

MBTI-Based Personality Assessment through Introducing a Puzzle Game

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Abstract— Personality tests are one of the tools that can help people to understand themselves better and propose their capabilities and weaknesses. Accordingly, they can choose a suitable career or improve themselves if they are self-aware of their behavioral characteristics. These personality tests speak about what people and their preferences are facing options because games seem to be a solution for studying people's personalities by facing them in real-world scenarios and giving them many options to choose from in the gameplay. This research not only investigated the capability of puzzle games as a replacement for classical self-reporting personality tests but also found the correlation of game elements with different personality aspects which are statistically significant compared to personality traits.

Keywords— Personality Assessment; Serious Game; Behavioral analysis; MBTI;

I. INTRODUCTION

For many years, psychologists have been working on personality and categorizing people into groups in which they have the same feelings and/or decision preferences in similar situations. Furthermore, they have been trying to find out how they can help people with these personality types in vital areas of their life like career recommendations and predicting their job satisfaction [1], team formation [2][3], and offering a method for learning through detecting Learning Style [4][5].

One of the most popular personality tests among researchers is Myers-Briggs Type Indicator (MBTI). This personality assessment was invented by Myers-Briggs based on Carl Jung's personality framework. According to Briggs and Briggs, MBTI divides people into sixteen personality groups that are cartesian products of the MBTI letters can be seen in Table I [6]:

For instance, in the MBTI types, ISTJ is a personality of introverted, sensible, thinking, and judgmental people. These types speak about people's preferences in making decisions[7]. Also, each letter independently interprets people's behavior.

David Keirsey has introduced another way of looking at MBTI personalities named Keirsey Temperament Sorter (KTS). It groups people into four main temperaments and then divides those into smaller groups. In the KTS, each category is called by the name of its specialists [8]. The main categories (temperaments) are exposed in Table II with correlated MBTI pattern and their description [9].

Some specialists consider the classical ways of self-reporting interviews as a drawback. They argue that people tend to choose what seems to be better than what they are. This phenomenon is caused by social preferences, the subject's lack of self-understanding, their strong desire to get a job or position, or just by mistake. Additionally, the longer formats of personality tests can be tedious, so people carelessly or randomly answer them [10].

To solve these problems, researchers experiment on various platforms like analyzing social media or monitoring people's behavior to detect personality types, make suggestions, and give recommendations based on those types [11] [12]. In this paper, we endeavor to show the capability of games to identify personality traits.

As mentioned, it is imperative to develop better test tools and create more entertaining ways to encourage people to do the test with enthusiasm and to be unaware of the test's correct answers. One of the solutions is using a gamification framework to make the test enjoyable for people. Not only gamification not help distract subjects from the test, but it can also not achieve its objectives if not designed effectively. So, making an actual game can be a better solution to conduct the test.

In addition, games can face people in real-world scenarios while some of them have critical to face in ordinary life at no cost or some other scenarios can be scarce, but in the game, we can create them whenever we want and study people's behavior in those situations.

TABLE I. PERCENT OF SIXTEEN PERSONALITIES

<i>MBTI letters</i>	<i>Full Name</i>	<i>Description</i>
E/I	Extraversion	These people get energy from activities in that other people are involved and get along well with them easily
	Introversion	They usually can only stand populated activities, which is energy-draining from their point of view, for a shorter time than others. Moreover, they do their best or prefer when they are alone. They have their own world, which is populated only with their ideas.
S/N	Sensing	They are detailed people who pay intensified attention to or perception from their five physical senses.
	Intuition	People with Intuition are fond of patterns and abstract things more than reality. Also, They enjoy doing new things.
T/F	Thinking	Thinkers are logical people who decide with logic and based on truth and evidence without regard.
	Feeling	Having the feeling in personality makes the possessor prioritize people feeling rather than pure logic.
J/P	Judgment	people with this personality are organized and structured. Planning and having a blueprint are important for them.
	Perception	Those people like to face events spontaneously. Also, they are a fan of taking life easy.

TABLE II. PERCENT OF 16 PERSONALITIES

<i>MBTI letters</i>	<i>temperaments</i>	<i>Description</i>
SJ	Guardians	Also known as tactical Serious about their tasks Respect law and regularity
SP	Artisans	Also known as tactical Good at art and sensing Love adventure and stimulation They believe in luck Impulsive and not organized
NF	Idealists	Also known as diplomatic Try to Become Better version of themselves Enjoy working with others and helping them They believe in tough standards
NT	Rationales	Also known as strategic or master of mind Good at problem solving and analyzing Finding efficient solution Putting all their efforts to achieve goals

In their study, McCord et al. developed a text-based fantasy game and compared the results with IPIP-50, another personality test. They find a moderate to strong correlation between people's personalities and their choices during the game [13]. Another study used a serious game with 122 subject samples of all genres and found that the personality profile of

players has a robust correlation with their BFF personality profile [14]. A long unity 3d game was designed by Afroza and his colleagues to examine ways to replace the Big Five personality tests with a game. Among 30 participants, ages 18 to 25, only valid measures for the "Neuroticism" trait were found [10].

