

Emotional gradients of characters in digital games and their impressions on users: the case of "THE IDOLM@STER SHINY COLORS"

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Short Report

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EMOTIONAL GRADIENTS OF CHARACTERS IN DIGITAL GAMES AND THEIR IMPRESSIONS ON USERS: THE CASE OF "THE IDOLMASTER SHINY COLORS"

ABSTRACT. In this paper, I have conducted an analysis that contributes to the design of digital game characters that have a more positive effect on the player. My focus in this paper is on the concept of "emotional gradient," which quantifies a character's emotional transition in a game. From prior research, I hypothesize that there is an association between the emotional gradient and the character's "experience". I tested this hypothesis using actual digital game characters that have been distributed. I calculated the emotional gradient of each character by text mining. At the same time, I measured the "experience" of each character through a web survey of game players. I then examined the correlation between the value of the emotional gradient and "experience". The results showed a significant correlation between the emotional gradient of JOY and SADNESS and "experience". The results are useful for the design theory of digital game characters.

Introduction

In many digital games, virtual characters play an important role, either as the user's own alter ego or as someone with whom the user interacts. The impression that digital game characters make on users is related to how absorbed they are in the game. Several studies have shown that there is a correlation between the liking a game character makes from the user and the positivity of the user's mood[17][5]. Previous studies have also shown that empathy for game characters[45] and collaboration with game characters[?] also contribute to positive user "experience"s. These studies show that character design has a significant impact on player "experience".

Notably, such effects are not only seen in digital games as entertainment, but also in serious games as Ill[?][3]. Serious games have been shown by previous research to be effective in supporting[38] autistic children and educating them about social issues[44][32]. The study of character impressions in digital games can not only improve the quality of games as entertainment, but can also contribute to the development of serious games.

Bopp et al. show that there are seven axes of digital game character elements that positively influence the player,[6]. In a simple game design, it is difficult to manipulate all seven of these axes, so a more efficient method must be found. As a method for designing game characters that give a better impression to players, Plass et al. have proposed a method of giving the impression they want to give by the appearance of the character[28]. HoIver, this method has the problem that the appearance of the character is narrowed down. Some studies suggest that "emotional contagion," in which emotions are contagious between players and game characters or between game characters, is important,[34][37]. Implementing emotional contagion in game characters requires a rather complex model.

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In this study, I consider a simpler method that can be implemented more easily: manipulating the impression of a game character only by the text uttered by the game character. It can be predicted from the aforementioned previous studies that the emotions expressed by the game character's text will influence the player.

This study further introduces the concept of "emotional gradient". The "emotional gradient" is the difference between the minimum and maximum value of a character's emotional transition as presented to the player. In other words, it is an indicator of the degree to which a character's emotions have changed. Why the emotional gradient is important is explained in the next section.

1.1 "agency", "experience", Emotional gradient In this study, I employ the "agency"- "experience" model presented by Cray et al. as a measure of game character impressions [12]. This model represents the impressions of various agents and characters in terms of two factors: "agency" and "experience".

"Agency" is a property related to "being alive," and "experience" is a property related to intelligence[12]. This model is widely used in the fields of human-agent interaction (HAI) and human-robot interaction (HRI). This model has been used in the field of HAI to evaluate the impressions of virtual characters [33][24] and in the field of HRI to evaluate the impressions of robots [14][2][43] is used to evaluate the impression of robots.

The reason why this model is useful for the impression evaluation of virtual agents and robots is that it can evaluate agents according to two different factors: "agency", which is a factor related to whether they are "biological" or not, and "experience", which is a factor related to whether they are "human-like". Therefore, I believe that this model can be adapted to the impression evaluation of game characters. From previous studies, it is known that the agent's "experience" is correlated with the effect of the agent's emotional contagion[25] and the user's perceived trust in the agent[24]. Thus, I can predict that digital game characters with high "experience" will have a positive effect on players.

It is also known that the values of "agency" and "experience" are affected by the agent's transitions over time. Miyake et al. should that the value of "agency" changes throughout the game between the user and the agent,[26]. In addition, a number of studies have shown that impressions of robots and virtual agents change depending on the interaction[30][21][18][41]. From these studies, I can expect that the "agency" and "experience" values of a game character can be changed by changing the character's state.

As a way to increase the "experience" of game characters, this paper focuses on the "emotional gradient". A number of previous studies have shown that robots and virtual agents that change their emotions can change the user's impression of them[11][30][15][?][29]. From the definition of "experience", I can also expect that game characters that transition emotions are seen as more human by users and therefore have higher values of "experience". Thus, I can expect game characters with transitions in emotion to increase "experience".

