

RATIONAL GAME THEORY AND SERIOUS VIDEO GAMES

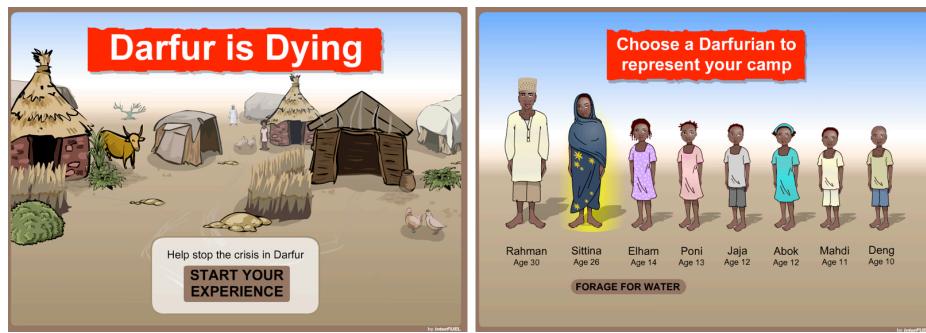
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ABSTRACT AND INTRODUCTION

Game Studies have emerged as a way to contextualize the socio-cultural impact of video games, but what of Rational Game Theory and its abstractions of interactive decision-making into the domains of mathematics, economics, and philosophy? This essay uses examples of serious video games, both produced and in concept stage, to show how they might be analyzed in the context of game-theoretic strategies such as the mathematical Nash Equilibrium and as interactions within philosophical considerations of Virtual Ethics. For the sake of clarity, I define “serious video games” as computational simulations of real-world events or processes that have pedagogical significance over and above their possible entertainment value.

COMPUTER SIMULATIONS OF COMPLEX SITUATIONS



Figures 1 and 2: Opening interface to the mtv.U online game *Darfur is Dying*.

I follow an mtvU.com link to a screen that offers the winning game from their “Digital Activist” campaign. It’s called Darfur is Dying and my first choice as a player is to dispatch one of eight African tribal family avatars out to forage for water. I choose the mom, Sittina, thinking that if she’s anything like the mom in our family, she’s probably the most competent forager, but as soon as I start walking in my stately way towards the well, the aggressive militia runs me over. I

learn from a followup screen that I face a grave risk of rape and abuse. Not being a quitter in spite of adversity, I click on the “Forage Again” button but alas, Sittina is not available for further gameplay. Dead. I guess. What a loser. I choose the dad but am told that adult males do not forage so I settle for Deng, a young boy. I run like hell with my little jerrycan – outrun the militia all the way to the well fill up my bucket, but it’s so heavy I can hardly move and bang, the aggressive militia gets me. Knowing if I choose “Forage Again” I’ll be dead like my mom, I choose to “Enter Camp.” I wile away time trying to help keep the camp’s health meter high but no matter what I do, the militia attacks and when I return to play the game, I’m dead. A loser. No one to team with, no positioning plan to follow, certainly no reward or victory if I can’t even return to camp with any water. No matter what I do as a player of this game, I simply cannot reach my goal of survival. However, since there has been a barrage of informational screens along the way, I know much more about the humanitarian crisis in Sudan.

As Dietrich Dörner observes in *The Logic of Failure*, it is fortunate that computer technology allows us to simulate complex situations, with the aim of solving problems such as humanitarian and environmental crises in Africa (p. 11). In the case of Darfur, Sudan, estimates of deaths from violence, disease, and hunger range from 480,000 to 530,000. Tribal farmers find themselves in perpetual subjugation by the state-supported Janjaweed militia. The *Darfur is Dying* game might lead one to take action as a social activist due to a recognition of the psychological factors bearing on post-colonial oppression, or due to observation of ideologically codified social semiotics, both being valid explorations within the field of Game Studies, but how might this case study be contextualized by the mathematically underpinned study of Game Theory? Despite my best attempts to shape the logic of the *Darfur is Dying* scenario into game-theoretic mixed-motive choice and outcome matrices, this particular case is not a good candidate for Game Theoretic analysis. However, before elucidating the reasons for its unsuitability, and then going on to other cases in which it does bear a factor, I would like to provide a description of mathematical Game Theory. The purpose is to show how it

might be used as a tool to make contributions to serious gaming and yield results that may not be reached in other ways or as quickly.

