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Emotion Engineering in Videogames

Toward a Scientific Approach to Understanding the Appeal of Videogames

(v 1.0.4)

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This is a very exciting time to be a videogame designer.
Videogame design is evolving from a barely understood activity done by genius designers driven by their gut feelings to a craft with shared techniques and methodologies. A common vocabulary cobbled from various fields (interface design, psychology, complex systems, physics, etc.) is slowly emerging. Successes and failures are analyzed...
But it's still a big mess, a large toolbox where any designer can find the right tool to confirm exactly what he believes in. There are no universally accepted truths, only opinions about what makes a great game, whether or not videogames are an art form or whether there is an effective method to teach videogame design.
We lack ways to compare games in an objective manner, ways to describe them in a shared language. Without proper description, there can be no true understanding. Success in videogames still hinges on applying traditional techniques, copying, marketing, luck or genius. And even if success is achieved, there's no guarantee that we can know why it happened.

Arts and sciences have rules and laws, not just techniques. But what are the rules of videogame design?
Where is our redox law? Our perspective rule? Our theory of relativity?
Where are the formal tools we can use to better understand, analyze, and improve games?
How big is the game design space and can we identify its virgin territories?
What are the rules we can bend or break to create totally new experiences?

This article presents a theory of what videogame game design is and explains how to find some of these rules.

> Caveat: If I sound pedant or over-confident in this article, please prefix any affirmation I make with "I modestly believe without being able to prove that". This work has generated many hours of doubt and self-doubt. I do not pretend to teach anyone the definitive meaning of trust, catching-up, fear, or of collecting a power-up. This is an ongoing work, as the version number above attests. If you disagree with me, please tell me why and I'm sure you'll be convincing enough to change my mind.

That said, let's start with easy questions that have clear answers: "What is game design?" and "What is a good game?"

What is Game Design

Players don't play to complete games, just as readers don't read to finish books. Players play to feel emotions. Game design is experience crafting for the purpose of emotion engineering.
Game design is intrinsically hard because its output is an interactive system that is twice removed from its goal. The game designer produces rules for interaction that, with the participation of the player, generate game states that themselves induce emotions in the player.

> Note: In [Emotional Design](#), Donald Norman describes three different levels of experience processing: visceral (how it makes the person having the experience feel), behavioral (how well it suits its purpose or function), and reflective (how it affects the person's self-image). Games can have a behavioral aspect, from being a learning tool to a systemic demonstration of a concept. This article focuses on the other two aspects: how games can have an emotional impact on their players.

If we can describe a given game state using a set of gameplay variables, we get the following cycle:
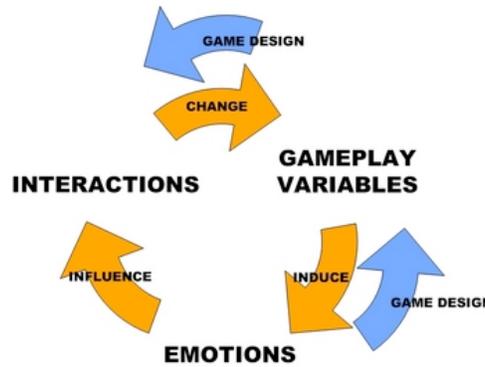
Interactions between the player and the game produce changes in the gameplay variables.
For instance, finding a heart container in Zelda and getting a bigger full health bar obviously changes *something* in the game state. We'll explore below what this could be.

Variations or stability of these variables induce emotions in the player.
For instance, having a bigger full health bar could make him more confident.

Player's emotions influence how he interacts with the game.
For instance, being confident might make him take more risks; pride might keep him chasing a high score; or boredom might make him stop playing altogether.

Some of these emotions are the result of a carefully crafted sequence of events. Others stem from the normal moment-to-moment interaction with the game. Since the players and their playing experiences are so different from one another, one cannot guaranty that a given player will feel a given emotion at a given point in a game. However, from our understanding of physiology, psychology, cognition or culture, we can identify situations that create the proper context for the expression of such an emotion.

> Note: This article is not about creating emotions with the content, the subject matter or the story, but through interactions with the game alone. Indeed, these are integral parts of the whole - emotions are enhanced by the appropriate setting or story - but the subject has been talked about at length by better qualified people elsewhere. So I'll skip this for now.

Game design works backwards around this cycle, trying to predict player emotions from changes in the interactive system. But our knowledge of the dependencies between interaction and emotion is so sparse that most changes require testing. Testing in part requires implementing the changes, which costs time and money. Thus, in a professional setting where budget is an issue, game design innovation can quickly become a risk.

