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Can people's brainhex type be changed with serious games? Evidence from the banking industry

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***Abstract**: The BrainHex model is one of the most researched models to represent player profiles in games. In this paper the author examines how serious games can be used to change the player profiles over time, even in heavily regulated environments, such as the banking industry. To understand if player archetypes change over time, I have conducted an exploratory study with 2531 bankers over the course of three years. Our results indicate that the players 'archetypes can potentially be changed with the help of serious games Age of the players and their role in the organization do not influence the change of the main archetypes, but can determine the amplitude of that change. The change appears to be significant across all age groups and roles in the organization and also persistent. A slight decrease in Y3, however, could indicate that the change could be reversible with the passing of time. The statistical analysis of the data collected indicates that the desired change in the main archetype can be obtained by having the players spend between 10 and 20 hours playing personalized serious games that facilitate the desired archetype and that those games should be designed to facilitate an easier level up mechanism. My results both confirm existing studies on the subject and have practical implications for the designers of serious games and gamification mechanisms, by indicating how serious games should be personalized to achieve the desired change in behaviour.*

Keywords: BrainHex; player archetypes; serious games, design mechanisms, level up, LMS.

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Introduction

The COVID-19 pandemics has forced many business organizations to adopt online training tools. These training tools offer the benefits of flexibility and self-pacing, but recent research also discovered some serious effects of online training, such as loss in motivation or even negative psychological effects (Pinzaru *et al*., 2022; Rivera-Vargas *et al.*, 2021). One solution to this problem is the mass adoption of serious games, games that are designed not only to engage the learners with the content, but also to provide a means of entertainment and mental wellbeing, while improving the skills and performance of the learners (Nieto-Escamez *et al.*, 2021).

The adoption of serious games can be a solution especially in compliance learning in heavily regulated industries, such as the financial industry. Compliance learning is generally considered to be boring by most employees in banking, yet it is mandatory and banks place

a huge importance on their employees understanding and operating confidently with the rules and regulations in effect at any given time. Role based serious games can simulate real life environment situations, where learners can experience different outcomes of applying the rules of the game and advance the knowledge of the learning in a fail-safe environment (Dima et al., 2019; Agoston & Dima, 2012; Donovan, 2012).

Once serious games became the prevalent strategy in motivating employees, most research has focused on improving methods and design methodologies to make serious games and gamification more effective and motivate the people they target. To increase motivation for different type of players game designers must understand different player types and how they react to different game mechanics. Player type models have been studied both by researchers and game designers for their practical importance in the serious game design.

Play style preferences mostly depend on basic psychological types (Nacke *et al.*, 2014). What this means is that individual players can be reliably "labelled" by applying these psychological types. Most player type models are built on these preferences and the Myers-Briggs Type Indicator (MBTI) is the basis for these models. The Myers-Briggs typology led to the development of the first demographic game design model, known as DGD1 (Demographic Game Desisn). DGD1 was developed by Bateman and Boon in 2005 and represented an adaptation of the Myers-Briggs typology to games. The limitations of the DGD1 model determined Bateman and Boon to continue their research until a new model was developed, DGD2. Unlike the previous model, DGD2 was based a lot less on the Myers – Briggs typology and made use of the Temperament Theory (Buss *et al.*, 1975). Although a step forward from the previous model, DGD2 has many of the same limitations. Together with DGD1, it paved the way for the BrainHex model, that provides a complete player typology.

The Brainhex model

The BrainHex represents a commonly used model for gamer personality based on neurobiology (Nacke *et al.*, 2011). It differentiates between seven player archetypes: Seeker, Survivor, Daredevil, Mastermind, Conqueror, Socialiser, and Achiever, based on their motivation to play video game. It is important to highlight that each archetype embodies a particular player experience, in a qualitative manner (Nacke *et al.*, 2014).

- *Seeker* – highly curious, enjoying both the discovery and the exploration of the game's world, as well as the amazement occasions.
- *Survivor* – enjoys experiencing the fear intensity, while surviving the terror and escaping the life-threatening situations.
- *Daredevil* – thrill seeker and risk-taking enthusiast that appreciates experiences that allow playing on the edge.
- *Mastermind* – very efficient decision-maker, experiencing solving puzzles and coming up with complex strategies as an inherent reward.
- *Conqueror* – victory seeker and challenge-oriented, that enjoy defeating difficult opponents, regardless their origin (AI-controlled or other competitors).
- *Socialiser* – enjoys the people interaction brought by the games, thus this archetype plays games as a way to socialise, to help people and talk to them.

