Playing with Game Theory: Deviant Strategies for Digital Design

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Since variety is mostly important to novelty and creativity within design, we looked at Mathematical Game Theory, as an approach establishing a cyclic, because continuously restartable, type of simulation, exploring alternative progressions and variations of systems. It is this systematic production of variants we played with for digital design.

We came up to methods of random and chance, of error and noise, of interaction and cooperation, all of them deviant strategies that have existed within arts and music before.

Keywords: Game theory; strategy; simulation.

Introduction to game theory

“Even if ‘future studies’ are merely a form of play, they can be very useful - like play itself”, wrote the physicist, mathematician, and Science Fiction author Arthur C. Clarke in the preludes to ‘Profiles of the Future’ from 1962. His book is concerned with ultimate possibilities, and not with achievements to be expected in the near future, it does not talk about how things would be, rather how things could be. In this way, it just illustrates the main topic of scientific game theory, which explores the fields of prediction, forecasting and decision-making using methods of statistics and modeling.

During World War II, John von Neumann and Oskar Morgenstern (1944) published their widely recognized and criticized Theory of Games and Economic Behavior, which constructs a formal, mathematical description of a game, and treats human behavior within a schema of alternatives and consequences. By employing the mathematics of point-set theory and of topology, it seeks merely to develop in systematic and rigorous manner a theory of rational human behavior. Von Neumann’s game theory investigates the functions of strategy, aiming at evaluation and determination of possible decisions, events, and consequences within a play. In other words: it is concerned with the development of a mathematical formalism which, in the end, informs the players about the best moves to win a play, and which in this way tries to depersonalize decision making. Claus Pias commented on this attempt of objectifying and anticipating interactive processes that game theory not only absolved from individual charge, but also made the bureaucratic dreams come true (Pias, 2002). These dreams, even applied to military decision-making during World War II, wanted to make processes independent of human intervention by
giving them over to an exact and impartial system. In this sense, game theory, calculating instant data, according to given rules, at a discrete point of time, is enrolled in a theory of digital computation. It is a strategic form of simulation, which is understood as a digital – because discriminating among discrete alternatives – manipulation of models.

We would like to emphasize the potential of simulating different progressions within a game theoretical environment. And apropos, this is the difference between games and game theory: We are not so much into playing a single participatory play for a single design, as it was theorized within the late seventies (JAE, 1979), rather we are looking for ways to explore different game theoretical strategies within simulating several plays. Thereby strategy – in the sense of John von Neumann – is being discussed as complete only virtually, and becoming actual only on the occasion of moves. More precisely: Strategies only appear within single tactics, and they can only be observed on a tactical level, which means only on the basis of information given at a moment of the simulation. The point we are interested in is that game theory aims at optimizing a virtual strategy by observing as many tactics as possible within a game. It is about trying out the variants of a cyclic model, which consistently produces sequences of different patterns and forms. In this sense, virtually exploring all possibilities of a development represents a strategic form of simulation, of creating many-worlds-alternatives, on the basis of which decision-making and acting within complex situations will be feasible. For design this method of systematically creating variants seems to be adequate to actual conditions of information society.

Strategy dynamics is however called an approach within game theory that criticizes von Neumann’s theory as a static model focusing on a single machine made strategy: it is not how it works in real life. Strategy is actually a dynamic and interactive process, which is partially deliberate and partially unplanned (J. Moncrieff 1999). So-called emergent strategies result from opportunities and constraints in the environment, and strategies in action describe series of small actions, which are typically not intentional, not teleological, perhaps not recognized. Rather than seeking for the one and only strategy ‘to win the game’, this dynamic model produces a multitude of strategic outcomes, which are actually able to consider problems that are dynamic themselves. In monitoring these outcomes it is possible to develop a circuit system of strategic critique, learning, feedback, and self-regulation.

It seems this approach to be the post heroic model of decision-making, which could also make sense to design, since it maintains the possibility to react flexibly and creatively on changing situations. How could finally the designer in times of post heroism appropriate this kind of open model?

We have to discuss the production of tactical variants within technical media. Thereby we are focusing on the computer.

