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DESIGNING THE NON-PLAYER CHARACTER OF AN EDUCATIONAL ADVENTURE-GAME: THE ROLE OF PERSONALITY, NATURALISM, AND COLOR

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Abstract

The basic idea of game-based learning is the fusion of fun and learning by using the motivational potential of video games in the educational context. Thus, the design of an educational game should be adaptive not only to the learner's cognitive abilities, but also to the individual preferences of the player. Especially the design of the non-player character (NPC) that takes the role of a teacher by providing guidance, hints, and companionship seems of crucial importance.
The presented study addresses to three design question with respect to an optimal NPC-design, namely the NPC's personality as well as the role of naturalism and color. Based on media equation and related research several hypotheses were derived. Independent variables were the NPC's personality (funny & friendly vs. severe & unfriendly), color (black & white vs. colored design), and naturalism (naturalistic vs. comic-like appearance), resulting in a 2 x 2 x 2-design. By means of eight different NPC-versions the players had to rate and indicate which of the versions they prefer for an NPC that provides guidance and companionship in an educational adventure-game. Dependent measurements include the selection of the preferred NPC as well as an NPC-rating.
The results of the used χ^2-tests indicate a clear preference for a colored, naturalistic NPC-design. For the NPC's personality the pupils favor a personality that was similar to their own, indicating similarity-attraction. Further results and implications for the design of educational games will be discussed.

Keywords
Game-based learning, design, Non-Player Character (NPC), color, naturalism, personality, user preferences, adaptivity

1. INTRODUCTION AND THEORETICAL BACKGROUND

1.1 Designing an Educational Adventure-Game

Game-based learning aims at a more enjoyable form of education that combines the motivational potential of video games with the pedagogical impulses of e-learning. Accordingly, the design of an educational game has to address two different maxims. First, optimizing enjoyment, and second, optimizing learning. In this sense intrinsic motivation is the crucial melting point of the both maxims, since enjoyment is supposed to enhance motivation and motivation in turn should foster learning.
Thus, the design of an educational game and the game characters seems of essential importance. Especially, the so called non-player character (NPC) that guides the learner through the game is a core feature of an educational game. Accordingly, the NPC is an important source of intrinsic motivation by providing not only hints but also social support. When designing an NPC several questions arise, namely with respect to the NPC's personality-characteristics as well as with respect of the role of naturalism and color of the graphical appearance.

1.2 Media Equation Theory and Extensions

The theoretical background of the study is mainly the media equation theory [1]. The media equation theory states "media equal real life". People behave towards media in the same way as they behave towards the real world, i.e., they apply the same social and natural rules (of the real world) to media. For example, people ascribe personality to computers and apply politeness rules as well as gender stereotypes to media. It is worth noting, that reactions in the sense of the media equation theory are a *ubiquitous* phenomenon. Media equation theory applies not only to specific individuals but rather to every type of media user. The studies on media equation included experienced (even computer specialists) as well as inexperienced computer user as participants. Normally, the social and natural reactions towards media are *automatic and unconscious*, i.e., users deny behaving in a social way towards media. Reactions in the sense of ME are not an exceptional behavior; rather they are *wide spread* and were found with respect to *different media* (television, computers, pictures). Accordingly, media must not be very sophisticated; also very simple features (line drawings and even the color of a screen-coverage) are apt to elicit social and natural behavior towards media.
There is broad empirical evidence in favor of the media equation approach that proves the application of several social and natural principles to media [1]. For example, it was found, that people react positively to *flattery* given by computers and that computers easily accepted as *teammates* [2]. Additionally, people apply *politeness rules* to computers [1]. For example, when someone is asked for a feedback regarding a presentation he/she (as a polite person) gives more positive answers when asked by the presenter himself. Contrariwise, one gives more honest, less positive answers if someone else (from the auditory) asks for his/her evaluation. Similar, computer users give more positive (more polite) evaluations regarding a computer program when the evaluation was given to the same computer whereas less positive (more honest) evaluations were given when another computer ask for the evaluation (or the evaluation was given paper-pencil based). This latter finding is especially important for the assessment of an accurate (not polite) evaluation of a computer program or video game. Moreover, also principles of intimate exchange respectively *reciprocal self-disclosure* in human-computer interaction were proven [3]. After the computer provided some information about itself (his system properties etc.) the users show greater willingness to give private information. Research on the media equation approach has also shown that people ascribe *personality* to a computer based on the verbal and visual cues it deliver and prefer computers that resemble their own personality [4]. However, there was not only evidence in favor of *similiarity-attraction* but also for *complementary-attraction* towards interactive computer characters [5]. This inconsistency of results matches the inconsistent findings in human-human interaction. Which of the two principles will be applied depends probably on the concrete context [6]. In accordance with *consistency-attraction* of human-human interaction people prefer consistent computer characters [4, 5, 7], i.e., characters that behave and appear in a consistent way (e.g. dominant gesture together with dominant voice compared to a submissive voice). There was also evidence for *gender-stereotyping* towards media. For instance, computers with female voices were seen as more competent regarding female topics like love & relationships whereas male-voice computers were ascribed a higher competence regarding male topics like math and technical issues [8]. Similar, if one TV-program was labeled as a "*specialist*" its contents received higher competence ratings compared to an identical program without such a label [1, 9].