In another paper, a particular game level was designed and added to a commercial game named Neverwinter Nights. They defined 275 indicators related to the "NEO-PI" test. Forty-four players played the game. A significant correlation was founded between the indicators and the personality test results [15].

In a 2013 study, Ferro et al. divided the player types using two different ways without personality tests. One clustering of players is a mix of Achievers, Socializers, Explorers, and Killers. The other clustering includes:

- The Competitor
- The Explorer
- The Collector
- The Achiever
- The Joker
- The Artist
- The Director
- The Storyteller
- The Performer
- The Craftsman

All or some groups are valid based on the genre and game design [16]. These groups can be a high-level interpretation of personality types and used as an indicator.

Several studies focused on commercial and online games from big companies like Minecraft, World of Warcraft, League of Legends, Battlefield3, and Skyrim. One of them found that players with a high openness, conscientiousness, and agreeableness score in the Big Five tests avoid killing in Minecraft if they do not have a good reason. Also, people who have a high level of conscientiousness play weaker with less killing per minute. Additionally, researchers designed a game according to the Big Five tests. They found a correlation between using maps, the number of valuable and useless movements, the problem-solving techniques, and the frequency of stopping the game by the player. This research conducted a small test on ten students with a role-playing game with twelve choices. The game results correlated well with the personality test scores [17].

Using fantasy worlds and elements might bias players since they embody the game's characters and cover their characteristics. So, a game designed more realistically leads to more accurate results [10]. In gender-unequal games like Shooter games, one gender might perform better. As a result,

such games need a careful design for personality assessments [18].

II. METHODOLOGY

A. Development and game design

In this research, two options were available for the game. One was using a premade game and measuring random things without control over the game flow. As a result, more logs are generated blindly, although this method is faster and involves fewer challenges during the game development phase. The other option was to develop a game from scratch, so we could have better control over it while imposing much higher costs and risks.

Also, players' pre-experience in commercial games can be a bias since more experienced individuals in a specific genre may perform better. Therefore, using a more neutral genre to minimize the previous experience's effect or change some rules to create a novel player experience is best. Overall, we opted for the second option and developed a game that fulfilled our cause better.

Through one year of development, we created a game using Unity and C# in the puzzle genre. For the puzzle part, there are ten different levels. Also, we provided twelve bounce points in case the player needed to skip the main level. In addition, people can pause and do the game from the checkpoint whenever they want.

Also, a few hidden or hard-to-find tricks were provided in some of the puzzles to make them easier to solve. Subjects with systematic thinking and careful attention to the puzzle could use these tricks.

The game is only made for Android devices; other platforms were excluded to create a uniform appearance in different devices and minimize the effect of various input-output devices like PC keyboards. The .apk file is downloadable for test attendants on a website made with C# MVC. On that site, there is also a link to an 87-item MBTI standard test created with google forms in Persian [19].

At the end of the game, the option to send logs is provided to the user. If the test attendant agrees to send the log, JSON files and logs will be sent to a specific API on the site, which is also written with C#.

B. Demographic information

This game and the MBTI test were done by 34 people consisting of 22 males and 12 females. People who participated in that test were professional computer engineers from Sapco (Iran Khodro) and students of higher education in computer engineering from the University of Tehran, and 12 people were not from fields related to Computers. All of these people are Iranians, and their ages are between 23 to 50.

In Table III, the MBTI personality of players can be seen. Moreover, in Table IV, the KTS and each letter's percentages are shown.

TABLE III. PERCENTAGES OF SIXTEEN PERSONALITIES

MBTI types	Percent
ISTJ	14.70
ISFJ	2.94
INFJ	8.82
INTJ	14.70
ISTP	2.94
ISFP	0
INFP	2.94
INTP	5.88
ESTP	8.82
ESFP	0
ENFP	11.76
ENTP	2.94
ESTJ	8.82
ESFJ	2.94
ENFJ	5.88
ENTJ	5.88

TABLE IV. PERCENTAGES OF THE MBTI LETTERS AND KTS

Indicators	Percent
E	47.05
I	52.95
N	58.82
S	41.18
T	64.70
F	35.30
J	64.70
P	35.30
SJ	29.41
SP	11.76
NT	29.41
NF	29.41

The player's average playing hours per week can be seen in Fig 1. This figure shows that most of our sample are not gamers.

Moreover, most of our players prefer to use mobile to play games routinely, as shown in Fig 2.

