A Serious Game for using Socio-Economic and Trust based Decision-Making Scenarios for Elicitation of Emotional Responses*

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Abstract. The relationship between Decision-Making and emotions has been investigated in literature both through theoretical and empirical research. Particularly, some paradigms have been defined, rooted in the Game Theory, that use socio-economic and/or trust based contexts to produce specific emotional responses in people. However, experiments with such game paradigms have most frequently been carried out in controlled settings only. As these methods have a potential usefulness in a variety of areas, we are interested in verifying their applicability "in the wild". To this end, we have developed a mobile game that integrates in a single plot four of the above mentioned socio-economic and trust-based game paradigms and aims at eliciting specific types and valences of emotions in different interactions. The paper discusses the outcomes of an experiment we carried out with eight participants in order to preliminarily test the usability of our game in authentic contexts of use. The results confirm that the designed game interactions are able to elicit emotional responses in the participants, also in ecological settings, that were expected based on the literature.

Keywords: Affective Computing · Serious Games · Emotion Elicitation · Game Theory

1 Introduction

Emotions usually play an important role in the decisions we make. This impacts our daily activities, ranging from how we behave, what we wear, what we eat to

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which investments we should make [17]. Classifying and detecting emotions can thus be useful for inferring one's inclinations during decision-making situations, with major implications in several areas such as e-commerce, financial trading, etc. [17]. Moreover, automatic emotion detection is being used in several avenues for improving wellness and/or mitigating the damaging effects of mental illnesses. Examples include teaching social interaction to children on the Autistic Spectrum using robotics [13]; detecting depression [22], etc.. With the latest technological advancements (in terms of e.g., miniaturization, computation power, memory size) automatic emotion detection has reached unprecedented accuracy and portability [16].

Development of such novel applications has been enabled by the discovery of the presence of certain patterns in emotional responses, most notably, in individuals with social anxiety [9], depression [22], and borderline personality disorder [21]. Several games exist that exploit well known Game Theory paradigms (e.g., social-economic tasks and dilemmas) and have shown to produce specific emotional responses not only in individuals with mental illnesses [10], but also in mentally healthy people (e.g., under socio-economic and trust based scenarios), as shown in Table 1.

Table 1: Decision-Making & Emotional Response Patterns in Socio-Economic and Trust Based Scenarios

Interaction Type	**Type of Pattern**	**Pattern Observed**
Ultimatum Game*	Decision-Making	Favours accepting any offer as responder and makes fair but lower offer to maximize profit
	Emotion Elicitation	Induces sadness when unfair offer is presented and happiness when fair offer is presented
Trust Game*	Decision-Making	Favours investing smaller amounts in the beginning and defect more often as trustee
	Emotion Elicitation	Induces sadness and anger when trustee does not return profit shares and happiness for the contrary
Dictator Game*	Decision-Making	Favours making lower allocations to recipients
	Emotion Elicitation	Induces happiness in being able to provide any amount of resource to the responder
Prisoner's Dilemma Game**	Decision-Making	Favours cooperative over selfish behaviour
	Emotion Elicitation	Induces anger, sadness and sometimes disgust when betrayed and happiness for the contrary

* [23, 24]
** [18]

Currently, such gamified activities are administered in person under controlled environments, which limits applicability of these methods outside clinical contexts. The wide popularity of Role Playing Games on mobile platforms [1, 4] have enabled the usage of Decision-Making games in several different real-world contexts. Therefore, we argue that such games Decision-Making could be an effective means for supporting/investigating several activities 'in the wild', e.g., by inferring one's mental state, level of satisfaction, socio-economic inclinations, etc.. More specifically, we hypothesize that the socio-economic interactions with Non-Playing Characters (NPCs) in our game can be used to elicit the types

