Feedback and Scenario Adaptation of Serious Games for Job Interview Training

Nadia Hocine[1,2]

[1]*Department of Mathematics and Informatics, University of Abdelhamid Ibn Badis of Mostaganem, Mostaganem, Algeria*
[2] *Laboratory of Computer Science and New Technologies, Mostaganem, Algeria*

Abstract: Serious games for job interview are promising tools for training social skills of individuals. They can help job seekers to learn skills that may need during their interviews and to cope with stressful situations. Serious games have been used by organizations to increase the applicants' engagement, to foster the recruitment process by proposing various automatic test scenarios and to predict the applicants' job performance. However, most existing games did not considered the applicants' personality and stress level to adapt the game experience. In fact, the personalization of the game can help to increase the applicants' engagement and their training performance, which may enhance the recruitment process. In this paper, we suggest an adaptive serious game for training social skills in job interview. We conducted an experiment with young job seekers. The results of the experiment show that the game helped the participants to be more prepared to job interviews. Moreover, the behavior of the virtual character has influenced the performance and the perception of stress. In particular, subjects with low score of Conscientiousness and with high score of Neuroticism were more influenced by stressful situations. These results may open up further research perspectives related to the use of serious games to evaluate the stress level of individuals and personalize the training to their needs.

Keywords: Serious games, Job Interview, Adaptation , Personality

1. INTRODUCTION

The process of training and preparing young adults for job recruitment has a significant impact on society growth [1]. It aims to foster the integration of young adults in various organizations that may have different methodologies to yield and retain the skilled resources. Most organizations rely on traditional methodologies on the basis of resumes, tests and formal interviews that can be time consuming especially when various constraints should be satisfied. They also often have difficulties in managing recruitment process with a large number of applicants who are not all suitable for the organizations' need of employment. In fact, job seekers who experiment their first formal job interview can be unaware about the nature of jobs that meet their expectations as well as the culture of the organization [2]. Therefore, using self-managed automated techniques can help the organizations in training and requirement process while reducing human intervention and satisfying the current needs of recruitment [3].

Serious games, or video games for purpose, have been emerged as a promising approach to engage and train job seekers and employees. They aim to make the interviews more engaging and fruitful by simulating various scenarios in order to select the most appropriate applicants to job offers. A Serious game can be used to train job seekers, to evaluate their skills and to predict their job performance [4] [5]. In addition, young job seekers can have difficulties in job interviews because of their reaction to stressors that may influence their performance to meet some jobs' requirements. Stress can manifest through various psychological and physiological responses among individuals [6]. Serious games may be therefore helpful to train applicants how to cope with stressful simulation and train their social skills. I can provide applicants with personalized training without the risk of real failure.

Different works suggested serious games for job interview and employees' training. Serious games were often used to motivate users as well to help them learn skills that may need during their job [7] [8] [9]. However, most works did not considered users' personality to examine their stress level and to adapt the training experience. For instance in [10] authors examined only the effect of the virtual interviewers' personality on players to enhance the realism of the simulation. The personality of the user was not considered to adapt the training experience. In [11], the study concerned the influence of the user's personality on the perception of the virtual interviewer. To the best of our knowledge, there are no works that have focused on

E-mail address: nadia.hocine@univ-mosta.dz

the adaptation of the game to the level of stress of job seekers on the basis of their interaction with a game and their personality.

In fact, young adults can have different responses to stressors that can be explained by various biological reactions as well as personality traits that may influence the individual's perception of the environment [12] [13]. The personality provides an important indicator about how the applicant will behave in some situations and therefore his/her ability to meet some jobs' requirements. For instance, many studies found that some constructs such as hardiness, self-efficacy and optimism can explain positive appraisal and effective coping [14]. Learning how to control his/her emotions and skills in challenging environments and situations can help young adults to be more aware about the asked job and to regulate their behaviors.

In this paper, we suggest "My Interview", an adaptive serious game for job interview training. It aims to support the job seekers to answer the interviewer's questions and to learn how to cope with stressful situations through adaptive feedbacks. We also investigated the data set of the experiment with young job seekers to generate rules that we used to adapt the game scenario on the basis of the player's personality traits. The objective of the game adaptation is to enhance the job seeker's performance and engagement.

The rest of the paper is organized as follows: First, we review related works on serious games for job interview training and stress management. Then, we present in Section 3 My Interview game. Section 4 explains the proposed feedback and scenario adaptation techniques. In Section 5, we present the experimental method we followed to evaluate the playability of the proposed game and the effect of feedback adaptation on players' perceived stress and preparation for interviews. Then, we present some sample results of the experiment. Finally, Section 8 discusses our conclusions and plans for future work.

2. Related Works

Serious games and technology-enhanced learning systems that involve virtual agents have been the focus of various studies in the recent years. In particular, different works were interested in making the training simulation more realistic, increase the trainees' learning performance and to help trainees to cope with stressful situations [7] [8] [9].