- *Achiever* – goal-oriented, enjoys completing tasks and challenges in the game, the satisfaction coming from long-term achievements.

The BrainHex model was applied successfully in the persuasive games for healthy behaviours (Orji *et al.*, 2013) and adaptive gamification (Monterrat *et al.*, 2017), as it was validated as a reliable, stable and consistent typology (Busch *et al.*, 2016). Recent work concentrated on using BrainHex archetypes for personalized games design (Busch *et al.*, 2016), as it proved to be a promising approach in this field.

My research aims to determine whether the main players' archetypes can change over time by being exposed to certain types of serious games that foster a change in behaviour. I am also interested in exploring how the age of the players and their roles in the organization are influencing that change. In addition to explaining the gaps in existing literature, my research also has practical implications for the designers of serious games.

The research methodology

Research objective

The subject of our research is a group of 2531 bankers from three different banks in Romania, engaged in a mandatory training program on MiFID II (Markets in Financial Instruments Directive). Of the entire group of bankers enrolled in the mandatory learning program, we have selected for this study only the ones that have completed the training program in each of the three years, to ensure consistency across the analysis. The entire group was divided in 5 subgroups according to the division in the bank they belong to (their role in the bank). The 5 subgroups are: Retail banking, Corporate banking, Risk & compliance Operations and Treasury services. They correspond to the typical structure of a bank Romania.

My research objective consists on determining if serious games can be used to change the player's main archetype according to the BrainHex model and if the factors that influence that change are intrinsic or extrinsic to the game design and related to the context of the players.

To achieve this objective I have begun by formulating two research hypotheses:

- H1: The player's archetype can change over time, influenced by the games played.
- H2: Factors such as age and role in the organization also influence this change.

H1 is constructed to close a gap in the existing research by validating recent results obtained by (Guimarães Santos *et al.*, 2021) and (Yildirim *et al.*, 2021) and also by evaluating the stability of the change over longer periods of time (two years). H2 is constructed to identify other factors that could potentially influence the change in player's archetype and that have not been previously identified.

To test the two hypotheses, we have designed six serious games based on the BrainHex player archetypes, as detailed in the table below, which was adapted from (Grosu *et al.*, 2021).

Table 1: Map of the BrainHex player archetypes on the 6 serious games developed

GAMES	Memory	Choices	Trader	Shooter	Decisions	Millionaire
Seeker			X	X		X
Survivor	X	X			X	
Daredevil			X	X		X
Mastermind	X	X		X	X	
Conqueror			X			X
Socializer		X			X	
Achiever	X			X		

We have included these games in The MiFID II mandatory learning program for the group of 2531 bankers. The 6 serious games have been designed to increase the engagement of the learners with the content, by taking into account not only the Brain Hex player archetypes but also the context of the learners, most importantly their role in the bank. As demonstrated in (Grosu *et al.*, 2021), the context plays an important role in influencing the engagement with the content.

Of the seven BrainHex archetypes, Conqueror, Socializer and Achiever are represented in two of the serious games, Seeker, Survivor and Daredevil are represented in three of the serious games and Mastermind is represented in four serious games. The learning program was designed to require each player a minimum 70% progress in each game, before being allowed to continue down the learning path.

Research instrument

Researcher in the field mostly use surveys to determine the player's main archetypes (Guimarães Santos *et al.*, 2021, Klock *et al.*, 2020) according to the BrainHex model. In our view, the surveys allow for personal biases to affect the final results, thus altering the results of the research. In most cases, users perceive themselves differently than their real behaviour in a serios game, as their personal perception is mostly influence by their aspirations rather than current reality.

Our research methodology is based on our capability to determine the player's main archetype algorithmically, with the help of the elearning platform. The elearning platform we have used *(https://elearning.boldtech.eu/)* is specifically designed for mandatory learning and collects 150,000 datapoints/user/hour, including their time spent playing games. Specifically on the serious games, the platform automatically collects data about the time spent playing each game, the individual performance in each instance, coins collected (score), and completion rate.