The considerations and findings described so far addresses mainly affective and socio-motivational variables that regards to user-friendliness and the entertainment aspect of games. However, according the personalization principle [10] and the so-called social agency theory [11, 12] these socio-motivational factors can also influence learning success. This view is also supported by several empirical findings on the implementation of human voices [11, 13] and the impact of so-called pedagogical agents [14].

2. EXPERIMENTAL STUDY ON THE DESIGN OF THE NON-PLAYER CHARACTER

2.1 Research Questions and Hypotheses

The described study concentrates on three questions regarding the design of the non-player character (NPC), namely the role of the character's personality as well as the impact of naturalism and color of the graphical appearance.

Regarding the *personality* of the NPC, one can regard to the assumptions of the media equation approach. Accordingly, principles of interpersonal-attraction might be important. There are two contradictory principles found in human-human interaction, namely similarity-attraction (i.e., preference for similar persons) and complementary-attraction (i.e., preference for dissimilar persons). Also the related research on the media equation approach and human-computer interaction, respectively, is contradictory and it seems to depend on the concrete context which of the two principles is applied. Thus, with respect to the NPC's personality two alternative hypotheses can be drawn. According to the similarity-attraction principle, players should prefer a NPC that resembles their own personality. Contrariwise, according to complementary-attraction principle, players should prefer a NPC with a dissimilar personality.
With respect to the *naturalism* of the character's appearance existing research findings are inconsistent [15, 16] and leads again to two alternative hypotheses. On the one hand, in order to enhance immersion a naturalistic design might be preferred because it is better apt to create atmosphere in the game. Contrariwise, accordingly McCloud's [17] notion that a more simple drawing implies a greater potential for involvement, players might prefer a comic-like appearance.
With regard to the role of *color* it can be hypothesized that a colored design will create more atmosphere and immersion, and thus will be preferred by the player.

2.2 Methodology

The different hypotheses were addressed by a 2 x 2 x 2-design. Independent variables were the NPC's personality (funny & friendly vs. severe & unfriendly), naturalism (naturalistic vs. comic-like appearance), and color (black & white vs. colored). All three variables were implemented as within-subjects variables.
Accordingly, eight different versions of a male NPC named "Galileo" served as experimental materials. The different NPCs were designed in a way that maximize differences with respect to the independent variables and minimize other differences (gender, hair-style, clothes etc.) as far as possible. For economical reasons only static drawings were presented. Table 1 shows the design and the accordingly stimulus materials.
In the beginning, the participants were informed about the function of the NPC as a guide that provides hints and companionship within an educational adventure-game. With this background information in mind they had to evaluate the eight different NPC-versions. For the evaluation of the NPC a bipolar 8-point rating scale was constructed. This scale was based on existing scale for speaker evaluation, the Speech Evaluation Instrument (SEI) by Zahn and Hopper [18] in the shortened version used by Mayer, Sobko, and Mautone [11]. Participants were asked to rate the NPC with regard to the 15 pairs of opposite adjectives (e.g., "The character seems to be literate – illiterate"), whereby each pairs adjective form the two ends of the 8-point Likert-scale. Each of these pairs belongs to one of three subscales: Superiority, attractiveness, and dynamism. The overall scores for the three subscales were calculated by averaging the scores of the corresponding five items. High values reflected a positive NPC-rating (i.e., more superior/attractive/dynamic), while low values indicated a negative NPC-rating. Additionally, further bipolar items were included with regard to the specific role of the NPC in an educational adventure-game (e.g., brave-cowardly, funny-severe, reliable-unreliable).