For instance, in [15] TRADIS framework that is a scenario-based serious game for job interview training was proposed. The game detects player's emotions, voice and facial expressions to adapt the virtual agent dialogue and behaviors. The player's personality traits and stress level were not considered to adapt the virtual agent.

A role-based serious game for job interviews was suggested in [10]. A virtual agent is used to help players to develop their social skills through a simulated scenario of

interviews and dialogues. They conducted various experiments to study the effect of game attributes, agent's gestures and feedback on player's emotional reactions. However, the game was not adapted to players' level of stress and personality traits.

Other works focused on a virtual interviewer to interact with a player through text-based conversations. In Reference [11], the game relies on text analysis to infer the user's personality. The authors studied the effect of interviewers' personality on user's confidence and listing. They conducted a study in which job applicants perform interviews with two virtual interviewers with two different personalities. They found that the user's personality influenced his/her perception of the virtual interviewer. However, the proposed game did not considered the adaptation of the virtual character to players' personality and stress levels.

The previous reviewed serious games for job interview training did not consider the trainees' personality traits and reaction to stressful situations to adapt the game experience. In fact, reaction to stressors may be different among trainees and depends on the perception of the environment. Learning how to control his/her emotions and skills in challenging environments and situations can help young adults to regulate their behaviors and increase their job interview performance.

Helping users to learn how to cope with stressful situations and control their emotions and skills has been the subject of many studies, especially in health and education contexts [16] [17] [18]. However, only few works were proposed for job interview training. For instance, biofeedback was investigated to help players to cope with stress [19]. Cardiovascular response of the heart rate variability was used by a virtual agent playing the role of a biofeedback trainer. This training method requires the use of specific sensors and devices, with can in turn limit it use for general public. Moreover, the serious game focuses only on biofeedback to determine the stress level without taking into consideration the personality of the player and his/her perception of stress and progression.

In this paper, we suggest an adaptive serious game for job interview training. Our research question is how to adapt the game according to players' personality traits and level of stress in order to increase their performance and engagement? First, we suggest a game adaptation technique based on feedbacks through the adjustment of a virtual recruiter's behaviors. The behavior of the virtual recruiter is adapted to influence the player's perception of stress and increase job interview performance. Second, to adapt the game scenario, we focused on multi-objective fuzzy classifier using a data set of the experiment that we conducted with young job seekers. The scenario adaptation technique takes into account the player's personality traits and his/her performance to adapt the training scenario. Next, we describe the proposed game, the game adaptation
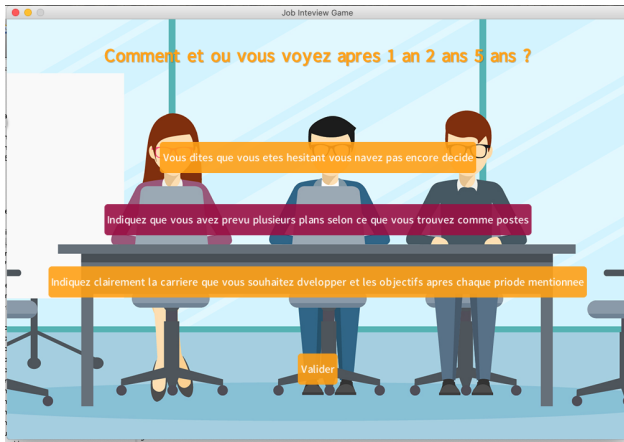
Figure 1. Example of a question-answering scene of My Interview game

technique and the experimental study.

3. MY INTERVIEW GAME

In this section we describe the internal knowledge representation of the My Interview game, the game architecture and game adaptation technique.

A. Knowledge representation

My Interview serious game seeks to help applicants to learn social skills that they need during their job interview. It aims to provide the applicants' with adaptive feedback in order to personalize their experience and increase consequently their performance and engagement. The game is based on questions' answering scenes, via quizzes, that are dynamically generated during the gameplay (see Figure 1) to ensure the variability of the content in the case of replay.

The learning content is structured though the following categories of questions:

- Personality: BFI-10 test, a 10-item short version of the Big Five Inventory [20], was included in the game to identify the applicant's personality.

- Motivation: A set of questions were proposed to find the most motivated applicant. This set of questions also determine how much the applicant is interested in the job position as well as the company.

- Experience: Even their resume shows the professional experience, it is essential to collect as much information as possible to determine whether applicants meet job requirements.

- Skills: This set of questions aims to determine applicants' skills and the mastery of certain tools.