**Design and determinate machines**

Up to now, there is no machine, which could handle data, decisions and differences in a way that it could take over designer’s position. Therefore, machines cannot yet replace human intelligence, which is not only integrative, but also creative, in means of association, transfer, intuition and humor. The problem, although much advance has been made, is the same as philosopher and cyberneticist Gotthard Günther had been speaking out on the so-called trans-classical, information processing machines since the 1960ies, and what today would be called the problem of ill-defined problems: „a machine, capable of genuine decision-making, would be a system gifted with the power of self-generation of choices, and the acting in a decisional manner upon its self-created alternatives. (...) the machine displays some independence from the programmer which would mean that the machine has the logical and mathematical prerequisites of making decisions of its own which were not implied by the conceptual range of the programme“ (Günther, 1970).
Heinz von Foerster (1993) called these kinds of machines non-trivial machines, as they are synthetically determined, but analytically – to an observer – unpredictable. In contrast to a trivial machine, which is a machine whose operations are not influenced by previous operations, which is analytically determinable, and thus predictable, for a non-trivial machine, deducing the structure of the machine from its behavior, becomes unsolvable. In this sense, machines become black boxes, when they contain rules, the observer does not know, such as emergent and recursive, self-organizing systems. Cyberneticist Ross Ashby described these machines as black boxes by introducing an observer who sets herself in any relation to a mechanism, who thus distinguishes information at a mechanism, within which not all of the system is accessible to direct observation.

But computers are mostly used as tools for solving well-defined problems, only being regarded as black boxes when malfunctioning; yet they can only simulate black boxes within programmed software.

How can we get together deterministic machines and design? Since design is difficult to be described as problem solving at all, because there can be discovered no problem at the beginning. Design could rather be understood as, in the first hand, generation, or imagination of a problem, as intention of a problem, which then has to be solved or worked out within a series of decisions. Design is actually about an emerging idea of a formal organization, coming out of a human black box, which has to communicate it. The designer, in order to articulate, to concretize, and to formalize his idea, needs to access and involve some kind of media, such as language, drawing or computers. And she has to find a way to come up with the possibilities, characteristics, and conditions of these media, in order to achieve a successful development of her thoughts.

As the idea controls making, and making controls the idea, Ashby calls the design process a communication from maker to made. In the words of information theory, communication is information selection out of a specific set of medial possibilities, and has to consider the novelty of information, in order to be discriminable from redundancy. Selection has to be innovative to be successful within communication processes, and so does design.

It is the term of selection which takes us back to game theory: If we remember the dynamical model of game theory, we will recognize that selections made by a designer, not only do concern a static problem, but this problem does not statically stay the same, but transforms, feedbacks, and evolves within the process. It is up to the designer to come across her strategies, never forgetting the media she is working in, and the development of processes, she is simulating. But this is not all: as design, i.e. selection, depends on its creative and innovative solutions, it requires open developments, which can be simulated within infinitely long game environments. These are simulations including an infinitely large number of possibilities, which may generate complex structures within self-organizational and emergent developments.

For design, the production of possibilities or variants is the most important precondition to novelty, and that the computer could help us simulating and exploring them. For this reason we have to work out strategies for the digital production of variants; remember: final selection is reserved to the designer.

**Random and change**

The concept of randomness, which is formalized within game theory of Markov Chains and within information theory of probabilistic concepts could support processes like brainstorming or other creativity techniques by simplifying variant production and selection. Ashby proved that novelty could not be attained without any random source (Ashby, 1956). Following Ashby, random – as Stanislaw Lem emphasized, the variety generator – enables development and can be used in innovation processes. Therefore, serendipity (the fortunate random) has always been playing a very important role for innovations in science, technology and arts.
It is maybe difficult to imagine the use of combinatorial, stochastic and permutational methods of chance before computers were invented. But random processes have been used to generate aesthetic works defined as aleatory art for a long time. An early example is the Musical Dice Games (musikalische Würfelspiele), in which a dice is used to compose music randomly. In 1787, Wolfgang Amadeus Mozart noted in his manuscript K 516f the instructions for a game to create a Minuet using a dice by cutting and pasting together pre-written measures of music. Other examples in music experimenting with chance and random include stochastic processes of Iannis Xenakis, who worked with Le Corbusier, indeterminate music of John Cage, sequencing and repetition methods of Pierre Boulez, who is the founder of IRCAM, Institut de Recherche et Coordination Acoustique/Musique, to name a few.

Similar to Mozart’s Würfelspiel of “cut and paste” editing, Tristan Tzara, one of the founders of the Dada, introduced the “cut-up” method of random action as a literary technique. In 1920, he proposed to create a Dadaist poem by cutting up a text at random and rearranging it to create a new text.

Tzara wrote about his formula in “Dada manifeste sur l’amour faible et l’amour amer” (Dada manifesto on weak love and bitter love): “To Write a Dada Poem: Take a newspaper. Take some scissors. Pick out an article, which is as long as you wish your poem to be. Cut out the article. Then cut out carefully each of the words in the article and put them in a bag. Shake gently. Then take out each piece one after the other. Copy them down conscientiously in the order in which they left the bag. The poem will resemble you and you will find yourself to be an infinitely original writer with a charming sensitivity even though you will not be understood by the vulgar” (Peterson, 1971).