RATIONAL GAME THEORY AND THE NASH EQUILIBRIUM

Rational Game Theory was developed in the early 1940s by John van Neuman and Oskar Morgenstern as a way to analyze models of conflict and co-operation and to understand decision making. Their theories were subsequently picked up by military strategists and economists such as Luce and Raiff who, in their 1957 book *Games and Decisions*, sought for an equilibrium in selecting strategies by all the players. Since the mid-1980s, Rational Game Theory has become a dominant model in economics, a field in which “rationality” is a benchmark of how well we do in the world and “game” is a strategic interaction.

One of the most prominent practitioners of Game Theory was the American mathematician John Nash. In 1994 Nash was recipient of a Nobel Prize in Economics. He was also subject of the film *A Beautiful Mind*, which, according to Nash’s colleague Avinash Dixit, was hopelessly flawed in its attempt to explain the concept of the Nash Equilibrium. Dixit (2004), in the book *Games of Strategy*, clarifies the Nash Equilibrium (NE) as a game with a list of strategies, one for each player, such that no player can get a better payoff by switching to some other strategy that is available while all the other players adhere to the strategies specific for them in the list (p. 87). Another way of looking at NE in relation to strategic interactions is as sub-game dynamics of positioning, coalition, and looting in which the desired goal is to do the best that one can in any given situation. (Viminitz 2005)

Turning back to *Darfur is Dying*, one can see that many of the keywords in the above Game Theory synopsis are simply not part of the vocabulary of the avatars’ character action descriptions. Where, for example, are possible coalitions or chances to loot rewards? Where are alternate strategies for Sittina and Deng and the rest of the family? How can they maximize their payoffs when all they have to look forward to in the gameplay is continual oppression and victimization? Unless there is an option for Deng or the other able-bodied members of the family to defect from the losing team to the

winning team in what would be called in Game-Theoretic language a “paradox of collaboration,” all they can hope for is continual simple subjection to the torment of hegemonic tyranny. This is fertile ground for analysis based upon post-colonial feminist relativism or ethnographic anthropology, but not a likely candidate to put under the lens of Rational Game Theory. As seen in the game, Sittina and the family are locked into a binary zero/sum game in which they unfortunately do nothing but lose. They are in a situation of oppression, but not of mixed motive conflict and certainly not a model of NE.

IN THE WRONG HANDS

There are startling revelations when we turn the tables to play a Darfur game from the oppressors’ point of view. NE sub-games of positioning, coalition, and looting games suddenly becomes manifest when we take off the suit of the Darfuran victim and put on the uniform of a well-equipped Janjaweed militia fighter – switching our dramatic virtual identity from that of victimized protagonist to that of antagonistic oppressor.

Consider this case study based on *Virtual Battlefield*, a 3-D military training game recently licensed for use by the United States Marine Corp. (*Virtual Battlefield*).



Figures 3 to 5: Screen shots from the game *Virtual Battlefield*.

My name is General Ahmed and my networked Janjaweed war unit and I play for real in this gameplay mission we call “Meet the Aggressor.” We’re shockingly awesome in matching camouflage fatigues, state-of-the-art night vision goggles and the software mission editor even allows us to interactively co-operative on missions using the most fearsome strategic tactics. We jump in our A-10, AH-1, CH-47, UH-60 aircraft, M1A1 tank truck or HMMWV tactical vehicle and easily

crush any enemy village insurgents in our way. In this war game experience, I can command large squads and hold positions, form coalitions with other artillery units, and pull out any one of my bootlegged Libyan-supplied weaponry like M16, M4, M249, M24, MP5, M9, Beretta, LAW Carl Gustav, or Stinger guns to loot and pillage those poor villagers. Wait! Heads up! Here comes one now. Looks like he's on the way to the water well. I communicate tactically to my artillery comrades with full audio capability, "Surround him and take him out!" Bang! Bye bye, Darfurian interloper. We'll see you in refugee camp if you play your cards right but only after we rough you up a little bit. Your mother is inside.

