Emotion Engines for Games in Practice

Two Case Studies using Gamygdala

Joost Broekens
Interactive Intelligence Group
TU Delft
Delft, The Netherlands
Joost.broekens@gmail.com

***Abstract*—The technology to simulate emotions for NPCs is industry ready. This has been the case for several years, and recent scientific advancements show that pluggable, black-box, emotion engines are feasible. We believe that exposure to, and ease-of-use of such engines are important factors that limit uptake. To facilitate this, we have developed a fully documented JavaScript-based version of GAMYGDALA including a plugin for the JavaScript-based game engine *Phaser*. Further, to seed imagination, we have developed two experimental games: an emotional arcade game and an emotional puzzle game. The games use GAMYGDALA to simulate NPC emotions and showcase novel gameplay enabled by emotion simulation. Further, these two cases show how straightforward simulating emotions is when properly supported by an emotion engine.**

Keywords— GAMYGDALA; NPC; Emotion Simulation; Emotion; Artificial Intelligence; Case study

I. INTRODUCTION

Emotion plays an important role in games and gaming [1, 2]. Games elicit emotions in players and can be designed to target particular emotional experiences. Gameplay can be adapted to measured player emotions [3]. Finally, games can contain NPCs (Non-Player-Characters) that simulate emotions. In this work we focus on the latter: simulating emotions for NPCs. When we refer to simulating emotions, we mean the process of automatically deciding when an NPC should express (or behave according to) what emotion and with what intensity. In other words, we refer to computational modelling of emotion in the sense proposed by Hudlicka [4]. Further, we focus on the "when to, what to, and how much to express", not on the "how to express and what to do", i.e., in this work we are not concerned with rendering emotional expressions or generating particular behavior that should follow particular emotions (e.g., fear followed by the behavior of fleeing).

Reasons to enable NPCs to simulate plausible emotional reactions at appropriate moments during gameplay include believability of the character [5], increase in variation of NPC behavior [6], and novel forms of gameplay [7, 8]. For a more in-depth analysis of these reasons as well as existing approaches see [2, 9]. With "plausible emotional reaction" we mean that the emotion of the NPC should make sense to the player, i.e., the emotion should be *psychologically valid*, at least to some extent.

While there are many computational models of emotion available [10, 11] that could be used in games and even experimental games that do so [8, 12], commercial games using such models are lacking behind (with some exceptions, see [2, 9]). We believe this is for a couple of reasons, including: the high degree of integration with, or dependence upon, AI of most models; the lack of examples of novel gameplay enabled by emotional NPCs; the lack of standard testing and development tools available and thus high risk and cost of development; the lack of exposure to these modelling techniques; developers lack of control over NPCs of which emotions are controlled by a model instead of a script; the conviction that gamers don't ask for emotional NPCs; and, a tendency to wait until a big game publisher bites the bullet.

In this work we attack two challenges: lack of gameplay examples, and, lack of exposure to technology. We have developed a fully documented JavaScript-based version of GAMYGDALA including a plugin for *Phaser* (www.photonstorm.com), a JavaScript-based game engine. Further we have developed two experimental games: an emotional arcade game and an emotional puzzle game. The games use GAMYGDALA to simulate NPC emotions and showcase how emotion simulation enables novel gameplay.

II. GAMYGDALA

GAMYGDALA has been proposed as a game-AI independent, easily pluggable, black-box emotional appraisal engine [9], and several examples of use have been proposed in the original publication. GAMYGDALA's appraisal mechanism is based on cognitive appraisal theory, in particular the OCC model proposed by Ortony, Clore and Collins [13]. GAMYGDALA emotionally appraises a situation for an NPC based on a mechanism called *goal-based event annotation*. A game developer/designer defines goals for NPCs, and annotates game events with goal-relevance information. When an event occurs, GAMYGDALA automatically decides the intensity of each emotion from a set of 16, including relational emotions such as anger, remorse and happy-for another. It further manages emotional dynamics for all emotional NPCs including onset, decay, mixing of emotions, and the calculation of factor-based affect based on Pleasure, Arousal and Dominance.

III. Two Games as Case Studies

In order to make GAMYGDALA easily available and usable to game developers, we have developed and published a fully documented JavaScript-based version including a plugin structure for the game engine *Phaser*. The project is available for download at GitHub (project: gamygdala), and can be played and explored online (www.gamygdala.com). In addition to a running example game explaining how to use GAMYGDALA, we have developed two playable demos to showcase novel gameplay enabled by the simulation of NPC emotions and relations using GAMYGDALA. In many cases, a basic emotion setup does not need more than a couple of lines of code. The two games are of different genres, to show that emotional NPC's enable different ways to enhance gameplay. We have, on purpose, not developed the stereotypically example - a rich and deep NPC interaction in an adventure or RPG-like genre - as many developers will see how emotions could benefit that type of character.