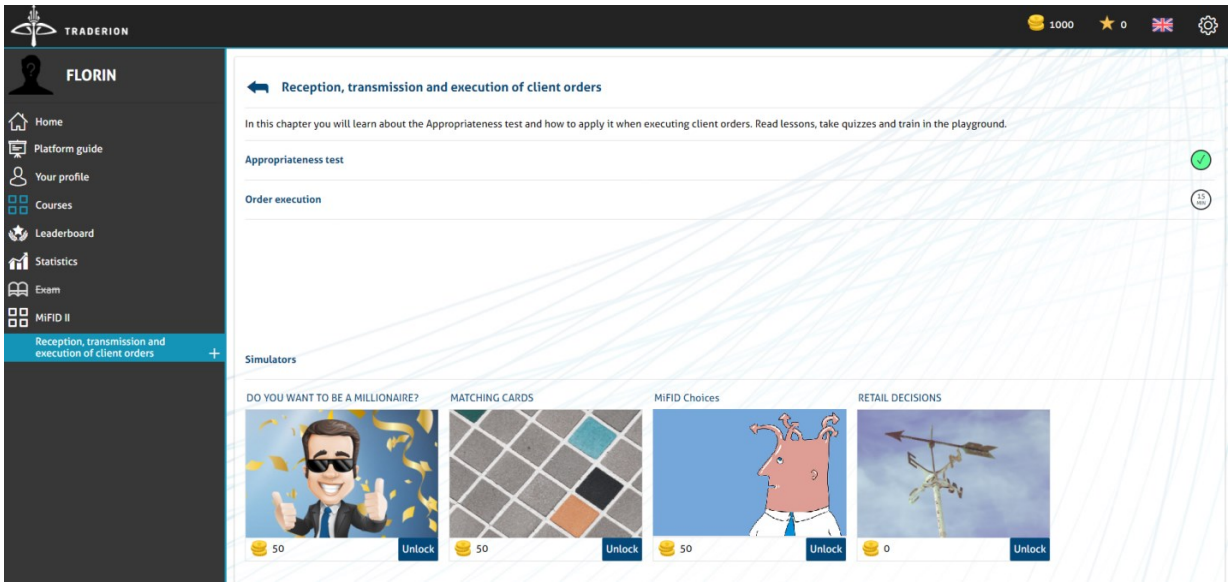


Figure 1. The eLearning platform used in our study (https://elearning.boldtech.eu/)

This has allowed us to accurately measure the initial player archetype in Year 1 and then also the change in player's archetype for each of the following years.

To test H2, we have been given the age of the players (intervals) and their role (corporate divisions) in the bank by the banks themselves. The distribution is detailed in the table below:

Table 2: The distribution of age group and role in the bank

Role / Age	Retail banking	Corporate banking	Risk & compliance	Operations	Treasury services
22-29	24%	18%	20%	22%	16%
30-39	20%	21%	21%	20%	18%
40-49	20%	22%	20%	19%	19%
50-59	18%	20%	20%	19%	23%
60+	18%	19%	19%	20%	24%

The data collected over the course of three years was managed and analyzed using SAS Viya (https://www.sas.com/). SAS Viya was integrated with the BOLD elearning platform as part of the Virtual Simulated Bank project developed by BOLD Technologies. Deployed in cloud, this is a powerful tool that allowed us flexibility and speed in analyzing the vast amounts of data collected from the group.

The experiment and results

The goal of the experiment was to change the dominant archetype across all age groups and role in the population so that Achiever becomes the dominant archetype. This goal was chosen because Achiever ranked low in most of the age groups and roles in the bank and it was considered as the most significant change to be generated with the help of serious games.

An important observation here is that, in addition to games, other elements of gamification have been built into the platform, such as leaderboards and coins. The players could see the leaderboard for each game at all times and had to pay 5 coins each time they wanted to play a game. To collect the coins, users must go through the content and correctly answer the mini quizzes at the end of each section.

In Y1, the Achiever archetype was not the dominant archetype in any of the age groups in the bank. In Y1, Achiever ranked high only in 30-39 (third most important archetype) and 40-49 (third most important archetype) age groups.