To summarize the previous research up to this point, I assume that "digital game characters with high "experience" have a positive effect on players." Based on the assumption that the following hypotheses can be made

- H: Digital game characters with large emotional gradients have higher "experience" perceived

This study aims to test this hypothesis using digital games that are actually distributed.

1.2 Emotion analysis Rather than creating an original game, this study will analyze a game that has already been actually distributed as its subject matter. The reason for this is that this study does not aim to show that the hypothesis holds in a controlled laboratory experimental

game, but rather to show that the hypothesis holds in a game character that has actually been distributed. Although many games are now distributed, few studies have analyzed their texts. Analyzing games that actually affect many players in society is just as important as creating and experimenting with controlled experimental games.

While there are many types of text mining, this study focuses on emotion(sentiment) analysis. Emotion analysis is a method for quantifying the emotions in text and is one of the most widely used methods for objective analysis of text. In previous studies, emotion analysis has been widely used in customer satisfaction surveys[19][39][22], hotel satisfaction surveys[39][4][42], and other studies widely used to analyze users' impressions of entertainment. There are also many studies that analyze the emotions of posts in SNS and visualize the emotional transitions of users in general[9][46][40]. These studies revealed the propagation of emotions among users of social networking sites.

Research on digital games and emotion analysis includes a review paper that used text mining to examine the effects of using digital games in education and a paper that uses text mining to propose a method for constructing scenarios[23] and a paper that uses text mining to propose a method for constructing scenarios[10]. However, few studies have conducted emotion analysis on digital game texts. Few studies have also focused on the "emotional gradient".

Method

In this analysis, the emotion gradient of each character in the game text was first measured by emotion analysis. Next, I calculated the mean values of "agency" and "experience" for each character obtained through a questionnaire in a crowdsourcing, and determined the correlation coefficient with the emotional gradient.

2.1 Selection of game In this study, "THE IDOLM@STER SHINY COLORS" distributed by Namco Bandai Entertainment Inc. was used as the game to analyze the text. This game is distributed as a smartphone game application and browser game. The game genre is a nurturing simulation game, and the main part of the playing game is reading texts. The game aims to produce girls (NPCs) who aspire to become idols and develop them as idols. The game is divided into several scenarios, and in the most basic "W.I.N.G." section, each idol is presented in turn with texts divided into five parts: OP, season 1, season 2, season 3, and season 4. For example, if you produce an idol named A, different text will be presented for each idol, such as A's OP, A's Season 1, A's Season 2 The text basically consists of dialogue between the producer(the player) and the idol, with more than half of the text being the idol's utterances.

As to why I have chosen this game as our subject, I have the following reasons. First, as mentioned earlier, this game's "W.I.N.G." section can be self-evidently divided into five parts. This allows for objective criteria to be used in dividing the text and analyzing the emotional transitions of the characters. Second, the text of the game consists of one-on-one dialogue between the player and a single idol (NPC). Therefore, the impact of the emotional gradient of a particular character would be directly felt by the player. Third, this game has a large number of players/fans in Japan: downloads exceeded 5 million in September 2022. In addition, 105,785 derivative works(fun fictions) of this game have been posted on pixiv, a Ibsite for posting derivative works, as of May 15, 2023. Therefore, it is expected that the results obtained from the analysis of this game will have a certain generality.

2.2 Calculation of emotional gradient The procedure for the analysis is as follows. The text of each idol's "W.I.N.G." version of the scenario was divided into five parts (OP, Season 1, Season 2, Season 3, and Season 4), and an emotion analysis was conducted on the character's speech within each text.

For emotion analysis, I used IBM Watson Tone Analyzer. This emotion analysis function calculates the percentage of sadness, joy, fear, disgust, and anger emotions in the text. IBM Watson Tone Analyzer is also used in several previous studies [1][31][36]. After calculating the percentage of SADNESS, JOY, FEAR, DISGUST, and ANGER emotions for each part, the emotional gradient for each emotion is calculated as follows.

$$(1) \quad \frac{(\text{Maximum percentage of the emotion} - \text{Minimum percentage of the emotion})}{\text{Minimum percentage of the emotion}}$$

The emotional gradient is calculated as the ratio of the minimum to the maximum of each emotion. The reason for this formula is that I predicted from prior research that the rate of increase or decrease of a character's certain emotions would change the character's "experience" [11][30][15][16][29]. In this study, I quantify the emotional gradient by this formula.