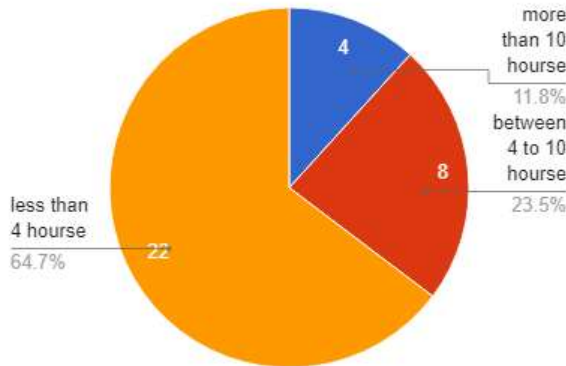


Fig. 1. The average playing hours of players in a week

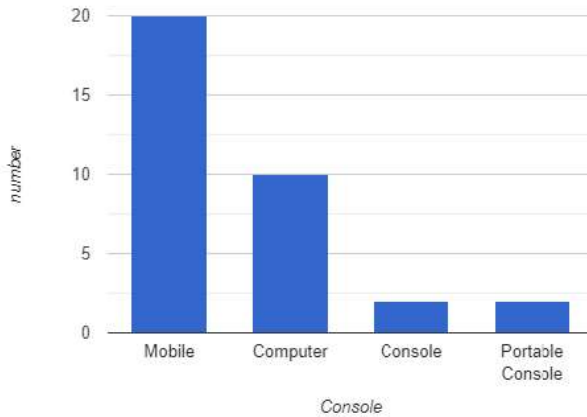


Fig. 2. The gaming consoles that players typically use

A. Evaluation

Our sample includes 34 participants, and due to sample size and significance, we focused on investigating MBTI letters separately, which had more people in them and their complement. For example, we try to find rules for the T-F of players. Also, we use Keirsey Temperament Sorter's four main groups (temperaments).

In this game, we have many different puzzle levels. Main puzzles have simple rules like:

- Swapping the place of elements of groups
- Finding a path in a graph with special rules
- Reaching the goal by moving obstacles to build a path through the goal

Each above level has three or more sub-levels in the easy-to-hard order. Before starting each main level, we asked players to choose between seeing the tutorial or skipping to the game and learning in practice.

Also, some bounce quizzes exist in order to help people win challenging levels without solving the primary quest. Another way of going to the next quiz is surrounding when the time is finished.

We extract the number of happening things from logs and then import the data to the IBM SPSS software to use an independent sample t-test to find significance between means with a ninety-five percent confidence interval.

For this paper, we introduced some indicators, and with those indicators, we try to find a correlation with personality elements. These indicators are:

- Seeing the tutorial or skipping it.
- The number of moves to solving a puzzle and finding tricks.
- The number of tries to solve bounces or wrong answers.
- The number of solved bounces (or side quests).
- The number of pauses and continues.
- Skip level with bounce execution.
- The number of surrounding
- Surfing on menus and seeing bounces

III. RESULTS AND FINDINGS

One of the factors mentioned in the last section is the number of moves to solve a puzzle. This factor can show the capability of people to find an answer to a puzzle or have a plan for movements with careful previous thinking.

Log data revealed that players with J rather than P had fewer moves to win; It is significant in the touring puzzle by 0.004 and other puzzles by 0.038. Also, Having SJ, or in the interpretation of Keirsey Temperament Sorter, which calls them the Guardians, had fewer moves with the 0.03 significance level than others who did not have these letters in their personality. Furthermore, the SPs made more moves with a significance of 0.016.

In a closer look at the psychological aspect of the above paragraph, Js are supposed to be good at planning things and task-oriented [20], so it seems they had planned before they started their moves. Because of that, they could pay less penalty to achieve the solution.

In the KTS, SJs are believed to be serious in their tasks that they are in charge of, well-disciplined, and try to respect the law. In this game, we showed the expected time to solve and the minimum number of moves a person can do optimally, so they tended to do these puzzles with fewer moves to fulfill the rules.

SPs are impulsive and tend to be good at arts but not at solving puzzles. Moreover, they need to be free and resist being

ted, bound, confined, or obligated. Also, it is common for them not to think about the results of their work and take it easy; because of that, it can be meaningful if they move more and then backtrack to another way and have more moves and penalties.

Executing bounce had a weak correlation with being I, which its p-value is 0.046. Moreover, Pausing or quiet and then resuming the game for Extraversion were more than Introversion with a p-value of 0.034. It might be because when Is faced a problem, they were not getting help from others and tended to surrender or execute bounce, which is more than Es but not significant, and Es try to stop finding Ideas or get help from others. Also, Players in the SP cluster used pause more than people out of this cluster, which is statistically significant with 0.002.

Going to the bounce menu was also significant for people with S. The p-value is 0.046. additionally, they executed more bounce to jump to the next level, though it was not significant.