This “Meet the Aggressor” mission is a particularly cruel example of the way a serious war training game might be played if licenced to, or pirated by, the Janjaweed military forces in Sudan. An analogy can be drawn to the September 2006 shooting at Montreal’s Dawson College where a violent video game fell into the wrong hands; a morally irresponsible individual rather than a political regime, but nonetheless bringing on an occurrence of murder and violence.

Unlike the *Darfur is Dying* social issue game, the *Virtual Battlefield* military software enables the player to take action … not as a social activist empathizing with the war victim, but rather as an oppressive force that traces its roots back to Glauconian justice as outlined by Plato’s in *The Republic*. Glaucon is cynical about human nature and he feels that if left unrestrained, humans will revert to natural greedy and selfish cruelty and that morality is a contractual transaction between scoundrels . This diffident attitude of justice served by payback can be systematized into a mixed-motive payoff matrix called the “Prisoners’ Dilemma” or “PD” — the cornerstone of Game Theoretic thinking.¹ *Darfur is Dying* simply does not fit into this PD matrix because there is no mechanism in this simple game for the avatars to defect against each other or to hold power over the oppressors.

¹ The Prisoner’s Dilemma (PD) is a mixed-motive situation in which the police arrest two people whom they know have committed a crime of theft. This offer is made to each prisoner: “If you confess to the theft, implicating your partner, and she does not also confess, you’ll go free and she’ll get ten years. If you both confess, you’ll each get five years. If neither of you confess, you’ll each get two years.” More can be found out about PD as a model of Game Theory at www.wikipedia.org.

On the other hand, the hypothetical “Meet the Aggressor” fits snugly into the model of Rational Game theory, in which rationality is a sign of how one does in the world, and game is a strategic interaction. Playing the role of the oppressor or aggressor in military simulations can situate a player’s virtual identity in a PD mixed-motive payoff matrix that traces its roots back to Glauconian cynicism and diffidence about human nature.

Alas, it is difficult to imagine reducing human decision-making into binary equations as ramified by PD, but according to Game Theory rationale, we are either defectors or cooperators and the natural choice is to defect in order to maximize one’s preferences. Further to this PD extrapolation, Nash Equilibrium game theoretic reductions are exemplified in “Meet the Aggressor.” In that game, the moral agents’ desired objective is to do the best they can in the given situation, so they exercise positioning, coalition and looting strategies – illustrating, in a horrible way, real-world genocidal practices poised to perpetrate crimes against humanity.

As a fortunate move away from diffident Glauconian thinking, seventeenth-century philosopher Thomas Hobbes proposed to move the corpus of human politics away from a position of mutual defection to a position of mutual cooperation, albeit through the implementation of a sovereign police state, effectively allowing courts and government to impose “external” solutions to the brutishness of mutual defections such as war (Hobbes). In the next section, I will analyze and evaluate video games as sets of interactions between smaller game-like situations in “virtual ethics” in order to demonstrate possible “internal,” rather than a sovereign “external” solutions to mixed-motive PD.

GAME THEORY IN PHILOSOPHY AND VIRTUAL ETHICS

Externalist solutions can be both expensive and corruptible, as has been noted by twentieth-century virtual ethicists David Gauthier and Peter Danielson. These Canadian philosophers share a goal of defining “internalist” solutions to PD and in this further study of Game Theoretic reductions, game-playing moral agents set up in the earlier Darfur examples will be tested in Gauthier’s “Morals by Agreement” (MBA) and Danielson’s “Artificial Morality” (AM) systems of virtual ethics.