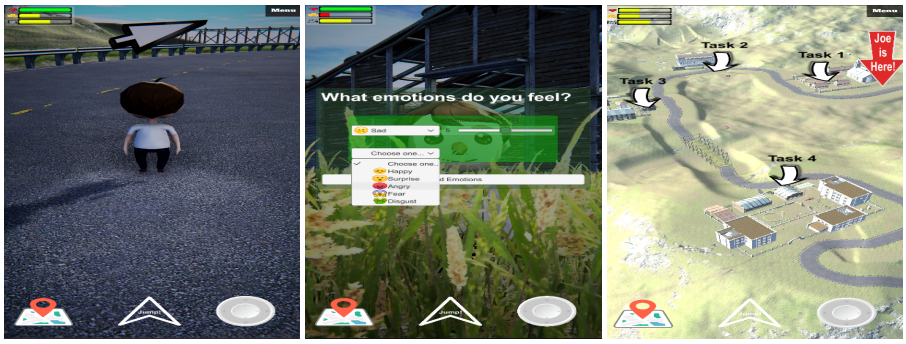
and valences of emotional responses that have been observed in experiments that used similar interactions in aforementioned studies. Accordingly, this paper presents the design of a mobile game exploiting Game Theory models aimed at eliciting various types of emotions 'in the wild'. Results from a preliminary experiment confirm the hypotheses stemmed from the controlled studies and hint at the possibility of a much more extensive testing and deployment.

2 The Game Design

2.1 Game Storyline, Dynamics and Mechanics

A player will live a day the life of "Joe", a boy in a small island named Laniakea. Every day, Joe has to complete a certain set of tasks by interacting with the locals. Joe has three resources (money, food, and health) in a limited amount. His goal is to keep his Overlord satisfied. The developed level of the game explores Joe's visit to a new part of the island, a small town called Caldwell, where he meets with a number of people (NPCs) and makes socio-economic and trust-based decisions during the NPC interactions.

Joe is required to follow the mechanics of the game to successfully complete the level [2, 3]. Certain mechanics ensure that the player carries out various types of Decision-Making processes. For instance, the first interaction is about borrowing money from someone rude, immediately followed by an interaction where the player is awarded for placing his trust on a stranger. This design is expected to instill a sense of positive uncertainty in the player, which will keep the player guessing what might happen in the next interaction and entice the player to try to reduce the uncertainties that may come up later in the game, as a result increasing player engagement [7]. A key aspect of this game is



(a) Player Heads-Up-Display (HUD)

(b) Emotion Self-Reporting UI

(c) Map-view of the level of the game

Fig. 1: Game UI, Emotion Self-Reporting & Navigation elements

the thorough engagement with NPCs during the interactions. Thus, while the

navigation among the interaction sites in the game is seen in third-person in the user interface, during all interactions the camera switches to a first-person view, so that the player interacts from the perspective of Joe, increasing the immersivity in these key moments.

Some of the other important mechanics that are in the game are given below:

1. Each NPC makes the player know where to go next right after the interaction.
2. An interaction has either a positive or a negative impact on one of the resources, as part of the economic aspect of the socio-economic interactions
3. In order to successfully complete the level, a player needs to have a sufficient level of at least two of the three resources.
4. While moving between one site of interaction to the next, the player needs to stay within the road bump barriers that surround the road in the level, as collisions with the bump barrier will reduce player's health, thus demanding the player to stay focused in the gameplay even in these "interlocutory" phases. This makes the game engaging by introducing an element of risk of failure and keeping the player in the 'flow' [15].
5. The player has a navigation aid arrow that always points towards the next NPC to interact with, along with a handy map feature that shows the locations of the NPCs in the scene together with the player's current location Figure 1a.
6. The socio-economic interactions do not lead to a failure of game progression as that would elicit some unpredictable emotional responses (while we are interested in the specific, expected emotional responses) [10].
7. The mechanic of having a sufficient level of at least two resources for a successful completion of a level is essential as it ensures that there would be no direct relationship between socio-economic interactions and a failure in the game progression.