2.3 Measuring character's "agency" and "experience" The "agency" and "experience" of the characters were measured by a web survey using Yahoo Crowdsourcing. The usefulness of Ib surveys has been shown by Crump et al. [7]. I used as a questionnaire the questions used by Gray et al. [13] to measure "agency" and "experience". The questionnaire consisted of three questions to measure "agency" and three questions to measure "experience". In the survey, participants who play "THE IDOLM@STER SHINY COLORS" were asked to name 10 of their favorite characters and were asked the above questions for each character. There were 636 respondents, 353 males, 124 females, and 159 participants who answered "other," with a mean age of 43.8 ± 11.1 years. All participants received 50 yen (0.37 dollars) as a reward. The experiment was approved by the Osaka Institute of Technology's Life Science Ethics Committee. Participants answered all questions on a 7-point scale. I defined the "agency" and "experience" of each character as the sum of the average of the answers to each question. I calculated "agency" and "experience" for the characters named by more than 10 people and determined the correlation coefficient with the emotion gradient.

Result

The emotional gradients of each emotion for the 15 target characters are shown in Table 1. The values of "agency" and "experience" for each character, as measured by the questionnaire, are shown in Table 2. I determined the correlation coefficients between the emotional gradients and "agency" and "experience". Table 3 shows the values of the correlation coefficients. The number in parentheses () is the p-value, with * for $p < 0.05$ and ** for $p < 0.01$.

There was no significant correlation between "agency" and emotional gradient. There was a significant difference between "experience" and the emotional gradient of sadness at $p < 0.05$ and between the emotional gradient of joy and "experience" at $p < 0.01$. Scatter plots of the

TABLE 1. The value of the emotional gradient of each emotion of each character.

character	SADNESS	JOY	FEAR	DISGUEST	ANGER
Mano.S	0.23	0.21	0.21	0.21	0.46
Hiori.K	0.59	0.59	0.60	0.71	0.40
Meguru.H	0.37	0.45	0.48	0.43	0.75
Kogane.T	0.65	0.41	0.33	0.48	0.42
Yuika.M	0.40	0.25	0.38	1.05	0.50
Mamimi.T	0.50	0.76	0.23	0.29	0.38
Kiriko.Y	0.25	0.55	0.44	0.97	0.91
Sakuya.S	0.31	0.50	0.68	1.70	0.72
Kaho.K	0.47	0.15	0.86	0.72	0.89
Chiyoko.S	0.70	0.50	0.60	0.53	0.49
Amana.O	0.52	0.69	2.11	0.64	0.87
Chiyuki.K	0.40	0.40	0.66	0.62	0.51
Fuyuko.M	0.72	0.59	0.33	0.58	1.57
Toru.A	0.56	0.76	0.47	0.41	0.56
Madoka.H	0.86	1.48	0.76	0.73	1.99

TABLE 2. The value of "agency" and "experience" of each character.

character	agency	experience
Mano.S	13.36	15.05
Hiori.K	13.96	16.12
Meguru.H	13.41	15.00
Kogane.T	14.88	15.54
Yuika.M	14.85	14.92
Mamimi.T	14.38	15.38
Kiriko.Y	14.22	15.44
Sakuya.S	14.36	15.64
Kaho.K	13.00	14.73
Chiyoko.S	14.92	15.42
Amana.O	12.21	15.86
Chiyuki.K	14.69	15.54
Fuyuko.M	13.79	15.57
Toru.A	12.00	15.83
Madoka.H	13.87	16.33

TABLE 3. Correlation coefficients between the emotional gradient of each emotion and "agency" and "experience"

	SADNESS	JOY	FEAR	DISGUEST	ANGER
"agency"	0.04(0.90)	-0.14(0.62)	-0.49(0.07)	0.27(0.36)	-0.19(0.52)
"experience"	0.56(0.04*)	0.79(0.00**)	0.29(0.32)	0.10(0.74)	0.36(0.21)

correlations between the Sadness and JOY emotional gradients, respectively, and "experience" are shown in Figure 1.