Solving bounce For Ss, with a p-value of 0.03, And T, with a p-value of 0.012, were more than other groups. Ts were good at solving bounces though they also had failed answers more than Fs, which is not significant.

People with Ss in their personalities are good at focusing and remembering details. Furthermore, they try solving problems through facts and keep working hard until they find the answer [20]; because the bounces are kinds of mathematical problems or could be reduced to them, these people showed the excellent capability to solve them.

People with T in their personality type are extremely logical and can tackle problems by challenging logic. In addition, they are task-oriented [20]. All in all, they show more diligence in solving main levels and bounces as side quests well.

In contrast to T, the players with J had fewer wrong answers until solving a bounce, which had a significant result with a p-value of 0.007. It seemed they chose to answer what they knew rather than struggling with problems they did not know based on logs.

SPs also had More fail-to-solve bounces with a p-value of 0,012; like T, they had more solves, but it was not statistically meaningful for SPs.

NTs solved bounces less than other groups, which was significant with 0.044; they did better in winning the main levels with a p-value of 0.037. In the KTS, NTs believed to be Master of mind, Inventors, and Architects. The main level's puzzles are about finding a path, and the Nt's characteristics help them conquer that kind of problem without solving the side quests, which we call bounces, to skip the levels.

In the case of reading the tutorial before the game, SJs with a p-value of 0.026 and SPs with 0.043 were reading it more often than other groups and preferred to start the game when they knew it better in this research.

Another thing that is good to be mentioned, the hours of playing games per week for Ts are less than the players with Fs,

with a p-value of 0.021. It was because the T cluster is task-oriented and tends to do other things rather than work unless their work is finished, and reality and real word facts are more important than fantasy to them [20]; so, they may play video games less because of these reasons.

Some indicators did not have significant results; for example, surrounding and surfing on menus and seeing bounces had near significance in some cases but did not become meaningful.

To sum up, for this part, we show statistically significant findings in Table V briefly.

IV.CONCLUSION

In this paper, we represented the game's capability to determine the personality features of players. Also, our goal was to demonstrate that games can be an excellent replacement for paper-based classical interviews because that method prevents people from becoming bored compared to answering long item personality tests. Also, they do it subconsciously without knowing the acceptable answer, so they show their true preferences and behaviors.

For this research, we had 34 players aged 23 to 50 who took the 87-item MBTI test, and we compared the answers with the game logs which had been sent at the end of the game.

The results of an investigation in our game logs were completely hopeful and demonstrated the correlation between

TABLE V. STATISTICALLY SIGNIFICANT FINDINGS

Indicators	Finding	P-value
E	More pausing/quitting	0.034
I	More executing bounces	0.046
S	More going to bouncing menu More solving bounces quiz	0.046 0.03
N	–	–
T	More solving bounces quiz Less playing game hour per week generally	0.012 0.021
F	–	–
J	Less number of moves Less failing to solve bounces quiz	0.004/0.038 0.007
P	–	–
SP	More pausing/quitting More moving to solve the main game More failing to solve bounces quiz More reading tutorials	0.016 0.002 0.012 0.043
SJ	Less number of moves More reading tutorials	0.03 0.026
NF	–	–
NT	Less solving bounces quiz More winning in the main game	0.044 0.037

the game and personalities exist. With more investment in more complex games and long-term examination, traditional ways of personality assessment can be replaced.

V. LIMITATIONS AND FUTURE WORKS

The game we developed for this paper can be played for 40 minutes to 3 hours based on the player's tendency to struggle with problems or surrender. If we can have a game with more extended gameplay, we can see each personality play the game at what time of the day and where they prefer to play.

Also, it is good to have other genres, like Shooter, Memorial puzzles, Strategic games, and Role play to see how different people choose between available scenarios. However, online games are harder to develop and interpret though it is good to test them and see players' competition and cooperation too.

As another limitation, having a well-designed game that does not have age, culture, or gender bias is problematic. For example, male players are thought to do better in Shooter games. For a good and universal personality test game, we need to consider this and find a solution for a general game that can cover most people with concentrated and more research in this area with a bigger team and years of study. Also, it needs to be tested in the long term to avoid biases in power and ways of playing the levels we can see in most commercial games from famous companies.

The sample size also needs to be bigger for further and more accurate investigation. For instance, if the sample size becomes bigger, we could also speak about the main sixteen personalities, which is not in our research and other mentioned works.

One of the problems in most papers in this area is that their suggestion for personality symbols and game elements in their game cannot be generalized to all games and give other researchers a manual or instruction to continue their way. Meanwhile, this problem does not exist in classical question-based personality tests.

For future works, we tend to have different genres and work on the game's result in more practical questions like helping team formation, recruitment, job selection, and self or work improvement based on player behavior.

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