The table below presents the combination between the different player archetypes according to the BrainHex model (the dominant one) and the age groups in the 3 years of the experiment. One important observation is that if a player was assigned to an age group in year 1, she/he was kept in the same age group throughout the entire duration of the study, even if they could have been assigned to new age groups in Y2 or Y3. We have only recorded 39 such cases throughout the entire duration of the experiment, thus making it irrelevant to the outcome.

Table 3: Combination of main archetype and age group

Age group / Main archetype	22-29			30-39			40-49			50-59			60+		
	Y1	Y2	Y3	Y1	Y2	Y3	Y1	Y2	Y3	Y1	Y2	Y3	Y1	Y2	Y3
Seeker	26 %	15 %	15 %	14 %	10 %	10 %	13 %	10 %	11 %	10 %	10 %	9%	16 %	14 %	14 %
Survivor	18 %	19 %	20 %	15 %	16 %	19 %	15 %	16 %	16 %	18 %	17 %	17 %	21 %	19 %	19 %
Daredevil	10 %	10 %	10 %	12 %	10 %	6%	11 %	10 %	10 %	18 %	16 %	16 %	19 %	17 %	17 %
Mastermind	5%	4 %	4%	8%	6%	6%	9%	7%	6%	11 %	9%	9%	8%	5%	5%
Conqueror	10 %	9 %	8%	17 %	16 %	15 %	18 %	15 %	15 %	18 %	16 %	16 %	14 %	13 %	13 %
Socializer	19 %	19 %	20 %	18 %	18 %	19 %	17 %	18 %	18 %	12 %	12 %	13 %	10 %	12 %	13 %
Achiever	12 %	24 %	23 %	16 %	26 %	25 %	17 %	24 %	24 %	13 %	20 %	20 %	1 2%	20 %	19 %

The results in Table 3 clearly indicate that player's archetype can change over time, influenced by the games played. Starting with Y2 and continuing with Y3, Achiever has become the dominant archetype across age groups. The percentage increase ranges from 41%, in the 40-49 age group, to 100% in the 22-29 age group. This result indicates that age is not an influencing factor in the players' archetype changing with the help of serious games, but it can influence the amplitude of that change. This requires further research, as the percentage modification is not linear as the age of the players increases and appears to be somewhat random.

We have taken our research one step further and looked at potential correlations between the improvement in the percentage of the achiever archetype and the games played by the player. As our entire research methodology relies on determining player's main archetype based on game interaction data, we have researched this data further and determined that the improvement in the achiever archetype (calculated as a percentage) is strongly correlated with both the time spent playing the serious games that foster this

archetype, as well as with the maximum level achieved by the players in each of the two games – Memory and Shooter.