Personality of the NPC	**Appearance of the NPC**			
	naturalistic		Comic-like	
	black & white	colored	black & white	colored
funny & friendly				
severe & unfriendly				

Tab. 1. Design and stimulus materials

After the NPC-rating the subjects were asked which of the presented eight different NPC-versions they would prefer as a helpful companion in an adventure-game. The subjects' reasons for their choice were assessed by means of a multiple-choice questionnaire which contains several statements. The statements refer to the NPC as a good friend, good advisor, his cleverness, attractiveness and likeability, as well as on more general reasons ("just acting on instinct"). The participants had to indicate which of the statements was true for their own NPC-selection.
Based on the media equation theory it can be suggested that the preference for a specific version respectively personality of the NPC might be influenced by the personality of the participants by means of principles of interpersonal attraction (similarity-attraction vs. complementary-attraction). Accordingly, two alternative hypotheses were drawn as described above. To order to test these alternative hypotheses, the subjects had to make a self-rating regarding their own personality. For this purpose, a self-rating of the subjects analogous to the NPC-evaluation was constructed. Of course, this is not the optimal solution to assess the personality of a person, but for ecological reasons we did not implement a whole personality inventory. Instead we used a self-rating analogous to the rating of the NPC.
Additionally several control variables were assessed including age, gender as well as experience with computer-games and adventure-games.

The study was conducted in school classes by means of a computer-environment which included the presentation of the NPC-versions as well as the assessment of the dependent variables. The computer-based experimental environment was constructed as follows:

- Short welcome and assessment of the subjects' data (age, gender etc.)
- Short introductory on the purpose of the study and the function of the NPC
- Presentation of the eight different versions of the NPC (full screen) one after another. To avoid order effects the order of the pictures was permutated.
- Overview of the eight different NPCs (miniature view)
- Rating of the eight NPC-versions
- Selection of the most favorite NPC
- Questionnaire on the participants' reasons for their choice
- Self-rating of the participants

While the pupils worked on the experimental environment, their teachers were present and could be asked for help.

2.3 Results

Altogether the data of 49 school children (24 male and 25 female) at the age between 9 and 16 were analyzed. Overall three versions of the NPC were most frequent chosen:

- The colored, naturalistic, funny & friendly NPC (28.6%, $n = 14$)
- The colored, naturalistic, severe & unfriendly NPC (38.8%, $n = 19$)
- The colored, comic-like, funny & friendly NPC (22.4%, $n = 11$)

All three versions were significantly more frequently chosen than the other versions. However, there were no significant frequency-differences between the three listed above.

To investigate the influence of the independent variables (color, naturalism and personality of the NPC) in more detail, the selection behavior was analyzed by a separate Chi²-test for each of the independent variables.
With respect to *color*, the participants significantly preferred colored versions over black and white versions. Only 8.2% of the subjects ($n = 4$) preferred a black & white NPC, whereas 91.8% of the subject ($n = 45$) chose a colored version ($\chi^2(1, 49) = 34.31$, $p < .001$).
Additionally, a significant preference for a *naturalistic* design of the NPC was found ($\chi^2(1, 49) = 7.37$, $p = .01$). Most of the subjects preferred a naturalistic version (69.4%; $n = 34$). Only a minority of 30.6% chose a caricature-like NPC ($n = 15$).
However, with respect to the personality of the NPC there was no clear preference ($\chi^2(1, 49) = 1.65$, $p = .20$). Altogether 40.8% of the subjects ($n = 20$) chose an introverted NPC and 59.2% of the subjects ($n = 29$) preferred an extraverted NPC.
To sum up, the selection behavior of the users revealed a preference for a colored, naturalistic NPC. However, with respect to the personality of the NPC no general preferences could be detected.

In order to identify potential individual preferences of user-subgroups additional Chi²-tests were conducted with respect to the assessed control variables (age, gender, experience with computer-games, and experience with adventure-games). Altogether two individual preferences could be identified. First, with respect to the gender of the user, female subjects prefer an funny & friendly NPC whereas male prefer an severe & unfriendly NPC ($\chi^2(1, 49) = 5.98$, $p = .02$). Second, there was a (non-significant) tendency that experienced adventure-gamers prefer a naturalistic NPC whereas non-adventure gamers prefer a comic-like appearance of the NPC ($\chi^2(1, 49) = 3.47$, $p = .06$).

The analysis of the reasons for the NPC-selection revealed no significant frequency differences for the potential reasons assessed by the multiple-choice questionnaire. The two most frequently indicated reasons (both indicated by 55.3% of the subjects) were “I think I would enjoy the conversation with him very much respectively more as with the other characters” and “He seems to be clever”. The least frequently indicated reason (indicated by 44.7% of the subjects) was “Just acting on instinct”.

