full non-membership (Rihoux and Ragin, 2008). A fuzzy set can be considered as a group, with the values 0 and 1 representing non-membership and full membership to that group, while 0.5 is the middle membership score suggesting maximum ambiguity as to whether a case

[1] For detailed guidance on implementation of fsQCA analysis, see Greckhamer *et al.* (2018) and Pappas and Woodside (2021)

[2] In cases of missing data, these were replaced with mean scores of the respective variable.

belongs or not to the group (Pappas and Woodside, 2021). Greckhamer *et al.* (2018, p.489) advised that "sample-based calibration should be avoided whenever possible" and, as is common for 5-point Likert scales, scores of 1 (strongly disagree), 3 (neutral) and 5 (strongly agree) were used in this study as corresponding to non-membership, cross-over point and full membership respectively. The outcome GTD was calibrated using the 5^{th} (49.5), 50^{th} (89) and 95^{th} (110) percentiles.

5.2.1 Necessity analysis for high performance

Prior to sufficiency analysis, necessity analysis is performed to capture the conditions that are necessary (yet not sufficient) to reach the sought outcome (Kent, 2015); high simulation game performance in this case. For the current study, this enabled the investigation of Proposition 2. For a condition to be necessary, the condition needs to exhibit a consistency score of at least 0.9 (Legewie, 2013) and preferably a coverage exceeding 0.75. Consistency reflects the degree to which cases in the sample that share a causal condition (e.g. high cognitive realism) agree in exhibiting the outcome (Pappas *et al.*, 2020). Coverage illustrates empirical relevance, which can be considered an indicator of importance (Legewie, 2013). Table III illustrates none of the conditions were necessary to achieve high performance in the simulation game, rejecting Proposition 2.

[Table III: Necessity Analysis – ABOUT HERE]

5.2.2 Sufficiency analysis for high performance

Following standard practice in fsQCA we derive an intermediate solution, being the set of consistently supported combinations (Kent, 2015). To generate these combinations, researchers need to determine frequency and consistency thresholds. The former reflects the minimum case number combinations for inclusion whereas the latter refers to the minimum value for a combination to be considered consistent. In this study, we set the frequency threshold at 5 and consistency at 0.75 (Rihoux and Ragin, 2008). Table IV shows this solution, allowing investigation of Proposition 1. Following best practice, we used a representation where black circles indicate the *presence* of a condition and white circles indicate a condition's *absence*. Larger circles indicate *core conditions* (presence or absence), while smaller circles indicate *peripheral conditions*.

[Table IV: Sufficiency analysis for high performance – ABOUT HERE]

Alongside the combinations, measures for both consistency and coverage for each solution are indicated in Table IV. Consistency can be considered similar to significance in multivariate techniques, whilst coverage is akin to effect size and overall solution coverage similar to R-Square (Greckhamer *et al.*, 2018; Woodside, 2014).

A two-stage process is followed when interpreting findings. Results are first interpreted individually to uncover distinctive features associated with each path. Next, a summary is provided outlining patterns that emerge across paths to reach a holistic view of the findings.

Table IV shows three configurations associated with high performance. The first pathway solution reflects the presence of cognitive realism and flexibility, alongside the absence of affordable loss, experiment and causation, with the absence of experiment being a core condition. The second pathway solution shows the absence of cognitive realism being core, alongside the presence of all other strategies, including experiment. The third pathway solution involves the presence of cognitive realism alongside the presence of flexibility, affordable loss and causation, yet with the absence of experiment being core. The last solution has the highest score for empirical relevance, followed by the second and first solutions respectively. The overall solution coverage is 0.49 which reflects the proportion of high performance explained by these three solutions. As for consistency, the second solution is the least consistent and its proportional reduction in inconsistency (PRI) (lower than 0.42) suggests this combination might exhibit both high and low performance (Greckhamer *et al.*, 2018). To further investigate this combination, a negation analysis was applied, to assess configurations leading to low performance. To avoid solutions associated with high and low outcomes being included, we only retained combinations with raw consistency and PRI consistency above 0.75 and 0.5 thresholds. Table V depicts the findings. As anticipated, pathway solution 2 emerged as a precursor to low performance, allowing the conclusion that whilst it can lead to high performance, it has a greater probability to generate a low performance outcome.

[Table V: Sufficiency analysis for low performance – ABOUT HERE]

In summary, the following key patterns can be observed:

- Flexibility is a key strategy for high performance as it is present in all solutions leading to a good outcome.
- When cognitive realism is absent, all four decision-making strategies are adopted by the learners. This combination has the potential to lead to both low and high performance. However, the likelihood for low performance remains higher.