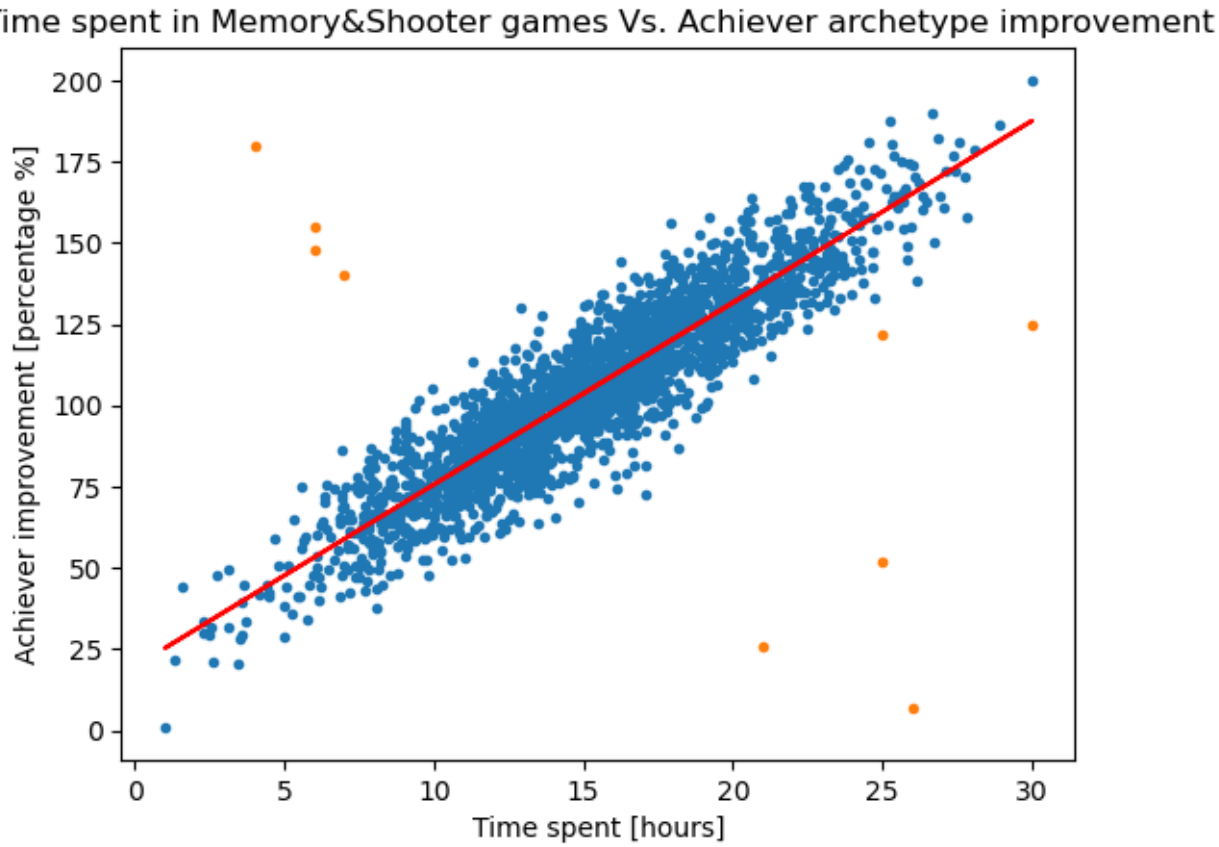


Figure 2. The correlation between the time spent playing Memory and Shooter and the achiever archetype improvement

One important observation here is that the players were only required to spend at least an hour playing each of the two games and, as can be observed from the Figure 2 above, the vast majority of the players have spent significantly more time playing these games. The strong corelation between the time spent (hours) playing the games and the change in the main archetype indicates that the desired change in the archetype can potentially be obtained by having the players spend between 10 and 20 hours playing serious games that facilitate the desired archetype. Further research could determine whether this amount of time should be concentrated in a short time interval (e.g., one month) or a longer time interval (e.g., six months) and how this concentration influences the change in archetype.

This result has important practical implications for the designers of serious games, as it indicates that the most successful games in helping the players change their main archetype according to the BrainHex model should engage the participants to spend an average time playing between 10 and 20 hours. Anything shorter than that is not sufficient to generate the desired change and, also, games that require longer time spent playing (e.g., more than 25 hours) disengage the players, resulting in poorer results.