Beat Generation writer William Burroughs described a method for writing based on “cut-up” experiments of Tzara (Burroughs, 1961), and invoked John von Neumann to investigate the uses of the “cut-up” technique. Burroughs considered the legendary book of game theory as an introduction of the cut-up technique into game and military strategy. He also demanded advantageous applications of game theory for artistic and scientific fields by wondering, how many discoveries have been made by accident.

One of the most significant projects using the concept of chance in visual arts was a ready-made by Marcel Duchamp; Trois stoppages étalon (Three Standard Stoppages) of 1913. He defined it as his most important work, because he created it by dropping three threads on to three Prussian blue canvases and sticking to the surfaces without any adjustments to the curves that chance dictated they fell into.

Whoever, Mozart, Tzara, Burroughs, or Duchamp, used chance procedures as a creative method they all delineated some combinatorial, stochastic and permutational formulas or recipes. In other words, they all described algorithmic processes, which can actually be implemented in computers that generate random results. If they were living today, they would definitely program to generate random sequences for their art works.

Computers generate pseudo-random numbers using algorithms that are seeded with the current system time. On a computer, it is impossible to generate true random numbers but as we cannot predict the results, they are random for us. A sequence of events is said to be random if there is no way of predicting the next event of a given kind from the event or events that have preceded and if the system obeys the regularities of probability (Bateson, 1979).

Gregory Bateson emphasized the value of the unpredictable, and maintained that the creation of new forms is not possible without any potential of chance and without any background of noise. All that is not information, not redundancy, not form and not restraints is noise, the only possible source of new patterns (Bateson, 1979).

We programmed a simple application, called deconstructivism generator, illustrating random; it produces new forms and compositions from 3D objects.
Error and noise

Mathematicians of the first half of the 20th century loved strategy games. In order to avoid any chance within playing, John Nash developed a game called Hex, which strictly worked upon logical rules (Milnor, 2002). Whoever made the first move and did anyhow lose, had made a strategic error. Until the nineties, game theory was concerned with the optimization of strategies, ignoring, that within arts, errors had been raised to an advanced strategy.

Futurist theory of Luigi Russolo (1913) is the first approach to ‘the art of noise’. Under the paradigm of classical modern innovativeness, he declared that only noises kept innumerable surprise in reserve, as they appear, in contrast to conventional music, irregular and confuse. Never entirely revealing themselves, all selected and coordinated noises would enrich men with a new and unexpected sensual pleasure. In his manifesto of 1913 Russolo asked for continually enlarging the fields of sounds towards the most complicated dissonances, by a variety of tones of noises, reproduced with appropriate mechanisms. Thus, Russolo built what he called the «intonarumori», acoustic noise generators that permitted to create and control in dynamic and pitch several different types of noises similar to those made by machines, but without imitating or reproducing them. These sounds were to be understood as «abstract materials», which could be controlled by the musician. Although, he claimed that his aim was not the creation of cacophonous sound, but rather a rigorous research into acoustics and harmony, his first concert in 1914 caused a huge scandal in Milan. Today, he is considered to be the first theorist of electronic music.

Computer theory came to the topic of noise from different paths. Only by learning from genetic coding, where enforced errors were firstly introduced to the deterministic computer, to widen the functionality of a system simulating mutation of natural evolution, computer theory is now considering error and noises as an important topic (Trogemann, Viehoff, Roch, 2000). Not only in the sense of industrialized hacking, where errors and mistakes of systems are hunted, in order to debug them, but also as a creative function, which is able to produce new connections and relations. Computer errors either triggered by the user or by the system itself, crop up all the time, completely unpredictable, beyond the borders of intention or conception. Finally they remembered Albert Einstein stating: “Anyone who has never made a mistake has never tried anything new.”

Japanese architect Kei’ichi Irié declares the occurrence of errors within computational design as chance, to exceed the borders of constrained imagination. In his eyes, ‘autogenerative processes’ within design could produce ‘what would happen if’ outcomes, and things, which rarely occur in the real world. Following Irié, previous schemes of architectural planning lack a tolerance of noise and errors. In contrast, his method could be compared to a computer program, which gets some input data, processes them, and externalizes them spontaneously.
to any output device. Thereby the computer is not turned into a drafting tool, it is rather used as an extension of thought processes, which can be revealed in a mechanism, and then manipulated. Experimenting with bugs, errors, and random, as he states, produces formations, which reveal basic premises as mental blocks, as only one set of options out of a vast array of possibilities. In contrast, random techniques would create a virtually endless and heterogeneous field of non-ideological variants, which could enrich hard-set design built on a bank of preliminary constraints. Irié even commented on his collaboration with a major industrial housing company: “Look at even the biggest manufacturing mechanism and you'll see in it what you might call a guiding will program, which is nothing more than an utterly, simple main routine with lots of sub-routines. You have only to understand the program and you can write whatever bugs you like. That is, just re-writing a few particulars, you can actually create maker-name mass productions. And what’s been created is in no way a work that my own architectural philosophy; it is an incidental re-write in a gigantic mechanism, a product of today's world. By creating a glitch in gigantic system, suddenly that system gives off a bright flash, a fresh dynamism.”