In The Chemistry Of Game Design, Daniel Cook outlines the benefits game designers would draw from a standardized quasi-scientific descriptive model. Such a model would help game rules design, iterative design, experience design, and even game testing, thus reducing the cost and risk of game design. If we extend his metaphor to biochemistry, we - like Watson and Crick - aim to unlock the secrets of the DNA of game design, but we're still struggling to become Mendels. Gregor Mendel was a 19th century monk who is known today as the father of modern genetics. Around 1860, he spent seven years experimenting with pea strains hybridization in his monastery's garden. His observations combined with some amazing insights led him to the discovery of the characters of heredity.
I think that if there are no widely accepted grand theories of game design, it's because Watson and Crick's discovery was built on Mendel's, and we're still lacking such a base. Mendel's success stems from the tedious repetition of a loop familiar to game developers: tweak some parameters, wait, observe and measure. But Mendel had an advantage over us: being a botanist, he had a fairly good idea of what to observe and measure: colors, shapes, textures, size, growth rates, etc. [Furthermore, he didn't care if his peas looked or tasted great, when game designers are trying to understand what make games good while making good games.]

If Science = Measures + Insight, what should *we* measure in our games to move toward a scientific understanding of game design, and how can we equate these measures with quality?
Measurement of game assets and gameplay is nothing new (be it Ben Cousins' systematic studies within a genre or Microsoft's usability labs), but I'm looking for **abstract game variables** that could measure any game in any genre.


What is a Good Game

If we could agree on what a good game is, the description would be a starting point for finding the gameplay variables that, like botanic for Mendel, would help us objectively measure game characteristics. Unfortunately, there are as many definitions of what a game is that you care to look for. There are fewer of what a good game is but it's still staggering. So I'll just pick one I like:

"A [good] game is a series of interesting choices" - Sid Meier

In my experience, this koan sticks to the memory of every designer who hears it, so there may be some truth in there. Let's parse it.

Choices imply that the player has a certain degree of **freedom**.

Noah Falstein (referenced here) professes that one can map the availability of choices during a given challenge to a convexity. A typical challenge starts with few choices since the starting conditions are set. As consequences from the first choices materialize, the sub-space of the attainable game space grows, thus increasing the number of available choices. When success or failure conditions are met, the number of choices decreases until the challenge is completed and no choices are left. This is for instance how the game can lead the player toward a climactic ending. What is interesting in this description is that it shows that choices are something we can count.
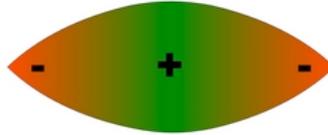
Convexity of available choices during a challenge

Falstein goes on to note the fractal nature of convexities in a game. Long-term goals can be attained by choosing between options of medium-term missions, themselves composed of short-term challenges.
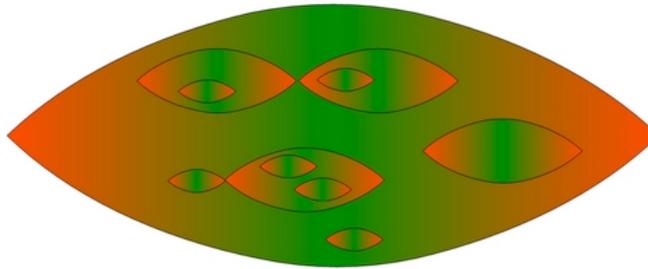
Sequences of fractal convexities in a game

This means that **freedom** is not one of the variables we're looking for, but more probably a defining characteristic for **a series of variables**. Since more freedom or more choices is not always better, we shouldn't be looking for ways of maximizing the values of our game variables, but for ways of attaining the ranges in which they procure the experience we want to design.

Next, a *choice* is only real if it is informed, meaningful and irreversible.

> Informed choice: To be able to make a choice, the player must be provided with a **system** of rules which logic he can understand and that he can trust to be consistent. Otherwise, his choice is random since he cannot predict its consequences.
> This is how, for instance, he can choose which unit or building to produce in a RTS.

> Meaningful choice: The player must have sufficient **data** to describe the context of his choice, the objects of his desire, his options, and the costs associated which each of them. If there are no costs, it's not really a choice since each option can be tried in turn. If there are neither costs nor contexts, choices don't matter. Context can be simple (*Placing a block in Tetris*) to extremely complex (*Final Fantasy X's sphere grid experience system*). Cost can vary from small (*Buying a potion when the player has plenty of gold*) to big (*Choosing one's character class in a MMOG, limiting the content one can experience*).