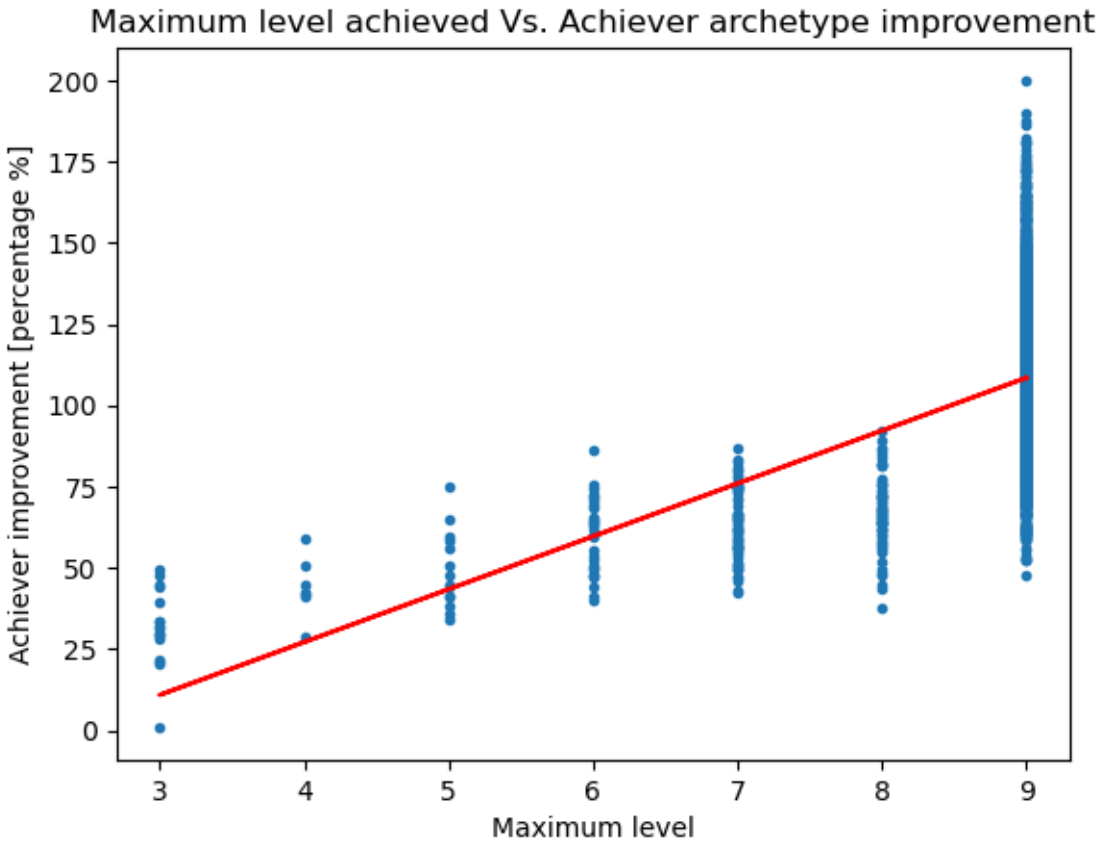


Figure 3. The correlation between the maximum level achieved by players and the achiever archetype improvement

The second regression model was applied to determine how the improvement percentage in the Achiever archetype correlates with the maximum level achieved by players when playing the two games that enable this archetype to thrive. The results indicate a strong correlation between the performance of the players and their archetype change (calculated as percentage). The most significant change in the main archetype happen to those players that have reached the maximum level in each of the two games. Further research is required to determine how the difficulty level of serious games can impact the change. In other words, is it useful to design serious games that are "easier" to play and reach higher levels, or games that are "more difficult" to play and reach higher levels. There is little research on this topic that the author identified. However, existing research appears to be supporting the idea that "easier" games are more efficient than the more difficult ones to generate the desired outcomes (Hamari *et al.*, 2016), (Alexander *et al.*, 2013).

The results in Table 3 also indicate that this change is stable, the results in Y3 being similar to those recorded in Y2. However, there is a slight decrease being recorded in each age group which might indicate that if the time horizon of the study is to be expanded to more than 7 years, this change could be reversed. This also requires further research and, if the experiment continues (the same group of bankers will continue to use the same LMS and set of games), we can analyze the results after sufficient years.

Another result that can be deducted from Table 3 is that Mastermind has decreased significantly across all age groups. In the 60+ age group, that decrease is 38%. The serious

games in this experiment all require players to solve puzzles and devise strategies to overcome the challenges presented in the game. This Mastermind archetype was the least represented one across age groups and by the end of the experiment decreased even further (26% on average, the biggest decrease compared to the other archetypes).

The table below presents the combination between the different player archetypes according to the BrainHex model (the dominant one) and the role in the organization for the players in the group. Unlike with the age group, if a player has changed role, we have assigned the player to the new group in Y2 or Y3. We have recorded only 12 such cases throughout the three years, also irrelevant to the outcome of the experiment.

Table 4: Combination of main archetype and role in the organization

Role / Main archetype	Retail banking			Corporate banking			Risk & compliance			Operations			Treasury services		
	Y1	Y2	Y3	Y1	Y2	Y3	Y1	Y2	Y3	Y1	Y2	Y3	Y1	Y2	Y3
Seeker	23 %	19 %	19 %	14 %	10 %	10 %	13 %	11 %	11 %	15 %	13 %	13 %	15 %	12 %	12 %
Survivor	26 %	20 %	20 %	13 %	12 %	12 %	24 %	17 %	17 %	20 %	17 %	17 %	16 %	9%	9%
Daredevil	8%	6%	6%	12 %	10 %	9%	9%	8%	8%	19 %	16 %	16 %	19 %	17 %	17 %
Mastermind	4%	2%	2%	8%	6%	6%	7%	5%	5%	6%	5%	5%	7%	6%	6%
Conqueror	8%	6%	6%	19 %	16 %	16 %	18 %	15 %	15 %	16 %	15 %	15 %	14 %	13 %	13 %
Socializer	21 %	21 %	21 %	18 %	18 %	19 %	19 %	19 %	19 %	13 %	15 %	15 %	10 %	12 %	12 %
Achiever	10 %	26 %	26 %	16 %	28 %	28 %	10 %	25 %	25 %	11 %	19 %	19 %	19 %	31 %	31 %