- When cognitive realism is present, two profiles emerge. The first involves the presence of flexibility with the absence of affordable loss, experiment and causation, whereas the second includes the presence of flexibility, affordable loss and causation, with the absence of experiment.
- Experiment and cognitive realism could be mutually exclusive. That is, when cognitive realism is present, experiment must be absent and vice versa.

6. Discussion

Figure 1 illustrates the various paths to high/low performance obtained in this study.

INSERT FIGURE 1 ABOUT HERE

From the outset, and in relation to Proposition 2, the analysis shows that perceived cognitive realism may not be an essential ingredient for achieving high performance in a business simulation game. To this extent, the study provides some support for prior research arguing that games do not need to be highly realistic to be effective in achieving the desired outcomes of a programme of study (Feinstein and Cannon, 2001; Wright-Maley, 2015); in this case, the attainment of high performance. However, the sufficiency analysis for Proposition 1 reveals that Pathways 1 and 3 do feature perceived cognitive realism as a condition. Further, Pathway 2, which does not include perceived cognitive realism as a condition, gives the lowest result for consistency and is more likely to lead to low performance. Hence, whilst a pathway that excludes perceived cognitive realism can give rise to high performance, it is more likely than other pathways to result in low performance instead; in this study, it appears to be a more ‘hit-and-miss’ approach than Pathways 1 and 3 in terms of performance outcomes. This finding is reinforced by the negation analysis (Table V) which shows that the configuration of conditions found in Pathway 2 can also lead to low performance. Thus, taking account of all pathway solutions and their levels of unique coverage and consistency, this research adds greatest weight to the arguments favouring cognitive realism in simulation games and its association with high performance, in line with the findings of Qian and Clark (2016) and Rumeser and Emsley (2019).

When considering the alignment of perceived cognitive realism with different decision-making approaches in the three high performance solutions, it is apparent that where participants perceive the game to be realistic, their decision-making approach is narrower and more defined. This suggests that these gamers are adopting a more considered approach to their decision-making, which in turn is associated with better performance outcomes. Findings on the role of cognitive realism therefore signify the importance of effective game design espoused by Dicheva *et al.* (2016). Users that become engrossed in the simulated environment and 'buy in to it' as a representation of the real-world are those that take a considered approach to adopting appropriate decision-making strategies and perform well.

Pathway 2 suggests that there exists a subset of gamers who do not perceive a high level of cognitive realism, but who might nevertheless achieve successful performance via a different approach. Rather than adopting a defined and focused decision-making approach, they pursue an experimental strategy that draws on all the factors. For this group, the approach is to try all available options to succeed. This approach may reflect different strategies and behaviours. The first possible explanation is that students are 'gaming the system'. That is, students try any available approach to manipulate the simulation game software to achieve the desired outcome. Their mind-set is perhaps to tackle the simulation game activity as a technical software challenge to be solved rather than as a real-world scenario to engage with based upon their understanding of business. This phenomenon has been observed elsewhere where games are used for education and training (Riemer and Schrader, 2022). In this sense, an association between low perceived cognitive realism and low authentic engagement amongst students (Schwarz *et al.*, 2020; Lee *et al.*, 2020) is evident. Nevertheless, despite the absence of perceived cognitive realism, good performance might potentially still be achieved. A second possible explanation is that the freedom and low-risk environment of a simulation game facilitates unconstrained and experimental game-play coupled with reflective engagement. Such an approach has been identified in previous research as being important for entrepreneurial development (Neck and Corbett, 2018). Rather than being detached from the simulation experience and 'gaming the system', students remain engaged through experimentation, driven by in-game reflection. The presence of flexibility in Pathway 2 (for which some level of reflection is required) indicates that this explanation based on playful experimentation and reflective engagement may hold true for some students perceiving low cognitive realism. However, this approach gives rise to less consistent performance outcomes, as shown in Tables IV and V, and is in fact more likely to generate low performance.

The above characterisation of students based on their approach to the simulation game may also explain why perceived cognitive realism and experimentation are mutually exclusive conditions within the three pathways. Whilst experimentation sits naturally within the 'try all options' strategy of Pathway 2, it aligns less comfortably with the focused and conservative approaches apparent in Pathways 1 and 3, where the perceived cognitive realism of the simulation game scenario appears to be associated with a more narrowly defined decision-making strategy.