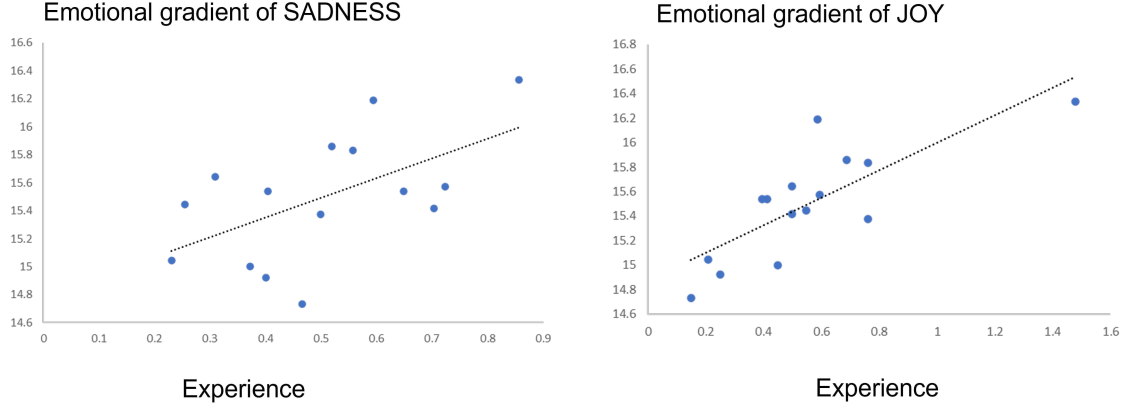


FIGURE 1. Left: Scatter plots of the emotional gradient of SADNESS and "experience". Right: Scatter plot of emotional gradient of JOY and "experience"

Discussion

From Table 1, I can see that there are large differences in the values of the emotional gradients among the characters and also among the individual emotions. From this, it can be seen that the character's emotional transitions are not constant, but vary according to the character's design. Table 2 shows that "agency" and "experience" values are different for each character, even for characters in the same game. In other words, it can be seen that game players are individually influenced by the characters. These warrant the assumptions of this study.

Table 3 shows that the emotional gradients of JOY and SADNESS are highly correlated with "experience". Prior research has shown that two of the emotions, JOY and SADNESS, are emotions that are involved in decision making, such as efficacy judgments[20] and meals[35]. Even in interaction studies, these two are implemented in many cases, even when only some emotions are implemented[27][8]. From this point of view, these two can be seen as emotions that have a great deal to do with "humanness". "experience", by definition, can be yield as a measure of "whether or not one seems to have human-like intelligence". Thus, the result that only the emotional gradient of these two emotions is related to "experience" is reasonable. Table 1 shows that JOY and SADNESS are the majority of character emotions in many parts of the game, and these two emotions are likely to be easily expressed through in-game text.

The graphs in Figure 1 dictate that these correlations do indeed exist. If I write the regression equation, for SADNESS

$$(2) \quad \text{"experience"} = 1.40(\text{SADNESS}'\text{emotionalgradient}) + 14.80$$

and for JOY

$$(3) \quad \text{"experience"} = 1.12(\text{JOY}'\text{emotionalgradient}) + 14.88$$

There was no significant difference between "agency" and the emotional gradient. "agency" indicates a character's "sense of being alive," and it is reasonable that there was no correlation between it and emotion.

These results indicate that game characters with larger emotional gradients of JOY and SADNESS have larger values of "experience" as perceived by the player. Prior research has shown that increasing "experience" has the effect of increasing the effect of emotional contagion[25] and the user's feeling of trust in the character[24], which is a positive emotion of the player, It is expected to have the effect of increasing players' positive emotions and satisfaction with the game. Thus, this study supports that a gradient in game characters' JOY and SADNESS emotions can increase player satisfaction.

A limitation of this study is that it only focused on a limited number of characters from a single game. Future work is needed to determine if the same trend can be observed for characters from other games.

Conclusion

In this study, I focused on the design of characters in digital games that are actually distributed. Among the factors related to character emotion, I focused on the "emotional gradient" and measured the character's emotional gradient using "THE IDOLM@STER SHINY COLORS" as the subject. As another variable, I focused on "experience", and measured the value of "experience" through a Ib survey. Assuming, as a hypothesis, that there is a correlation between the emotional gradient and "experience", I checked whether there is a correlation between the measured emotional gradient and "experience". The results revealed that there is a positive correlation between the emotional gradient of sadness and joy emotion and "experience". The results are useful in designing game characters that provide a more positive and immersive emotional "experience" for users.

Conflict of Interest Statement

The author declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Author Contributions

TM,came up with the model and experimental design. TM conducted the experiments and analysis. TM drafted the manuscript. All authors participated in the review and revision of the manuscript and have approved the final manuscript for publication.

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