2.2 UI Elements

Figure 1 shows 3 snapshots of the game UI elements. Figure 1a shows the default UI, in which the player status panel is placed at the top left corner of the screen, the freely pivoting white arrow indicating the NPC location is at the top center, at the bottom left is the navigation map button, while the multi-directional on-screen joystick to control the playing character is placed on the bottom left with the 'Jump!' button at the bottom center. The player status panel itself contains three status bars for the limited resources that the player has, namely health, money and food, in that order from the top. The horizontal length indicates the level of the respective resource. At anytime during the gameplay, clicking on the navigation map icon displays a top angled view of the entire scene, with markers for locations of the tasks ordered according to their sequence of occurrence in the game, as well as the real-time position of Joe in the scene (Figure 1c).

As self-reporting is a standard practice in literature [16, 20] for capturing emotional responses of individuals after an event, we have incorporated it into

the gameplay itself. After each socio-economic interaction, the player is displayed the UI shown in Figure 1b to self-report his emotional state at that moment. The options for self-reporting emotional state includes the six emotions considered to be the basic building blocks of all of our emotions, which are *Happy, Surprise, Sad, Angry, Fear,* and *Disgust* [8]. This is so that we may be able to derive more complex emotions from the data collected in the future [14].

(a) Ultimatum Game NPC (b) Trust Game NPC (c) Dictator Game NPC

(d) Prisoner's Dilemma Game Prisoner NPC (e) Prisoner's Dilemma Game Jailer NPC

Fig. 2: NPC interactions

2.3 Decision-Making Interactions

There are several well known game paradigms in Game Theory to analyse social behaviour of individuals under economic constraints. Some of these also require a co-operation between the players [6]. Examples of games that utlise such paradigms include: Ultimatum Game, Trust Game, Chicken Game, Dictator Game, Prisoner's Dilemma, etc..

In our design, we have chosen four different types of player-NPC interactions, that are explained in Table 2, in the order in which they appear in the game.

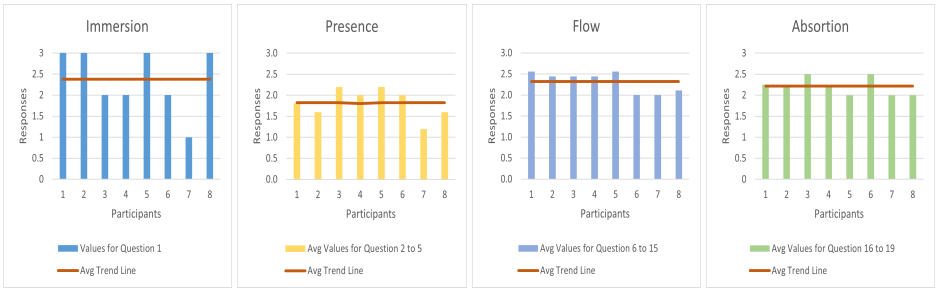
The table also explains the expected emotional response from our players when they experience the interactions in our implementation.

3 Data Collection using the Game

3.1 The Experiment

A 'within-subjects' experimental design was followed for our experiment and so, no control groups were considered as this approach has been shown to be effective for 'in the wild' experiments [19]. Our small scale data collection was conducted to perform a preliminary study 'in the wild', with 10 individuals, out of whom 8 decided to fully participate in sharing their emotional response data that was captured by the game software. The participants were selected on the basis of them not having a diagnosis of any neurological conditions (such as autism), affective disorders (such as depression) and whether they had access to an Android device. A formal ethics review was conducted by Queen Mary Ethics of Research Committee (QMERC) and they deemed the study to be low risk in nature, subsequently providing their approval for the experiment.