The presence of flexibility in all pathways is noteworthy. Although not a core condition in any pathway, its presence suggests that participants pursuing all high performing pathway solutions were willing to adapt their decision-making based on reflection. They recognise, reflect upon and react to changing circumstances and opportunities arising during gameplay. This is consistent with both the considered approaches of Pathways 1 and 3, where deviation from a plan may be appropriate where outcome feedback and evolving conditions require it, and also Pathway 2, where flexibility may be considered inherent in a proactive experimental gaming strategy. Finally, the existence of flexibility and other effectual reasoning approaches alongside causation in both Pathways 2 and 3 reflects prior studies showing interplay between effectual and causal reasoning in decision-making (Harms *et al.*, 2021; Stroe *et al.*, 2018). As in the real-world of business, it is evident that successful decision-making in simulation games cannot be easily compartmentalised into neat and distinct approaches.

7. Conclusions and Implications

This paper has sought to understand the interplay between perceived cognitive realism, decision-making and performance in the context of business simulation gaming. It makes a significant contribution to theory by examining associations amongst these key variables which have, to date, remained unexplored by prior research. Underpinned by decision-making theory pertaining to effectual and causal reasoning and adopting a configuration approach based on fsQCA modelling, the study has analysed the complex nature of associations giving rise to successful gaming performance, extending our understanding of the role of perceived cognitive realism. It does this by showing that, in addition to having well established associations with behaviours and outcomes such as engagement and learning, cognitive realism also interacts with other key dimensions critical in the real-world of business, namely decision-making and performance.

The study found that none of the conditions measured in the study, including perceived cognitive realism, were essential pre-conditions for successful performance. However, three alternative routes to superior performance were identified. Whilst flexibility was a feature of all three, showing the importance of reflection, the diverse configurations apparent across the pathways are striking. In two pathway solutions, users could achieve success through engaging with the game as a cognitively realistic representation of the business world and adopting decision-making approaches associated with aspects of both effectuation and causation but excluding experimentation. Alternatively, they could consider the game as cognitively unrealistic, experimenting with the full range of alternative approaches to decision-making and adopting either a 'gaming the system' mind-set or a strategy based on playful experimentation and reflective engagement.

Whilst all three pathway solutions represent feasible ways to achieve successful performance, the second solution, associated with a strongly experimental decision-making approach and low perceived cognitive realism, is sub-optimal in terms of performance. It scores less well for consistency than the other two solutions, making it a riskier route to success. In fact, negation analysis confirms that it will more likely lead to low performance. Thus, the approach may be less transferable to real-world contexts where the consequences of failure associated with high-risk decisions are significant. Therefore, in training future managers it may be desirable to discourage the Pathway 2 approach by creating game environments that users perceive to be cognitively realistic. Further, it could be argued that an experimental decision-making strategy risks a shallower approach to engagement with the simulation (i.e. 'gaming the system'), thereby undermining the alignment of gaming capabilities with the achievement of the intended outcomes of a programme of study (including supporting the ability of future managers to perform successfully).

The implications of the study findings for game designers and educators are clear. Higher perceived cognitive realism amongst users is associated with a more considered approach to decision-making, resulting in consistently successful performance. Game designs that create the conditions for high perceived cognitive realism are more likely to align with the goals of business educators; training future managers who can successfully make decisions to drive business performance. This therefore requires close cooperation between designers and business educators to ensure that underlying business principles that drive game performance outcomes are aligned to the reality of contemporary businesses. However, given that findings showed cognitive realism and experimentation to be mutually exclusive but that an experimental pathway with low perceived cognitive realism can produce good performance and reflective learning, there remain arguments in favour of less cognitively realistic games. Different levels of perceived realism are associated with different behaviours, therefore choices around realism represent important design considerations. This needs to be considered in the context of educators' objectives for an activity. Do educators want learners to experience an environment where real-world constraints are encountered that may limit decision-making options, or do they want an environment less constrained by real-world considerations but which may align with a freer, more experimental approach? Both are valid approaches; in highly realistic games, a more considered, even conservative, strategy based on established theory may be rewarded whereas less realistic games may result in higher performance for those following a more experimental path. Educators need to know what they want for their students in the broader context of their studies and future careers. For instance, an entrepreneurship module may place greater weight on experimentation than a course to train managers in large corporations. For game designers, the challenge is to develop a range of game environments suitable for different learning contexts, or games that are sufficiently flexible to allow tailoring by educators towards users' professional development needs.