MORALS BY AGREEMENT (MBA)

Canadian philosopher David Gauthier (1986) developed the first system of virtual ethics as a way to impose “internal” solutions to PD in the 1980s. “Morals by Agreement” (MBA) is concerned with providing a judiciary framework for moral behaviour within a theory of rational choice. Gauthier argued that the rational principles for making choices include some that constrain the social actor pursuing his own interest – actions that he identified as moral principles (p, 3). In other words, MBA brings in a kind of “golden rule” thinking to adopt a cooperative, moral point of view that shifts the essence of morality from mutual defection to mutual cooperation.

An allegory Gauthier uses to explain MBA is the “pill and the orange blob” story – a story that when taken out of its allegorical context can represent a “pill” or “infusion” of religion, indoctrination, operative conditioning, genetics and so on. (Viminitz 2005).

Given that people’s natural inclination is to defect on each other to maximize their own preferences, Gauthier suggests that we give people special pills that provoke an orange blob to form on their foreheads. Then orange blob people scrutinize each other and will cooperate with other orange blob people rather than non-blob people. He called the pills “constrained maximizers” and we can think of the orange blob population as being “Conditional Cooperators” or CC. The non-blob people are psychopathic “Unconditional Defectors” or UD, cooperating with no one.

The next step in this process is applying Gauthier’s game theoretic reduction to construct a small game-like “Orange Blob” situation that functions as a basis for the development of a complex set of interactions in virtual ethics. This could be a short interactive plot nodule, similar to the computational Interactive Drama *Façade*. An orange blob CC player representing, say, a UN peace officer called Juliet, navigates around a typical Darfur village to talk to and identify “friendlies” from among the population morality pool. The object is to discern if they have orange blobs on their foreheads or not. The idea is to determine, on the basis of a simple algorithmic scoring code, what kind of CC scrutiny costs might be incurred

This MBA judiciary framework is limited to two moral dispositions. It is only designed to be played out as one round of interactions as a way to narrow the gap between rationality and morality. Much like the *Darfur is Dying* example, this “Orange Blob” plot nodule could be observed as a Game Studies exploration in ethnographic significance, or, even within Drama Studies, as a computational interactivity experiment. The game does not yet qualify as an interesting extrapolation of Game Theoretic concepts.

AGENTS IN ARTIFICIAL MORALITY (AM)

The second system of virtual ethics as a way to impose “internal” solutions to PD is “Artificial Morality” (AM), developed in the 1990s by Canadian philosopher Peter Danielson (Vallentyne, 1991). AM expands upon Gauthier’s dispositional dualism by bringing two additional moral dispositions into a morality pool that Danielson calls “H-” or “Hobbes-Land.” Appropriately enough, Hobbes Land is named after Thomas Hobbes, whose theory holds that the natural condition of humans in a state of nature is to be perpetually involved in mixed-motive games.



Figure 5: The *Darfur is Dying* refugee camp as analogous to “Hobbes-Land.”

Peter Danielson’s argument, like my own, is that binary dynamics are too limiting to be interesting because pill and blob CCs protagonists would simply take over the pool, thereby causing the psychopathic UD antagonists to die out through a process of rational invasion. Through the addition of two moral dispositions of Unconditional Cooperators

(UC) who, as their name suggests, cooperate with everyone unconditionally, and Reciprocal Cooperators (RC) who cooperate when cooperating is a necessary condition but otherwise defect, Danielson's artificial pool of moral agents becomes a system of four dispositions — CCs, UCs, RCs, and UD. In this system, UC cooperates with everybody; CCs cooperate with UCs, CCs and RCs; RCs cooperate with CCs and RCs, and UD, being psychopaths, cooperate with no one.