- Job requirements: A set of questions that verify the mastery of the skills required for a specific job position proposed throught the game.
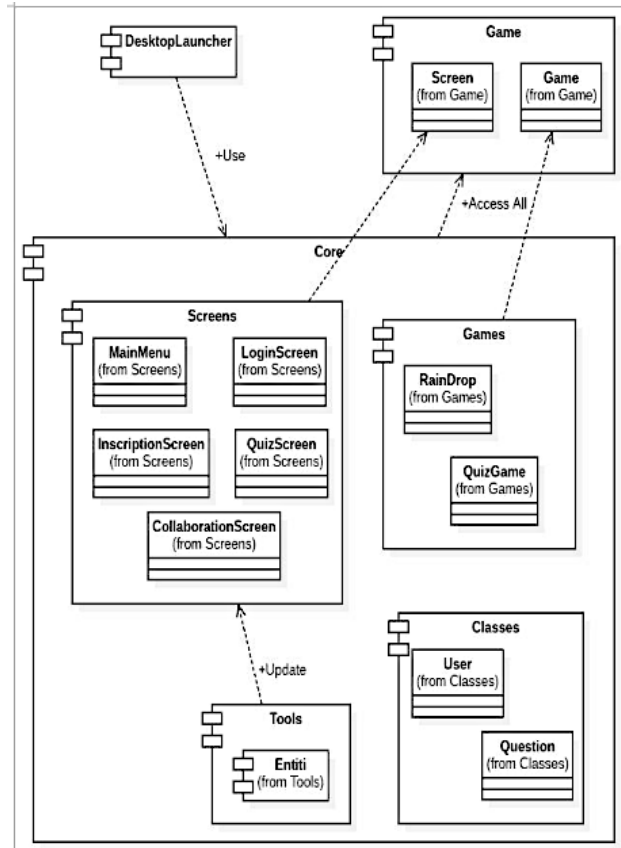

Figure 2. The internal architecture of My Interview game

B. Game architecture

The game structure is inspired from the classical theater principals as we proposed in [21] [22]. Following this model, the scenario is composed of a set of acts associated to the scenario sub-goals. An act can be characterized by its place and time period in the story or the game. Acts may also be divided into scenes; in classical theater each regrouping between entrances and exits of actors is a scene, it describes a change of settings. In a game context, the scene can involve specific characters and or human players with a specific role that cannot be changed during a scene.

The game architecture consists of scenes (or Screens) and acts (or Games) a set of mini-games. As shown in Figure 2, the main components of My Interview Game are:

- Model (or Classes): It consists of users' profiles as well as the learning content that is structured through a set of questions' categories as described in the previous section.

- Games: In this component, we find all mini-games of My Interview game that can be suggested to a player. For instance, QuizGame is a mini-game that focuses on auto-generated question-answering scenes. Other mini-games are used to create an enjoyable

Figure 3. Virtual assistant in My Interview game

Figure 4. Non-verbal gestures of the virtual recruiter in the game

game experience by allowing social interaction. For instance, in Raindrop mini-game, the player tries to collect missing pieces and find right answers before the adversaries. The objective of a player is to increase his or her score to get the opportunity to pass an interview. This may help improving the players' engagement and promote social interaction.

- Screens: Each mini-game is composed of a set of screens. Screens are used different mini-games such as: home screen (called MainMenu) and login screen (LoginScreen). Interview screens suggest questions (QuizScreen). In fact, in My Interview game, the content is related to a training purpose following question-answering scenes. The player is asked to pass the interview by answering a set of questions to improve his or her score. Each correct answer added points to the score and incorrect answers does not decrease it. Finally, in collaborative screens (CollaborationScreen), the player is asked to complete collaborative and competitive tasks such as finding missing pieces before adversaries in RainDrop mini-game.

- Tools: This component aims to adapt the game experience. It includes all game entities and generated rules used to adjust the game feedbacks and scenario. Next, we describe the adaptation technique used in My Interview game.

4. game Adaptation

We present in this section our proposed feedback and scenario adaptation techniques of My Interview game.

A. Game adaptation based on feedbacks

The game includes virtual agents who play two roles: the assistant and the recruiter.

The assistant is a non-player character who guides the player and help him or her to progress in the game scenario

(see Figure 3). The player has to unlock the levels and obtain sufficient points to progress in the scenario. He or she obtains feedback about his or her progression during the gameplay. The objective is to improve players' ability to cope with stressful situations in job interviews.

The virtual recruiter appears only during the interview with the aim of involving the player in various scenarios to simulate the reality. Figure 4 shows the different non-verbal gestures of the virtual recruiter. The virtual agent aims to emulate mimicry, gestures and social relationships of recruiters. Moreover, through verbal and non-verbal behaviors, the virtual recruiter provides also the player with feedback following his or her actions and answers to questions.

Two strategies of feedback adaptation are proposed in this game:

The first strategy is based on quiz scenes and did not include explicit stressful situations. The feedback is adapted following the player's actions and answers to questions. The objective is only to encourage the player to continue the interview. Following this strategy, the virtual recruiter emulates only neutral or happy gestures.

In the second strategy of feedback adaptation, scenes with stressful situations include elements that may cause stress (see for instance Figure 5). The objective is to help the players to self-evaluate their reactions and to cope with stress in order to increase their performance. For instance, the following scenes with stressful situations are involved in the game:

- The recruiter stops the interview and leaves the room. The player continues, after that, his or her interview.