Further findings indicate that flexibility is a key capability for successful managers. Hence game designers and educators should seek to build in environmental changes and critical incidents (Lean *et al.*, 2014) that provide opportunities for users to implement flexible responses. Further, the design of appropriate in-game reports providing market information can aid reflection and support performance-oriented flexible adaption.

Certain limitations of the current study should be noted. Although it reveals the combinations of perceived cognitive realism and decision-making approaches resulting in high performance (or, for negation analysis, low performance), it does not draw conclusions on any causal relationships between cognitive realism and decision-making. Longitudinal studies should be undertaken to confirm causal links. Similarly, qualitative studies could be undertaken to provide deeper insights on the obtained combinations, particularly Pathway 2 which emerged as the most ambiguous solution and one that is more likely to lead to low performance. Further, the realism measures adopted focus purely on cognitive realism. Future research could extend the measures used to encompass physical dimensions of realism. Additionally, it should be noted that the choice of performance as the key outcome variable for the study has both benefits and limitations. The rationale for using this measure is that it corresponds with the outcome measures used in the real-world businesses that business simulation games seek to imitate. Further, it has not been the focus of significant prior research in the domain of game realism. However, some may argue that rather than performance, learning is the key measure of interest in a business game. Whilst the two measures may have some association in that in-game learning can result in high performance, it is recognised that learning also occurs post-game when participants reflect on their past performance. Although learning is not the chosen focus of this study, it is important to acknowledge that both good *and* poor performance can result in learning. Consequently, for those who consider learning to be the primary aim of a simulation game, performance may be viewed as being of secondary importance as an outcome. Finally, whilst the study had a high response rate from diverse participants, the findings would benefit from wider corroboration across different user contexts and simulation games. Nevertheless, it is hoped that the novel approach adopted allows both game designers and educators to make more informed choices to support the development of future business managers.

[Appendix: Items and factor loadings – ABOUT HERE]

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Table I: Survey Population's Characteristics

Gender	% of Respondents
Male	56.93
Female	43.07
Age	**% of Respondents**
<21 Years	20.44
21-25 Years	63.50
26-30 Years	2.92
>30 Years	7.66
Prefer Not to Say	5.48

Table II: Constructs' Reliability and Validity

	Causation	**Realism**	**Experiment**	**Affordable Loss**	**Flexibility**
Composite Reliability	0.91	0.84	0.84	0.88	0.79
Cronbach's Alpha	0.89	0.73	0.72	0.79	0.60
Average Variance Extracted (AVE)	0.61	0.65	0.64	0.71	0.55
Full Variation Inflation Factor (VIF)	2.10	1.05	1.68	1.74	1.21

Table III: Necessity Analysis

	Consistency	Coverage
Causation	0.94	0.59
Experiment	0.85	0.62
Affordable Loss	0.90	0.59
Flexibility	0.94	0.59
Cognitive Realism	0.90	0.63

Table IV: Sufficiency analysis for high performance

	Causation	Experiment	Affordable Loss	Flexibility	Cognitive Realism	Raw Coverage	Unique Coverage	Consistency
1	○	◯	○	●	●	0.23	0.02	0.91
2	●	●	●	●	◯	0.34	0.08	0.77
3	●	◯	●	●	●	0.39	0.11	0.86
	Solution Coverage		0.49		**Solution Consistency**		0.76	

Frequency cutoff: 7; Consistency cutoff: 0.77

● *Condition present and peripheral* ○ *Condition absent and peripheral* ◯ *Condition absent and core*

Table V: Sufficiency analysis for low performance

Causation	Experiment	Affordable Loss	Flexibility	Cognitive Realism	Raw Coverage	Unique Coverage	Consistency
●	●	●	●	◯	0.40	0.40	0.82
Solution Coverage		0.40		**Solution Consistency**		0.82	