> Irreversible choice: A choice, to be truly significant, must create a set of conditions that have a high degree of **persistence**. Otherwise, this means that the cost paid is meaningless.
> For instance, a player can change his mind after committing to a Zerg rush strategy in Starcraft, but it will cost him time, require some effort, and impede his chances of winning.

Incidentally, this means that some game variable changes can be **temporary** - those that are the consequences of actions that are not considered choices, like most actions performed by the game's systems.

Finally, making a *choice* implies that one has the means to act upon it. It would be of no use to the player to decide where to go if Mario couldn't run or jump. So **action** is also one of our variable characteristics.

A *series* of interesting choices implies a structured experience, an overarching context. Such experience can be qualified by how it changes the player (**self**) or his relation to others (**social**). If the experience didn't affect the player, it would just be wasted time and energy.

Lastly, if the choices are *interesting,* they're neither boring nor trivial. They're challenging. In A Theory of Fun, Raph Koster posits that fun stems from dealing with challenging situations and acquiring skills to solve them. Similarly, Daniel Cook tracks the player's **mastery** with skill trees.

Game Design Variable Categories

This list of concepts needed some structure to become useful. It eluded me until I remembered Will Wright's amazing [Dynamics for Designers](#) lecture at GDC 2003. His ability to describe the possible dynamic systems in a neat multi-dimensional taxonomy was eye-opening. I decided to organize these concepts into orthogonal families that would provide the axes for various tables. The first one describes the categories of variables:

	Freedom	Mastery	Data
Action	Opportunities, Tools and Abilities	Trained reflexes, Tactics	Game world resources and collectibles, Operational rules
System	Exploration, Experimentation, Purpose	Learning skills and using them to gain more control	Preparation, Constitutive rules
Self	Strategy, Creativity	Exploiting skills, knowledge and metagame data	Mementos, Achievements, Memories
Social	Community support, Shared experience	Competition, Cooperation, Teaching skills	Status, Metagame, Implicit rules

Action is the level of the body, the visceral, immediacy and short feedback loops.

System is the level of the mind, the cognitive, logic and plans.

Self is the level of the soul, reflexive thoughts, goals, private experiences and inner changes.

Social is the level of the community, shared experiences, rituals, culture and relationships.

Freedom deals with measuring choices and opportunities for choices.

Mastery deals with measuring skills, their acquisitions and their uses.

Data deals with measuring content, information, rules and real-life objects.

Freedom at the Action level: Everything that empowers or hinders the player while making short-term choices. Action opportunities (*An enemy presenting its weak spot, Finding a key in a Zelda dungeon*). New tools allowing new interactions (*Zelda's boomerang or grappling hook, Mario's flying cap*). New abilities (*Increased health, Increased strength*).

Freedom at the System level: Everything that empowers or hinders the player while making medium to long-term choices. Avenues of exploration (*Free-roaming gameplay*), clear goals (*Getting a quest*), letting the player experiment with the rules and creating safe environments where to do so.

Freedom at the Self level: Everything that empowers or hinders the player while making choices about the nature of his experience. Strategic and creative thinking (*Specialization, Self-imposed limitations, Speed runs*). Content creating tools (*Level building, Customization, Machinima*).

Freedom at the Social level: Everything that empowers or hinders the player in his relationship with other people. Facilitated multiplayer experience and modes. Sharing content and experiences. Active community. Community support and community management tools. Social image conveyed by the playing experience (*Coolness, Geekiness, Weirdness, Novelty, etc.*).

Mastery at the Action level: Everything that empowers or hinders skill acquisition and skill use at the immediate or physical level. Athletic skills. Rapid appreciation of the parameters of a situation and appropriate response (which can imply the forming of a medium-term plan). Training. Immediate feedback. Affordance.

Mastery at the System level: Everything that empowers or hinders cognitive skill acquisition and skill use. Giving the player the level of control he needs to act on his plans (agency). Providing information about the constitutive rules (see below) (*Tech tree in Civilization, Graphs in SimCity*). The ability to exploit these rules. It's the dynamics in [Robin Hunicke](#), [Marc LeBlanc](#) and [Robert Zubek](#)'s [MDA framework](#).

Mastery at the Self level: Everything that empowers or hinders skill acquisition and skill use that allow for better control over the game experience. Exploiting metagame data (*Reading a walkthrough*). Ascribing own meaning to the experience. Feedback about the learning process (*Being encouraged, congratulated, rewarded, mocked, stirred up, etc.*).