- A second recruiter enters to the room, laughs and asks the player to leave for a moment. This recruiter asks then the player whether he or she wants to return to complete the interview.

Figure 5. Example of scene with a stressful situation

TABLE I. Fuzzy rules. Extraversion (E), Agreeableness (A), Consciousness (C), Neuroticism (N), Openness (O), Performance (P), high (++), moderately high (+), medium (.), moderately low (-), low (−)

Rules	E	A	C	N	O	P	Stressful scenario
(1)	-	++	+	-	++	-	Yes
(2)	−	−	−	++	.	-	Yes
(3)	++	++	+	-	−	+	Yes
(4)	++	++	-	+	.	-	Yes
(5)	.	++	++	-	-	.	Yes
(6)	.	++	+	+	-	+	Yes
(7)	++	++	+	+	−	+	No
(8)	++	++	.	−	−	.	No
(9)	++	++	++	+	++	−	No
(10)	++	+	−	−	.	+	No
(11)	++	++	.	+	++	+	No
(12)	++	++	.	+	.	.	No

- The second recruiter arrives and announces that the player will not necessarily be selected for the position or the internship, and leaves. The player can continue, after that, his or her interview.

When the player starts his or her first training session, he or she is provided with a game scenario with the first feedback strategy. Then, when he or she progresses in the game levels, the second strategy of feedback adaptation is selected for him or her. The objective of feedback adaptation is to help the player to learn how to cope with stressful situations while increasing his or her performance.

B. Fuzzy rules based scenario adaptation

Feedback adaptation may be limited as it did not consider the player's personality and stress level to adapt the game experience. Therefore, we suggest a game scenario adaptation technique based on an evolutionary fuzzy system. In particular, fuzzy rules are used to make decision on the game content on the basis of the personality traits of an applicant. Following a deductive approach, rules allow more transparency and interpretability of decisions. Job recruiters and experts can easily inspect the rules and understand the system's behavior. This may facilitate the human intervention to improve rules and validate the reliability of the system. It can also help in the acceptability of the serious game as a training tool and as a decision support system.

1) Fuzzy rule-based systems

Fuzzy logic has been successfully applied to different problems in various domains in which the decision depends on uncertain variables. It has been commonly used in decision support systems by focusing on fuzzy rules. These systems are called Fuzzy rule-based systems (FRBSs). They focus on if-then rules in which fuzzy logic represent the knowledge through a combination of a set of variables.

FRBS have been investigated in a wide range of problems, especially for Fuzzy classification. The latter is used to learn from data sets of past experiences in order to predict knowledge and generate automatically rules [23]. Different approaches were based on evolutionary computation [24], called evolutionary fuzzy systems [25] to generate rules. These systems meld the approximate reasoning of fuzzy systems with the capability of evolutionary algorithms as they can be robust in optimization, learning, classification and adaptation problems [24] [26]. To find accurate solutions while ensuring the interpretability of the fuzzy model [27], many research works were focused on multi-objective evolutionary algorithms (MOEAs) [28]. MOEAs are used to find optimal solutions to problems that include multiple performance criteria.

2) Scenario adaptation based on generated fuzzy rules

To adapt the game scenario, we focused on a MOEA to classify users' stress level according to their profiles, especially their personality traits and past performance in the game. We identified two classes of categorized data: stressful scenario and no stressful scenario. In fact, using personality traits data and the performance of the player in the past game level, we determine his or her scenario stress level to make decision about the future training objectives. The rules generated are consequently used to generate the next game level that is personalized to the applicant.

The fuzzy classifier model can be described as fellows:

Let consider $D = \{d_1, d_2, ..., d_n\}$ a data set of n inputs where $d_i = (\vec{x}_i, \vec{y}_i, \vec{w}_i)$, $i = 1...n$.

$\vec{x}_i = (x_1^i, x_2^i, ..., x_p^i)$ a vector of real input attributes where $x_j^i \in \left[l_j, u_j\right] \in \mathbb{R}$, $j = 1...p, p \geq 0$ and l_j and u_j are the minimum and maximum values for the real input attribute j. It represents the values of personality traits of the player as well as the score of the current level of the game.

$\vec{y}_i = (y_1^i, y_2^i, ..., y_q^i)$ a vector of integer for the categorized attributes where $y_j^i \in \left\{1, ..., v_j\right\}$, $j = 1...q, q \geq 0, v_j > 1$ is the

number of classes for the categorized input attribute j.

$w_i \in \{1...z\}$ is a value for the categorized output attribute where $z > 1$ is its number of classes. It represents how the player has probably found the level: stressful or not stressful.

The fuzzy classifier τ formed as an output a set of fuzzy rules $R = \{r_1, r_2, ..., r_m\}$ where $m \geq 1$. A fuzzy rule $r_i, i = 1...m$ consists of p fuzzy sets A_i where $i = 1...p$ associated to a data set D.