Frequency cutoff: 7; Consistency cutoff: 0.82

● *Condition present and peripheral* ◯ *Condition absent and core*

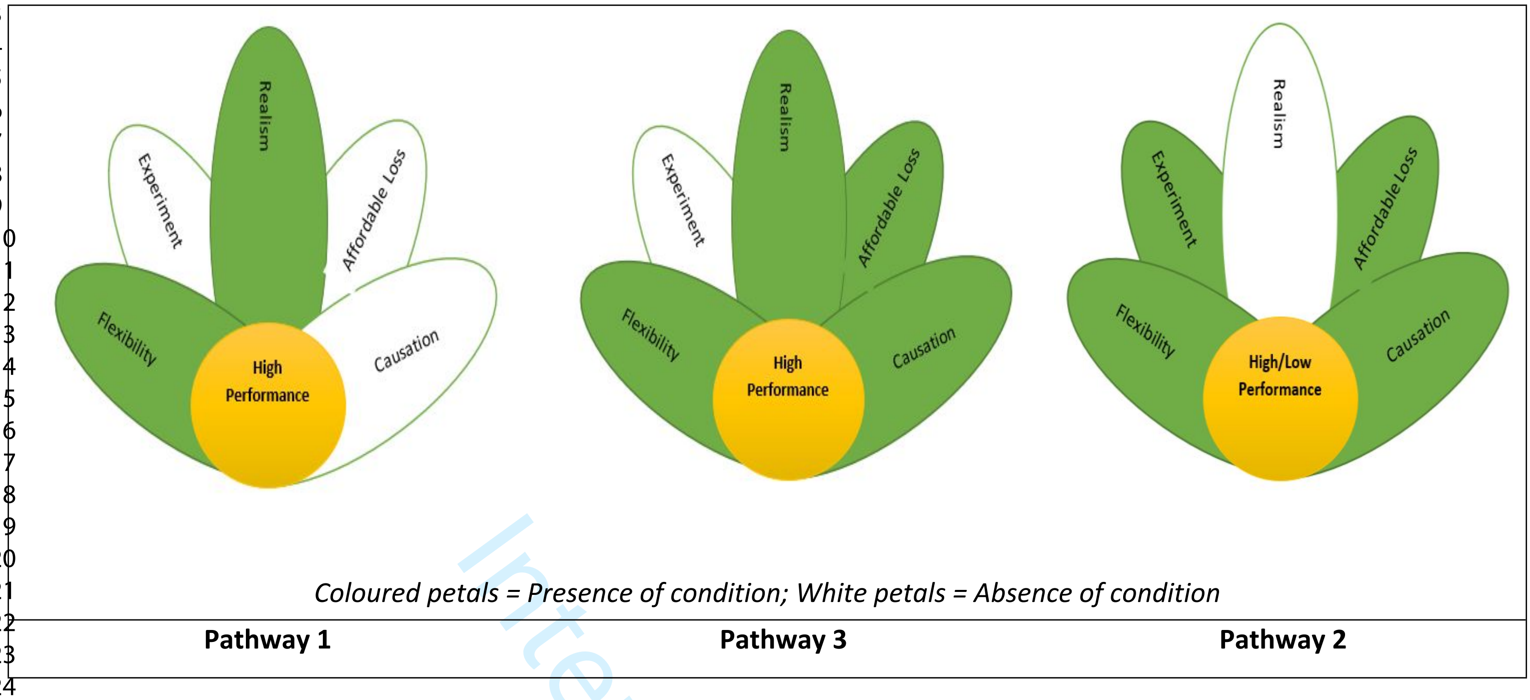

Figure 1: Pathways to High / Low Performance

Appendix: Items and Factor Loadings

Item	Loading	Mean	SD
Causation			
We will analyse long run opportunities and select what we think will provide the best returns	0.825	4.271	0.663
We will develop a strategy to best take advantage of resources and capabilities	0.823	4.316	0.703
We will design and plan business strategies	0.816	4.301	0.778
We will organise and implement control processes to make sure we meet objectives	0.782	4.096	0.75
We will research and select target markets and do meaningful competitive analysis	0.762	4.143	0.842
We will have a clear and consistent vision for where we want to end up	0.675	4.037	0.838
We will design and plan production and marketing efforts	0.789	4.051	0.759
Experimentation			
We will experiment with different products and/or business models	0.791	3.786	0.833
We will stick with providing the same product/service from the beginning to the end of the simulation	0.776	3.399	1.061
We will try a number of different approaches until we find a business model that works	0.836	3.985	0.86
Affordable Loss			
We will be careful not to commit more resources than we can afford to lose	0.807	4.022	0.807
We will be careful not to risk more money than we are willing to lose with our initial idea	0.866	4.037	0.868
We will be careful not to risk so much money that the company would be in real trouble financially if things don't work out	0.856	4.129	0.882
Flexibility			
We will adapt what we are doing to the resources we have	0.717	4.232	0.587
We will be flexible and take advantage of opportunities as they arise	0.809	4.356	0.611
We will avoid courses of action that restrict our flexibility and adaptability	0.714	3.927	0.797
Cognitive Realism			
The simulation provided a realistic experience of running a business	0.884	3.882	0.942
The logic of the game modelled the real world accurately	0.803	3.673	1.013
The simulation provided an authentic experience of strategic management	0.731	4.007	0.798