A. *Friend or Foe: emotional arcade game*

The base genre of this game is a simple arcade game. Your goal is to collect all stars in a level without being eaten by monsters. Due to collecting stars in a level, the monsters will grow to hate or like you using GAMYGDALA's relationship functionality. You can observe how they feel because they express their emotional state. Those who like you express happy-for, those who hate you express resentment. This is because collecting a star generates an event that gets appraised by GAMYGDALA. The event is defined to be positive for your goal of winning. As there is only one single goal defined for the player (*win*), this event will trigger either happy-for or resentment in the monsters depending on their relationship to you. After collecting a star, the relationship is intensified (more positive for friends, more negative for foes). Once a monster's relation with you is more than 0.5, it stops hurting you. However, once a monster's relation with you is less than -0.5 it hurts you double. This means that in the second half of the level, friends can be pushed away, and foes need to be taken extra care of. The complexity of adding the appraisal and relationships using GAMYGDALA is trivial (7 lines of code in total). The game showcases that emotion simulation can, with very little effort, enrich arcade-like gameplay in ways other than merely expressing an emotion for realism or fun.

B. *Everyone's friend: emotional puzzle game*

The base genre of this game is a puzzle game. There are six characters in the game. To solve the puzzle you must find out which character wants which prize(s), and make all characters happy. GAMYGDALA adds the following gameplay. First, because prizes are configured as goals, the characters simulate the right emotional responses when receiving a prize they want. Second, because relations are defined between characters (e.g., Wrecking Ralph likes baddies but hates heroes), some characters react to prizes given to others. Thus, helping one character might upset another. Third, the goal of this game is an affective one, it is to make all characters *happy*. The complexity of making this emotional puzzle game, we would claim could be a proper genre in itself, is low. The most complex part is the configuration of the relation intensities between characters so that a solution is possible but not too easy. For a commercial game, such a balancing process could easily be automated at puzzle generation time.

IV. Conclusion

In this work we address two practical challenges regarding emotion simulation technology in games:

We facilitate uptake with an easily accessible and usable version of GAMYGDALA (JavaScript with *Phaser* plugins).

We provide two concrete example games, each presenting novel affective gameplay, other than the usual kind involving NPC interaction in narrative-rich games.

Although two cases are perhaps not enough to convince critical readers of the broad possibilities of affective NPCs, it is a necessary start. We belief it is straightforward to envision other emotion-based gameplay, including: action scenes with end-bosses that can be defeated by making them like you because you kill minions they don't like; and, strategic quests where the goal is to manipulate NPCs in order to get better deals during item exchange (a la Oblivion). Having an emotion engine for emotion simulation, just like having a physics engine for physics simulation, will greatly facilitate the development of novel game genres.

References

[1] Karpouzis, K., et al., Guest Editorial: Emotion in Games. IEEE Transactions on Affective Computing, 2014. 5(1): p. 1-2.

[2] Yannakakis, G.N. and A. Paiva, Emotion in games, in Handbook on Affective Computing. 2014, Oxford University Press. p. 459-471.

[3] Yannakakis, G.N. and J. Togelius, Experience-Driven Procedural Content Generation. Affective Computing, IEEE Transactions on, 2011. 2(3): p. 147-161.

[4] Hudlicka, E., To feel or not to feel: The role of affect in human-computer interaction. International Journal of Human-Computer Studies, 2003. 59(1-2): p. 1-32.

[5] Reilly, W.S. and J. Bates, Building emotional agents. 1992, School of Computer Science, Carnegie Mellon University: Pittsburgh, PA.

[6] Hudlicka, E., Affective game engines: motivation and requirements, in Proceedings of the 4th International Conference on Foundations of Digital Games. 2009, ACM: Orlando, Florida. p. 299-306.

[7] McCoy, J., et al., Social Story Worlds With Comme il Faut. Computational Intelligence and AI in Games, IEEE Transactions on, 2014. 6(2): p. 97-112.

[8] McCoy, J., et al. Prom Week: social physics as gameplay. in Proceedings of the 6th International Conference on Foundations of Digital Games. 2011. ACM.

[9] Popescu, A., J. Broekens, and M.v. Someren, GAMYGDALA: An Emotion Engine for Games. IEEE Transactions on Affective Computing, 2014. 5(1): p. 32-44.

[10] Marsella, S.C. and J. Gratch, EMA: A process model of appraisal dynamics. Cognitive Systems Research, 2009. 10(1): p. 70-90.

[11] Aylett, R., et al., FearNot! – An Emergent Narrative Approach to Virtual Dramas for Anti-bullying Education, in Virtual Storytelling. Using Virtual Reality Technologies for Storytelling, M. Cavazza and S. Donikian, Editors. 2007, Springer Berlin Heidelberg. p. 202-205.

[12] Mateas, M. and A. Stern. Façade: An experiment in building a fully-realized interactive drama. in Game Developers Conference. 2003.

[13] Ortony, A., G.L. Clore, and A. Collins, The Cognitive Structure of Emotions. 1988: Cambridge University Press.