Each fuzzy set can be described by a membership function :

$$\mu_{A_i}(x_i) = exp\left(-\frac{1}{2}\left(\frac{x_i - a_i}{\sigma_i}\right)^2\right)$$

where $a_i \in \Re$ is the center and σ_i is the variance. The set of membership functions $\mu_{A_i}(x_i) : X_i \to [0, 1]$ is called the data base [25].

We used the multi-objective evolutionary fuzzy classifier on experiment data set . Table 1 summarizes a sample of the obtained rules.

The scenario adaptation technique consists therefore in using the automatic generated rules to make decision about the next level in the game. The scenario is updated by involving default scenes or scenes with stressful situations according to the previous level of the player. In particular, the scenes with stressful situations are involved in the game scenario only when the previous level of the player was predicted as not stressful for the player. This may help players to cope with stressful situations and improve consequently their performance.

5. METHOD

We conducted an experimental study with young job seekers to investigate the effect of feedback adaptation on their preparation for a job interview. We were interested only by the effect of feedback adaptation regarding subjects' personality traits. We studied whether the applicant's personality traits influence his or her perception of stress and performance using My Interview game.

A. Participants

A total of 41 job seekers (>18 years, 63% men) were recruited in the study (aged 22.36 ± 1.93 years). The study protocol was executed at the Mathematics and Informatics Department at University of Mostaganem, Algeria. Each participant played the game using a laptop (see Figure 6). The total game session duration was approximately 20 minutes. They all followed the same experimental protocol and responded to the same questionnaire.

B. Procedure

We followed the same procedure to evaluate all subjects. At the beginning of the experiment, we only explain to the player that this is an interview preparation system with

Figure 6. A participant playing My Interview game

general questions. We also explained that he or she will answer additionally a questionnaire, not included in the game, at different steps of the experiment (before playing, at the end of the first gameplay and at the end of the second gameplay). Then, the subject plays the game. He or she first answers the personality questionnaire when registering. After that, the subject answers a set of questions of the interview to increase his or her score. At the end of the interview, the subject obtains a score as well as feedback about his or her experience.

We divided randomly the subjects into two groups:

- Group 1: Subjects play My Interview Game with the first strategy of feedback adaptation. Following this strategy, the virtual recruiter appears when answering questions with various non-verbal gestures (explanation, neutral, happy, etc). However, the virtual recruiter did not give direct feedback on answers. Only in the case of three successive wrong answers, he appears with a reaction of dissatisfaction.

- Group 2: Subjects of this group play under the similar conditions as Group 1, except that the feedback is adapted following the second strategy described in Section 4.A. The game scenario in this case involves a scene with stressful situation. In fact, we are interested in studying the effect of nonverbal behavior of the virtual recruiter [29] on the player's perception of stress and performance.

C. Measures and statistical analysis

The following measures were considered in the study:

1) Preparation for the interview

We asked each participant whether he or she is prepared for an interview using a 7-item likert-type scale (1: not at
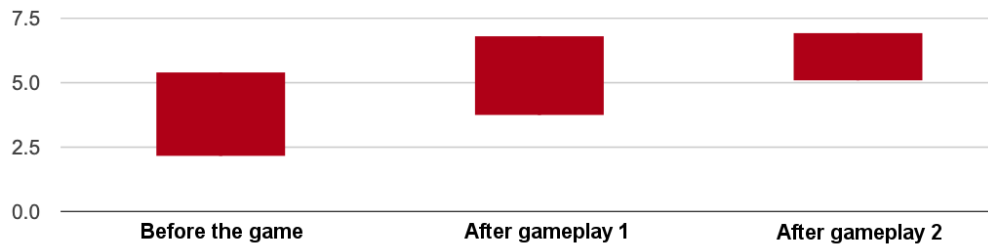
Figure 7. Perceived preparation of the interview of all subjects

all, 2: slightly, 3: moderately, 4: fairly, 5: considerably, 6: perfectly and 7: extremely). This question was asked before playing the game, at the end of the first interview gameplay as well as at the end of the second interview gameplay. The objective was to study the effect of the game-based training on the subjects' perception of preparation for the interview.

2) Perceived stress

Stress assessment has been performed in the literature by means of various questionnaires such as perceived stress scale [30] and job stress [31]. It consists in asking whether a certain situation or relationship is a source of stress. In this experiment, we only asked each participant his or her general perception of stress when participating to the next interview with a simple 7-item scale (1: not at all, 2: slightly, 3: moderately, 4: fairly, 5: considerably, 6: perfectly and 7: extremely). This question was asked before playing the game, at the end of the first interview gameplay and at the end of the second interview gameplay. The objective was to study the effect of the game-based training on the subjects' perception of stress.

3) Performance

To evaluate the effect of the game on participants' performance, we recorded the scores of the two gamplays (i.e. two interviews). The score represents the number of correct answers to interview questions.

4) Personality traits

We recorded the measures of BFI-10, a short version of the Big Five Inventory [20] that is included in the game. Five scores were computed for the following personality traits [32]:

- Openness to experience: which describes people who are creative, curious, imaginative, disconnection of norms and conventional values and intense experiences of emotions.