The participants were from diverse age groups (2 teenagers, 2 people in their 20s and 4 people in their 30s) and academic backgrounds (2 high-school students, 1 Data Engineer, 3 Software Engineers and 2 post-doctoral candidates). The participants played the game on their own Android devices and physical environment the players were in was not controlled (hence, the aforementioned 'in the wild' setting for the experiment). The number of subjects was chosen in order to meet the requirements for a preliminary usability testing, assuggested by Turner, et al. (approximately 5 participants should be enough [25] to guarantee that 90% of the usability issues are covered). The participants were asked to provide their feedback on their engagement with entire the game after they had played it and the form provided to them was the Game Engagement Questionnaire (GEQ) introduced by Brockmyer, et al. [5].



(a) Immersion Responses (b) Presence Responses (c) Flow Responses (d) Absorption Responses

Fig. 3: GEQ responses according to the four areas of engagement assessed by the questionnaire.

Table 2: Game Theory Paradigms used for Socio-economic [23] and Trust-based [18] player-NPC interactions. The first three games are of socio-economic type, the last one trust-based

Game	**Description**	**Our Implementation**
Ultimatum Game	There are two players, a Proposer and a Responder. The proposer is given some money and asked to propose a split amount to the responder. The responder can accept or reject the offer.If the responder accepts, the two players get the agreed amount,if the responder rejects the offer, neither getsany money.	In our game, the NPC is the 'proposer' and Joe is the 'responder'. The NPC makes an unfair offer. The polarity of the interaction is negative: meaning that the NPC dialogues are condescending and slightly rude but not offensive, as such interactions in Ultimatum game settings have been shown to produce more distinct negative emotional responses with higher valence [23]. Figure 2a shows part of the dialogue between Joe and the NPC.
Trust Game	There are two players, a Trustor and a Trustee. The trustor is given some resource,e.g. money and asked to propose a split with the trustee. The trustee can accept or reject the offer. Whatever amount is given to the trustee is doubled/tripled in the game. But the trustee has the freedom to choose whether or not to repay the trustor any amount.	In our game, the NPC is the 'trustee' and Joe the 'trustor'. If Joe chooses to trust the NPC with his food, the NPC chooses to reward Joe and returns the Joe's share on the profit. The polarity of the interaction is positive, meaning that the NPC dialogues are uplifting and indicating gratefulness of the NPC. This is due to two reasons. First: to balance the negativity of the Ultimatum Game's NPC, as prolonged negativity may effect the decisions of the player [11]. Second: positive polarity interactions in Trust Game settings promote co-operation [24]. Figure 2b shows part of the dialogue between Joe and the NPC.
Dictator Game	There are two players, a Dictator and a Responder . The dictator is given some money and asked to donate a fraction (or the whole) amount to the recipient. The responder has to accept the donation. The dictator also has the option of not donating any amount and the recipient has no say in this game.	In our game, Joe is the 'Dictator' and the NPC is the 'responder'. This interaction is designed as such that if Joe chooses to donate some of his money, the NPC expresses his gratitude for the generosity. Otherwise, the NPC will still be polite and the interaction has a positive polarity in either scenarios. This positive polarity is important as it will ensure that the prior trust game interaction having a positive polarity will not seem like a one-off phenomenon and will consolidate the notion that not all NPCs are rude. This will also influence the next interaction, which has a negative polarity, as any changes in the narrative elicit stronger emotional responses in the players [12]. Figure 2c part of the dialogue between Joe and the NPC.
Prisoner's Dilemma Game	There are three players, a Jailer, Prisoner A and Prisoner B. Both the prisoners are interrogated by the jailer on a crime they are accused of. If both the prisoners accuse each other, they both get 1 year of prison. If neither accuses the other, they both get 5 years of prison. If one of them, for instance prisoner A, accuses B while B does not accuse A, then A will walk free and B get 10 years	In our game, the NPCs play the role of the 'jailer' and the 'prisoner B', while Joe is the 'prisoner A'. The interaction is designed as such that the player chooses to help the prisoner-NPC to complete the final task, and by being associated with this prisoner-NPC, Joe becomes an accomplice to the jailer-NPC. This interaction is specifically designed to orchestrate a betrayal from the prisoner-NPC, which is supposed to elicit a high valence of negative emotional response [6]. Figure 2d shows part of the dialogue between the prisoner NPC and Joe, while Figure 2e shows part of the dialogue between the jailer and Joe. NPC and Joe