Mastery at the Social level: Everything that empowers or hinders skill acquisition and skill use at the social level. Exploiting the [metagame](). Learning to bluff. Shaping one's image in the community. Being invested with and performing a role. Competing for ranking. Group play (*Guild raids*). Being a mentor.

Data at the Action level: Information that takes form in the game, that can be interacted with (*Health pack, FFVII's materias*). Persistent information at this level can take the form of a collection (*Pokémon's Pokédex*). [Katie Salen]() and [Eric Zimmerman]() in [Rules of Play]() define the operational rules as what we usually call the "rules of the game", the ones you have to know to be able to play (*The ranking of hands in poker, Press A to jump, No credit in RTSs or RPGs*).

Data at the System level: Information about the game state. Player preparation (*Setting-up the Tetris board so as to clear four lines with an I piece, Equipping a dragon-slaying sword before fighting a dragon*). The constitutive rules that, according to Salem & Zimmerman, describe the inner workings of the game (*AI, Physics, Catch-up behaviors*). The player doesn't know them at first but he can learn or guess some of them. It's the mechanics in the MDA framework.

Data at the Self level: Information relative to the relationship between the player and the game, to the act of playing. Trophies, traces left by the experience or created by the player.

Data at the Social level: Information governing the relationships between the player and other people (not necessarily players themselves), as it pertains to the game. Metagame information (*Strategy guides, Forum discussions about the game, Fan fiction*). Badges and honors linked to reputation and achievements. Salen & Zimmerman's implicit rules, the rules of etiquette, of the [magic circle](), that should be respected without having to mention them. They include social rules (*Don't be a jerk*) and game-specific taboos (*Don't spy on someone else's monitor in a competitive multiplayer game*).

Second caveat: These are not our variables but the categories they belong to. A given game can thus have an influence on several variables in the same category, linked to different processes or systems. For instance, Freedom at the Action level in GTA handles both the choice of paths and of vehicles. This means that this model is still incomplete, each cell being its own dimension. However, I believe this is the most detailed generic model using these variables. A more detailed model would require specific sub-categories for each cell, a work that is well beyond the scope of this article.

Although this table went through many revisions, I cannot affirm that it spans the whole of game design space. After all, I have only experienced a limited subset of the currently known games. However, I seem to be able to describe the effect of any game interaction I can think of as variations in one or several variables belonging to these categories. Whether I'm on to something or have thoroughly blinded myself is for you to judge.

Since these variable categories are abstract, it may be difficult to understand how they're linked to concrete interactions. The two following tables give examples of how game interactions cause changes in variables in each of these categories. The first table shows changes emanating from the game's actions, the second from the player's actions. Changes can be either temporary (requiring little effort to cancel) or persistent (affecting the value of the variable durably).

GAME INDUCED VARIABLE CHANGE			Major Decrease		Minor Decrease		Minor Increase		Major Increase	
			Temporary	Persistent	Temporary	Persistent	Temporary	Persistent	Temporary	Persistent
Action	Freedom		End of big action opportunity	Linear path, Difficult to find options (*Confusing menus, Quasi-modal controls*)	End of action opportunity, Misleading cue, Temporary loss of ability	Avatar death and respawning, Local reset, Simulation conventions (*Usable vs. non-interactive objects*)	Action opportunity (*Timed door opening*), Resource gain (if player can choose how to spend it)	New minor persistent ability (*Gauge increase*)	Big action opportunity (*Flying cap in Mario*), Large resource gain (if player can choose how to spend it)	New major persistent ability (*[Orthogonal ability - Harvey Smith]()*)
	Mastery		End of big advantage opportunity, Misdirecting affordance	Permanent loss of ability, Inappropriate controls, New controller (*Guitar Hero, Steel Battalion*)	Temporary loss of ability, Randomness	Difficulty increase	Advantage opportunity (*Block + Counter combo*), New short-term goal (if game is balanced)	Affordance, New ability to trade resource for preparation (*Increased life gauge, Buff*)	Big advantage opportunity (*Exploiting an enemy's weak points*), New medium-term goal (if game is balanced)	Kinesthetic isomorphism (*Wii Golf*), New persistent ability, Insufficient difficulty increase
	Data		Large resource loss	Inability to complete collection (*One way journey in Beyond Good & Evil*), Iconic /	Resource loss	Allow permanent world change (*Broken things, NPC death*)	Resource available	Allow permanent world change, Collectible available, XP available	Large resource available	Rare collectible available