The results in Table 4 also support H1 and contradicts H2. Achiever has become the dominant archetype in all the departments of the organization. The percentage increase ranges from 63% in Treasury, to 160% in Retail. This result indicates that role is not an influencing factor in the players' archetype changing with the help of serious games, but it can influence the amplitude of that change. The change appears to be significant in Retail, Corporate and Risk and less so in Risk and Treasury. One possible explanation is that people in Risk are inherently less concerned with achieving long term goals as their careers are the most stable ones in banking. On the other hand, Treasury staff is already formed of mostly high achievers.

The biggest transformations are in Retail and Risk, two areas where staff is mostly exhibiting archetypes such as Survivor. The number of players in each of the two roles that exhibited Achiever as their main archetype more than doubled (160% increase for Retail banking and 150% increase for Risk & compliance), which is a strong indication that serious games and gamification are powerful tools that can be successfully used to change the behaviour of players.

It is also important to mention that the change of main archetype appears to be stable across all roles, as the percentages in Y3 are the same as the one in Y2. Of course, if we expand the time horizon of the experiment, a reverse in this change can still occur.

Conclusions

In this paper we have demonstrated that serious games design can be used to change the player's main archetypes according to the BrainHex model. Our findings demonstrate that being exposed to certain serious games over time will change the behaviour of the players, as well as their main archetype. Our findings are in line with recent research in the field and expands the findings of (Guimarães Santos *et al.*, 2021), (Oliveira *et al.*, 2020) by demonstrating that the change in player's archetype can happen over a longer period of time than previously demonstrated.

This change, our data also demonstrates, is not affected by personal factors such as age or role in the organization. This might sound counterintuitive, as players who work in risk and compliance can potentially have their main archetype changed to one like Conqueror, an archetype that is typically found in treasury (sales & trading) or in corporate banking. What is even more interesting, is that this change occurs across all age groups, including in those who are statistically less open to playing games or to changing their behaviour. Vice versa, players who work in highly competitive environments such as Treasury can have their main archetype changed to Survivor, an archetype that is typically found in roles such as Risk and compliance or Retail. What this means is that serious games can potentially be used by learning and development managers to alter the behaviour of their colleagues to achieve the desired business outcomes. For example, if an organization desires that their staff in certain roles assumes more risks, to profit from existing market conditions, they can achieve that by using serious games such as Trader or Millionaire to change their behaviour.

The limitations of our research derive, first and foremost, from the time horizon of the study. The 3-year time horizon might not be sufficient to determine if the change in archetype is definitive or not. Our future research will focus on expanding the time horizon of the experiment to more than 7 years, to determined if this change is definitive or can be reversed with the passing of time. This, of course, depends on whether the same group of bankers will continue to use the BOLD LMS for at least another 4 years, to allow us to collect the relevant data.

Another limitation of our study is demographic in nature, as all the participants in our research are from the same country, Romania. As this demographic factor can have an impact on the context of learning, this limitation can influence the general impact of our results. The mitigation of this limitation comes from the fact that we have collective extensive data for each participant and their behaviour, data that can be compared with other demographic groups in future studies.

Last but not least, future research should be focusing on analyzing the impact of the initial main archetype on the final outcome. Further statistical analysis is required to determine how the initial archetype influences the change in behaviour over time and how this can be used, practically, when designing serious games.

We are also looking to analyze the impact social context has on changing the players' archetype. We will research how serious games combine with the social context to influence this change and how this can be used to design more effective learning programs. In addition, we will focus our future research efforts on examining how realistic and complex a serious game needs to be to help change players' archetypes and, ultimately, their behaviour at work, where and when it matters the most.

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