- Conscientiousness: is related to organization, control and self-motivation to achieve goals. High scores refer to people who are persistent, punctual, ambitious and persevering.

- Extraversion: which determines the volume of interpersonal interactions. People with high score of Extraversion are sociable, active and affectionate.

They may also be considered dominant, self-confident and require much stimulation.

- Agreeableness: is related to interpersonal relations, with a strong aspect of compassion. People with high score of Agreeableness are kind, generous, highly empathetic, helpful and relying heavily on others.

- Neuroticism: is linked to the chronic of emotional adjustment and psychological sufferings. People with high Neuroticism have low tolerance for frustration, feelings of anxiety, hostility and vulnerability.

All statistical analyses were performed with a significance threshold of $p < 0.05$. We ran an analysis of variance (ANOVA) with repeated measures to investigate the differences on the preparation for the interview. We also analyzed mean differences on the other measures using t-test and repeated-measures t-test. The normality of the distribution was assessed with the Kolmogorov-Smirnov test.

6. RESULTS

We analyzed the effect of the serious game on the interview training perception. In particular, using a Likert-type scale, we asked all subjects about their perception of preparation for the interview before playing the game, at the end of the first gameplay and at the end of the second gameplay.

We have found significant differences in the perception of preparation for the interview. $DF\_n = 2$, $F = 16.28$, $p = 0.020$, $SS = 67.57$, $MS = 33.78$. The game has positively influenced the preparation for the interview for all subjects despite their group (see Figure 7).

The difference between Group 1 and Group 2 was significant in terms of perception of stress, $t(40) = -4.34$. The value of p is .00484, The result is significant at $p < .05$.

We also analyzed the performance of the players in job interview. The difference between the scores of two successive gameplays was significant only in Group 2. The performance of the players has been negatively influenced by the behavior of the virtual character (virtual recruiter). Figure 8 represents the box-plot diagram that show the difference between the scores.
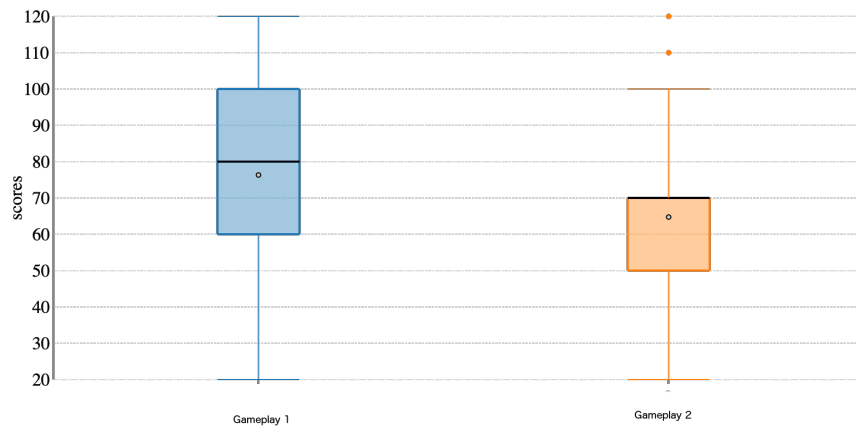
Figure 8. Box-plot diagram showing the difference of scores

Moreover, we examined whether personality traits may influence the players' perception of stress at the end of the first gameplay. Subjects of Group 2 with low score of Conscientiousness and those with high score of Neuroticism were more influenced by the behavior of the virtual character. The perception of stress were significantly different $t(11) = -2.35$, $p - value = .0117$ and $t(7) = -4.34$, $p - value = .0048$ respectively.

7. DISCUSSION

Serious games have been emerged as a promising approach to motivate trainees, prepare them for their job interviews and learn them how to cope with stressful situations [7] [10] [11]. However, to the best of our knowledge, there are no works that have focused on the adaptation of the game to the level of stress of job seekers on the basis of quantitative measures of their interaction with the game elements and their personality. Only some recent studies have suggested biofeedback to adapt the training experience [10] and to evaluate stress level [19]. However, these works have not considered users' actions as well as their personality traits to adapt the game [10] [19]. Moreover, we believe that using high cost solutions on the basis of technology-enhanced techniques may influence the usability and accessibility of the game for a large public.

Personality traits may influence the individual's perception of the environment and perceived stress [12] [13]. Adapting the game following users' behaviors and personality traits may enhance their engagement and their training performance on one hand. On the other hand, using quantitative measures to evaluate stress level and adapt the game may help in enhancing its usability and accessibility for a large public.

In this paper, we suggested a serious game for job interview training that seeks to support young job seekers to answer the interviewer's questions as well as to control their behaviors and actions especially in challenging situations. We suggested two strategies to adapt the game feedback.