In order to get more information about the optimal personality of the NPC and to test the two alternative hypotheses regarding interpersonal attraction we analyzed the two comparable versions of the funny & friendly versus the severe & unfriendly NPC that were chosen most frequently, i.e., the accordingly colored naturalistic versions. For these analyses we included only subjects that have chosen one of the two versions and compared the rating of their chosen NPC in order to get specific results for the actual preference.
By means of t-tests for the NPC-rating (for subscales as well as for the single items) the evaluation of the two colored naturalistic versions of the chosen NPC, i.e., the friendly & funny versus the severe & unfriendly were compared. (These analyses served also as a manipulation check, i.e., if the chosen NPC-version was actually perceived as friendly & funny or severe & unfriendly, respectively.)
The analyses revealed significant differences with respect to the items kind-unkind ($t(24) = 8.80$, $p < .001$), warm-cold ($t(27) = 6.39$, $p < .001$), friendly-unfriendly ($t(31) = 5.06$, $p < .001$), pleasant-unpleasant ($t(25) = 6.30$, $p < .001$), likeable-unlikable ($t(27) = 5.19$, $p < .001$) which altogether reflect the found significant difference for the SEI-Subscale attractiveness ($t(29) = 8.24$, $p < .001$). Additionally, there were also significant differences for the single items unaggressive-aggressive ($t(31) = -4.88$, $p < .001$), extraverted-introverted ($t(31) = 3.20$, $p < .01$), open-minded-narrow-mined ($t(31) = 2.60$, $p = .01$), happy-sad ($t(21) = 6.20$, $p < .001$), funny-severe ($t(31) = 4.53$, $p < .001$), and interesting-boring ($t(26) = 3.15$, $p < .01$).

Altogether the chosen funny & friendly NPC was rated as being more kind, warm, friendly, pleasant and likeable as well as unaggressive, extraverted, open-minded, happy, funny and interesting. Correspondingly the severe & unfriendly NPC was perceived as being more unkind, cold, unfriendly, unpleasant and unlikable as well as more aggressive, narrow-minded, sad, severe and boring.
To test for the alternative hypotheses on similarity-attraction versus complementary-attraction with respect to the participants' personality, the subjects were divided in several subgroups by means of median-splits for the analogous items of the self-rating. Afterwards the selection behavior of these subgroups was analyzed by means of a Chi²-Test. For example, we divided the subjects into introverted versus extraverted persons by means of median-split for their self-rating of the item extraverted-introverted. Afterwards we analyzed by a Chi²-Test if extraverted versus introverted participants chose more often an extraverted versus introverted NPC.
These analyses revealed several differences that were in line with the similarity-attraction principle: Warm and pleasant people preferred a warm and pleasant NPC. On the other hand, people that rated themselves as cold and unpleasant preferred a more cold and unpleasant NPC (warm-cold: $\chi^2(1, 27) = 4.64$, $p = .03$; pleasant-unpleasant: $\chi^2(1, 25) = 6.17$, $p = .01$). The same was true for the item interesting-boring ($\chi^2(1, 26) = 5.49$, $p = .02$). People that rated themselves as interesting chose more often an NPC that appeared more interesting; contrariwise boring people prefer a boring NPC. Also for the item extraverted-introverted the results provided a tendency in favor of similarity-attraction ($\chi^2(1, 23) = 3.65$, $p = .06$): Extraverted subjects preferred an extraverted NPC whereas introverted users preferred an introverted NPC.

To sum up the data, a clear preference for a naturalistic, colored design was found. For the NPC's personality the data supports the hypothesis in favor of similarity-attraction. Additionally, female pupils preferred the friendly & funny NPC whereas male pupils favored a severe & unfriendly NPC. The data suggest various reasons for the NPC selection including the likeability and the assumed intelligence of the NPC as well as "just acting on instinct".

3. DISCUSSION

The presented study demonstrates the diversity of user preferences and provides a base for a more user friendly design which is of outstanding importance for an educational game since the core of game-based learning is the fusion of learning and fun. The results on the NPC's preferred personality underline the importance of being adaptive not only regarding the user's cognitive abilities but also with respect to other individual user-characteristics in order to enhance motivation and enjoyment which are the crucial features in a voluntary played educational game.

Thus, the results lead to three concrete design recommendations:

- Use a colored NPC.
- Use a naturalistic NPC.
- The personality of the NPC should be adaptive to the player's personality in the sense of similarity-attraction.

The described study concentrates on affective and motivational variables. The cognitive effects of these design features have still to be proven. Additionally, the research questions regards to the design of a helpful NPC that can be thought as a companion of the player or one of the "good guys" in the game. Regarding the design of the opponents of the player, i.e., monsters and the "bad guys", there are still several aspects to clarify. Overall the presented study provides first recommendations for the design of educational games. However, there are several open questions which will partly be addressed in the further course of the EC-project ELEKTRA (Enhanced Learning Experience and Knowledge Transfer).

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