3.2 Analysis of the Collected Data

The GEQ contained 19 questions that can be clustered to represent four different aspects of player engagement, which are: Immersion (question 1), Presence (questions 2 to 5), Flow (questions 6 to 15) and Absorption (questions 16 to 19) [5]. Each question had three possible answers, 'No', 'Maybe' and 'Yes', which were coded to 1, 2 and 3, respectively, in a Lickert scale. Figure 3 shows the responses for each of the aspects of engagement. The responses for the latter three aspects were averaged for each participant over the range of questions for each aspect. The orange horizontal line in the response charts shows the average response score for each aspect , which was 2.4 for Immersion, 1.8 for Presence, 2.3 for Flow and 2.2 for Absorption. Hence, the average trend indicates that the player reports tended to be closer to 'Yes' for Immersion, Flow and Absorption than for Presence, and this was anticipated. The questions for Presence, in fact, included questions like "My thoughts go fast?", "Things seem to happen automatically?", "I played longer than I meant to?", etc.. The game required a conscious effort to interact and take decisions. Hence, it is likely that the players would feel a higher cognitive load while playing our game than in other games they played before, naturally leading to more frequent 'No' and 'Maybe' for questions relevant to the Presence aspect of engagement, and a lower average for that aspect. Overall, the GEQ responses indicate that players were sufficiently engaged for us to assume that their reported emotions were resulting solely from the game interactions. There were no significant differences between the responses of different age groups, meaning that the game was nearly equally engaging for different ages.

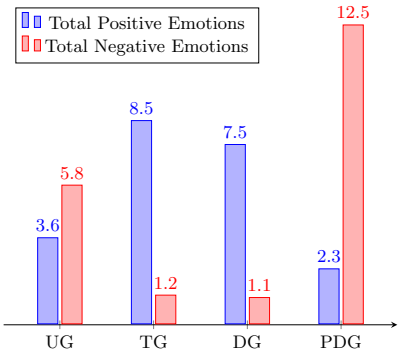


Fig. 4: Total Negative Emotions and Total Positive Emotions for each type of interaction

Figure 4 shows that the interactions with negative polarity in speech and expression of the NPC as well as having negative fairness (Ultimatum Game, UG and Prisoner's Dilemma Game, PDG) actually elicited higher total negative emotions (Sad, Angry, Fear Disgust), while the interactions with positive

polarity in speech and expression of the NPC as well as having positive fairness (Trust Game, TG and Dictator Game, DG) elicited higher total positive emotions (Happy, Surprise). This is in line with literature, as discussed in Subsection 2.3 and observed in Table 2 for each type of NPC interaction we implemented in the game. Also the very high total negative emotional response from the betrayal in the Prisoner's Dilemma confirms what is known in controlled environments.

4 Conclusion

In this paper, we have presented a game design that implements socio-economic and trust based interactions and we have demonstrated that the mobile game, with its characters and interactions, is capable of eliciting specific emotions with high valence from its players in a predictable manner. Importantly, these results confirm, 'in the wild', what is known in literature from controlled experiments. Hence, such games can be applied in areas that were discussed in Section 1 of this paper, while also opening the doors of possibility of utilising our game to detect abnormal emotional responses (such as the ones that do not coincide with our findings) and using those to infer if a player might have affective disorders.

The scope of this game is limited by the number and type of player-NPC interaction narratives. However, such preliminary results encourage new research to identify more scenarios to elicit predictable emotional responses, so to increase the diversity of the interactions in the game and enhance its variety and appeal.

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