The first strategy is based on encouraging applicant to progress in their interview. In the second strategy, the behavior of the virtual recruiter is adapted in order to involve more stressful situations in the game. We also proposed a scenario adaptation technique that considers player's personality to adapt the learning experience. We focused on a multi-objective evolutionary fuzzy classifier to generate rules. The objective is to enhance the engagement and the performance of job seekers in their job interview.

We conducted a primary experimental study to evaluate the effect of feedback adaptation of the serious game on users' interview preparation, performance as well as stress perception. The objective is also to initiate game rules used for scenario adaptation. We divided the subjects into two groups: Group 1 subjects were provided with the game with the first strategy of feedback adaptation. As for Group 2, subjects played the game that involved additionally a scene containing elements that may cause stress through a set of verbal and nonverbal behaviors of the virtual recruiter.

The results of the experiment showed that the proposed game has positively influenced the preparation for the interview. The players found the game helpful to train their skills and they were all engaged in the training session. We also find that the behavior of the virtual recruiter has influenced the players' perception of stress and their performance. Moreover, we analyzed data of Group 2 to investigate the relationship between the perception of stress and the personality traits in Group 2. Subjects with low score of Conscientiousness and with high score of Neuroticism were more influenced by the behavior of the virtual characters. The behavior of the virtual character influenced individuals who have less control and self-motivation skills as well as individuals with low tolerance for frustration and feelings of anxiety.

The results of this experiment show that the individual's personality may influence the perception of stressful situations in job interview. Players can have different needs

in terms of training to cope with stress. The results of this experiment are promising and may open up further research perspectives related to the use of serious games traces to evaluate the stress level of individuals and personalize the training to their needs.

8. CONCLUSION

In this paper, we have presented My Interview, an adaptive serious game for job interview training. We suggested a feedback and scenario adaptation of the game that considers applicants' level of stress and personality to adapt consequently the game level. The results of the experimental study show that game helps applicants to be prepared for the interview. We also find that applicants' personality traits may influence their perception of stress.

In this experiment, the light was shed on feedback adaptation and its effect on users' performance and preparation for an interview. We have not considered the effect of scenario adaptation as all rules were similar to players in the experimental protocol. In our future works, we plan to evaluate how scenario adaptation can influence the subjects' training performance in long-term. We will also evaluate how social interaction between players may influence their perception of stress and performance. Finally, we will investigate the acceptability of the serious game as a recruiting tool for enterprises.

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REFERENCES

[1] M. Jawaad, A. Amir, A. Bashir, and T. Hasan, "Human resource practices and organizational commitment: The mediating role of job satisfaction in emerging economy," *Cogent Business & Management*, vol. 6, no. 1, p. 1608668, 2019.

[2] S. Laumer, A. Eckhardt, and T. Weitzel, "Online gaming to find a new job–examining job seekers' intention to use serious games as a self-assessment tool," *German Journal of Human Resource Management*, vol. 26, no. 3, pp. 218–240, 2012.

[3] S. Mishra and S. P. Kumar, "E-recruitment and training comprehensiveness: untapped antecedents of employer branding," *Industrial and commercial training*, 2019.

[4] M. B. Armstrong, R. N. Landers, and A. B. Collmus, "Gamifying recruitment, selection, training, and performance management: Game-thinking in human resource management," in *Emerging research and trends in gamification*. IGI Global, 2016, pp. 140–165.

[5] M. Fetzer, J. McNamara, and J. L. Geimer, "Gamification, serious games and personnel selection," *Pulakos, J. Passmore, & C. Semedo (Eds.), The Wiley Blackwell handbook of the psychology of recruitment, selection and employee retention*, pp. 293–309, 2017.

[6] T. H. Holmes, "Life situations, emotions, and disease," *Psychosomatics*, vol. 19, no. 12, pp. 747–754, 1978.

[7] A. T. Ferreira, A. M. Araújo, S. Fernandes, and I. C. Miguel, "Gamification in the workplace: A systematic literature review," in *World conference on information systems and technologies*. Springer, 2017, pp. 283–292.

[8] M. Hernández and J. Moreno, "A systematic literature review on organizational training using game-based learning," in *Iberoamerican Workshop on Human-Computer Interaction*. Springer, 2018, pp. 1–18.

[9] I. Obaid, M. S. Farooq, and A. Abid, "Gamification for recruitment and job training: Model, taxonomy, and challenges," *IEEE Access*, vol. 8, pp. 65 164–65 178, 2020.

[10] P. Gebhard, T. Schneeberger, E. André, T. Baur, I. Damian, G. Mehlmann, C. König, and M. Langer, "Serious games for training social skills in job interviews," *IEEE Transactions on Games*, vol. 11, no. 4, pp. 340–351, 2019.

[11] J. Li, M. X. Zhou, H. Yang, and G. Mark, "Confiding in and listening to virtual agents: The effect of personality," in *Proceedings of the 22nd International Conference on Intelligent User Interfaces*, 2017, pp. 275–286.