Let us suppose that the simple “Orange Blob” MBA plot nodule is first of all played out as “round one” of a complex series of nodules strung together with the goal of trying to find an innovative solution to solving genocide in Darfur through the use of Game Theory. The second round, or what I will call the “Darfur H-Land” plot nodule, might hypothetically be located in the same village only this time with the use of the parameters established by Artificial Morality with its increased dispositional pluralism. In order to conform with the algorithmic formulae below, the moral agents in the disposition pool for this round comprise: Seven CC conditional cooperators, represented by Deng and his teenage friends, along with Juliet and other UN peace keepers; eight UD, represented by General Ahmed and his “Aggressor” psychopaths; six UCs represented by Sittima and all the other “pussycat” moms who cooperate with everybody; and nine of the interesting fourth group of RC moral agents who only cooperate when cooperating is a necessary condition and otherwise defect — a group that is a little more predatory than the typical CC. For the purpose of Darfur H-Land, this new group of RC moral agents can be suitably represented as arms dealers or oil industry turbo-capitalists.

Relatively simple mathematical formulae, based on a payoff utility scoring system that, in this case, do not include the CC and RC scrutiny costs, are implemented to logically prove that populations reach an equilibrium over a round of gameplay. The formula looks something like this for the “Darfur H-Land” round in a payoff system: UD psychos = 4 (i.e., first choice being unilateral defection), CC scrutinizers = 3, UC pussycats = 2, and RC predator/cooperators = 1. The formula is also based on the above-designated quantity numbers of 6 u (UC), 7 c (CC), 9 r (RC) and 8 s (UD) in the population pool.

Formula, if UC, 3 (u-1) + 3c + 1r + 1s

	<u>Total</u>
If UC: $3(6-1) + (3 \times 7) + (1 \times 9) + (1 \times 8)$	53
If CC: $(3 \times 6) + 3(7-1) + (3 \times 9) + (2 \times 8)$	79
If RC: $(4 \times 6) + (3 \times 7) + 3(9-1) + (2 \times 8)$	85
If UD: $(4 \times 6) + (2 \times 7) + (2 \times 9) + 2(8-1)$	70

According to Danielson's system of Artificial Morality, there is only one round of gameplay. The triumphant moral disposition, with 85 points, is the RC or Reciprocal Cooperator group who are represented in the Darfur H-Land plot nodule by the predatory-yet-cooperative businesspeople wheeling and dealing in armaments or oil industry speculations. These simple formulations are made without consideration of variations such as CC or RC scrutiny costs or other variations that could be added at the interstices of plot nodules such as dislodgement thresholds and invasion conditions. Nor do these formulations take into account whether coalition strategies are available or, most importantly, whether multiple rounds are allowed over an epoch of interest. However, provisions have been made in an experimental system of virtual ethics developed by Paul Viminitz called "Artificial Prudence" (APr) that repair constraints of MBA and AM by allowing moral agents to play multi-round non-iterated tournaments over an epoch of interest. As a result, in RC continues to score at least as well as any of his competitors in any given round but does not necessarily score as well as might a moral agent of an alternative disposition, in terms of cumulative take (Viminitz 2003). APr's parametric robustness also understandably brings with it arithmetic complexities, but as software developer Chris Crawford puts it, "The brutal truth is that you must embrace the slobbering monster of mathematics if you are to succeed in interactive storytelling." (Crawford, 102)

If this Darfur H-Land of virtual ethics were developed and produced as a playable game representing the politics and economics that drive the forces behind the genocide in Darfur, it might become a model of a specific reality that could help us reflect on errors and draw conclusions about what actions could be taken in earnest to end the genocide.

CONCLUSION

As seen in these walkthroughs and examples, computer simulations can enable us to observe and record planning and decision-making and examine their determinants in a way that is easier than staging investigations in the real world. In this essay I have used a series of games set in Darfur, Africa that might, if produced, enable a more solid understanding of what the future will hold in Africa and how priorities might have to be established or changed. Dietrich Dörner (1996) concurs that computers can indeed provide opportunities for reflection by providing experimental platforms to bring us face to face with our mistakes. Dörner, in agreement with a long legacy of cognitive psychologists, drama therapists, and creative artists, declares that “Make believe has always been an important way to prepare ourselves for the real thing.” (p. 199)

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