The term glitch derived from the German ‘glitschen’, to slip, describes a short-lived fault in a system, and is used in computing and electronic industries. Since the 1990ies it has been adapted to name a genre and a method of electronic music working with clicks and cuts to generate new qualities of electronic sound. That is, it splices together small “cuts” (samples) of music from previously recorded works. These cuts are then integrated with the signature of Glitch music: beats comprised of glitches, clicks, scratches, and otherwise “erroneously” produced or sounding noise. At the same time the computer technology allows exact timing, repeats, and perfect symmetry within the music, which, beyond errors, expresses a deep understanding of digital logic, patterning and order (Ilschner, 2003). There is more than a futuristic ideology of technology, Glitch rather adopt a ready-made thought of John Cage, who claimed that by staging, any sound could become music. Glitch technique does not try to reproduce, as far as possible, analogue sounds of existing instruments, but tries to generate autonomous electronic music, which is reflecting medial conditions of digitalization. By reducing electronic music again and again to its basic structures, it is possible to totally reconstruct music within digital media (Ilschner, 2003). In terms of game theory, we could call this method, the reset of a game environment, to start playing anew, under different parameters and conditions. In this way, Glitch music experiments upon different roles and places, which are assigned to different sounds and rhythms, thus producing new sound escapes. In other words: looping, differentiated in iteration, recursion, and repetition, comparable to the repeatability of game theoretical models, seems to be a powerful strategy for design, composition, and formation.

We coded an application of data type conversion, which could be understood as Glitch technique, as it represents a set of data in an erroneous way: instead of outputting the text data into text signs, we channeled them into a pixel graphics, which does not make any difference to the computer but to us, as for us sense is totally lost. What reminds, are structural or rhythmical patterns of the text, the skeleton of an architecture that can be reused in a different context, just a form of recycling, or a ready-made strategy, producing an aesthetics of failure.

Interaction and cooperation

It was game theory, which primarily simulated interaction and cooperation. Robert Axelrod (1984) developed a model of the evolution of cooperation within the eighties. In his Prisoner's Dilemma game, there are two players, each of which has two choices; cooperate or defect. Defection will always yield a higher payoff than cooperation, no matter what the other does. The dilemma arises from the fact that if both defect, they are both left worse off than if they
had both cooperated. If B cooperates, then A gains more if A does not cooperate. If B does not cooperate, once again A gains more by not cooperating. However, the reality is that interactions amongst human beings are much closer to the iterated prisoner’s dilemma game, which shows the emergence of cooperation.

For design, there has been no other opportunity than cooperating since its beginning. But it seems up until now that it is about forms of division of work, which is characteristic to design and architecture. We are rather interested in sharing the same process, by working simultaneously, by feedback and criticizing, and by communicating – in one word: by interaction.

Approaches to computing have tried to include interaction since the sixties (Licklider, 1960), for broader models of thinking and of research are needed to express all possible scientific and design questions. Computational processing requires open testing of assertions about design problems beyond closed-box mathematical function evaluation. In this sense, computation should emphasize open processes involving interaction among machines and users, rather than the closed transformation of an input to an output. Computer scientist Peter Wegner claimed: “The radical notion that interactive systems are more powerful problem-solving engines than algorithms is the basis for a new paradigm for computing technology built around the unifying concept of interaction” (1997, p. 81).

Even if we do not follow Wegner’s opposition of rationalist and algorithmic Turing machine versus empiricist interactive machine, we can learn a lot from his approach: The irreducibility of interaction to algorithms demands for a reflective and systematic behavior of the actor or agent – the designer within our case – in interaction with the computer. All these forms of interaction can transform closed systems to open systems, which are characterized by interaction histories describing the behavior of systems over time. Thereby interactions work through interfaces, which can be described as primitive building blocks of interactive systems, and thus as central media of interaction. Designers will have to include this topic of interfaces to their personal strategic system, and thus make interaction to their strategic focus.

We believe this interaction should be some kind of complementary, deviant interaction, using, as described above, random and failure, exploring aesthetics of noise, experimenting on variation, in order to make the computer a machine of indeterminacy. Strategic interaction could make the computer a catalyzer of novelty.
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