[12] A. Bibbey, D. Carroll, T. J. Roseboom, A. C. Phillips, and S. R. de Rooij, "Personality and physiological reactions to acute psychological stress," *International journal of psychophysiology*, vol. 90, no. 1, pp. 28–36, 2013.

[13] J. Kallio, E. Vildjiounaite, J. Koivusaari, P. Räsänen, H. Similä, V. Kyllönen, S. Muuraiskangas, J. Ronkainen, J. Rehu, and K. Vehmas, "Assessment of perceived indoor environmental quality, stress and productivity based on environmental sensor data and personality categorization," *Building and Environment*, vol. 175, p. 106787, 2020.

[14] H. Afshar, H. R. Roohafza, A. H. Keshteli, M. Mazaheri, A. Feizi, and P. Adibi, "The association of personality traits and coping styles according to stress level," *Journal of research in medical sciences: the official journal of Isfahan University of Medical Sciences*, vol. 20, no. 4, p. 353, 2015.

[15] K. Anderson, E. André, T. Baur, S. Bernardini, M. Chollet, E. Chryssafidou, I. Damian, C. Ennis, A. Egges, P. Gebhard *et al.*, "The tardis framework: intelligent virtual agents for social coaching in job interviews," in *International Conference on Advances in Computer Entertainment Technology*. Springer, 2013, pp. 476–491.

[16] T. Bickmore, A. Gruber, and R. Picard, "Establishing the computer–patient working alliance in automated health behavior change interventions," *Patient education and counseling*, vol. 59, no. 1, pp. 21–30, 2005.

[17] Z. Zhang, H. Trinh, Q. Chen, and T. Bickmore, "Adapting a geriatrics health counseling virtual agent for the chinese culture," in *International Conference on Intelligent Virtual Agents*. Springer, 2015, pp. 275–278.

[18] M. Kavakli, M. Li, and T. Rudra, "Towards the development of a virtual counselor to tackle students' exam stress," *Journal of Integrated Design and Process Science*, vol. 16, no. 1, pp. 5–26, 2012.

[19] T. Schneeberger, N. Sauerwein, M. S. Anglet, and P. Gebhard, "Stress management training using biofeedback guided by social agents," in *26th International Conference on Intelligent User Interfaces*, 2021, pp. 564–574.

[20] B. Rammstedt and O. P. John, "Measuring personality in one minute or less: A 10-item short version of the big five inventory in english and german," *Journal of research in Personality*, vol. 41, no. 1, pp. 203–212, 2007.

[21] N. Hocine and A. Gouaich, "Difficulty and scenario adaptation: an approach to customize therapeutic games," in *Serious games for healthcare: Applications and implications*. IGI Global, 2013, pp. 107–134.

[22] N. Hocine, M. Ameur, and W. Ziani, "Keep attention: A personalized serious game for attention training." in *GamiLearn*, 2019.

[23] I. Gadaras and L. Mikhailov, "An interpretable fuzzy rule-based classification methodology for medical diagnosis," *Artificial intelligence in medicine*, vol. 47, no. 1, pp. 25–41, 2009.

[24] O. Cordón, F. Herrera, and P. Villar, "Generating the knowledge base of a fuzzy rule-based system by the genetic learning of the data base," *IEEE Transactions on fuzzy systems*, vol. 9, no. 4, pp. 667–674, 2001.

[25] F. Herrera, "Genetic fuzzy systems: Status, critical considerations and future directions," *International Journal of Computational Intelligence Research*, vol. 1, no. 1, pp. 59–67, 2005.

[26] A. F. Gómez-Skarmeta and F. Jiménez, "Fuzzy modeling with hybrid systems," *Fuzzy Sets and Systems*, vol. 104, no. 2, pp. 199–208, 1999.

[27] J. M. Alonso and L. Magdalena, "Special issue on interpretable fuzzy systems," 2011.

[28] C. A. C. Coello and G. B. Lamont, *Applications of multi-objective evolutionary algorithms*. World Scientific, 2004, vol. 1.

[29] A. N. Finnerty, S. Muralidhar, L. S. Nguyen, F. Pianesi, and D. Gatica-Perez, "Stressful first impressions in job interviews," in *Proceedings of the 18th ACM International Conference on Multimodal Interaction*, 2016, pp. 325–332.

[30] S. Cohen, T. Kamarck, and R. Mermelstein, "A global measure of perceived stress," *Journal of health and social behavior*, pp. 385–396, 1983.

[31] C. Cooper, "Stress in the workplace," *British journal of hospital medicine*, vol. 55, no. 9, pp. 559–563, 1996.

[32] T. A. Widiger and P. T. Costa Jr, *Personality disorders and the five-factor model of personality*. American Psychological Association, 2013.

Nadia Hocine is currently an associate professor at the University of Abdelhamid Ibn Badis of Mostaganem, department of Mathematics and Informatics, Algeria. She is also a member of Computer Science and New Technologies Laboratory. She received her Ph.D from University of Montpellier, LIRMM laboratory, France. Her current fields of interest include: system adaptation, serious games and user modeling.