				Symbolic content *(Super Mario World)*					
System	**Freedom**	Non interactive scene, Railroading	Deadlock, Hidden depth *(Negative feedback for early experimentation)*	Guidance *(Goal highlighted on map)*	Clear goal, Simulation conventions *(Most NPCs have no memory)*	Concurrent goals, Parallel challenges	Unlocking content, Easter egg *(Hidden content)*	Alternative methods, Parallel challenges with mutual assistance *(Noah Falstein)*	Safeguards, Error catching
	Mastery	Increasing difficulty of current challenge	Inappropriate complexity, Cheating opponent or AI, Hidden rules	Involuntary gameplay mode switch *(Stealth / Flight)*	Complexity increase, Negative feedback *(Catch-up)*, Inconsistent or random behaviors, Balance, Homeostasis	Hint, New long-term goal (if player has agency)	Positive feedback *(Limit moves)*, Negative feedback *(Catch-up)*	Lowering difficulty of current challenge *(Dynamic Difficulty Adjustment - Daniel Arey, Evan Wells)*	Consistent behaviors from game entities, Insufficient complexity increase, Iconic / Symbolic content with clear affordance *(Super Mario World)*
	Data	High cost of failure	Lack of structure, Large score penalty, Unusable resource *(Gold excess in Zelda TP)*	Preparation erosion *(Time-limited buffs, Evolving conditions)*	Score penalty, Hidden useful information	Preparation *(Buff, Choosing the right equipment for a given challenge, Tactical positioning)*, Easter egg *(Rules data)*	Tutorial, In-game help, Score increase *(Conditional bonus)*	Emergent behavior	Consistent behaviors from game entities, Large score increase *(Conditional multiplier)*
Self	**Freedom**	Tedious tasks, Inability to pause or save game	Repetitiveness, Lack of depth, Expensive game *(Add-on, Fee)*, Time-consuming game	Bad context description *(No access to mission briefing, No map, Invisible trigger)*	No surprises	Checkpoint	Giving player time to think, Low pressure, Numerous checkpoints	Automated quicksave, Shortcut, Sequence of discrete challenges *(Planets in Super Mario Galaxy)*	Short levels, Quicksave and Instant reload mechanisms, Short game
	Mastery	Unwinable challenge (Without the player's clear understanding that he must lose) *(Must be detected to trigger story event in stealth game)*	Confusing rules with no feedback for wrong interpretation, Inappropriate difficulty, Inefficient interface, Unpredictable behavior, Deception *(Unfair Platformer)*	Pretend danger *(Non-attacking enemies)*	Violating cultural rules or meanings	Game opponent with obvious AI flaw	Acknowledgement of player's progress, Encouragement	Teaching a design meta-rule *(Enemies can't hurt you until you engage them in combat)*	Clear context *(Display current mission briefing after loading game)*, Status, High score, Emergent behaviors
	Data	Lack of progress feedback, Lack of context in loaded game	Lack of content, Lack of variety, data loss, Short game, Recycled content *(Fight same boss twice)*, Violating IP rules	Minor bug, Mode hiding data from another mode	Breaking the fourth wall, Crash, Losing data	Progress feedback *(Map update)*, Data management in menus, Options configuration, Easter egg *(Metagame data)*	Customization (outside abilities), Merchandising, Achievements, Metagame data *(Play stats)*	Introduction to new setting, Story exposition	Save game, Journal, Respect for IP
Social	**Freedom**	Badly designed matchmaking, Being kicked, Server down	Alliance, Cooperation, Being banned, Unreliable service, Online game closes down	GM arbitration, Toading	Enforced community etiquette	Facilitating player communication between challenges	Modding support	Good matchmaking	User-created content repository or sharing facilitation
	Mastery	Irresponsive GMs, Not restricting access to newbie-unfriendly areas	Cheating allowed, Exploits, Lack of community management, Lack of community self-management tools	Allow ganging up	Difficulty to communicate with other players, Lack of real-time communication tools or customization	Player ranking for one challenge *(Podium)*	Newbie support *(Asheron's Call's allegiance system)*, Training grounds for groups	Cooperative modes, Group achievements, Newbie greeting ritual	Ranks, Badges, Ladders, Automatic publication of high score, Elder game, Complementary roles *(Classes in MMOG)*
	Data	Lack of official response to problems or rumors	Community data loss, Other players' anonymity	Allow spam	Lack of community nexus	Acknowledgement of players' interactions *(TF2, Burnout Revenge)*	Player association customization *(Insignia)*, Metagame data	Beta testing, Meme, Viral marketing	Reputation system, Player association support, Social

								(FAQ), Group achievements		network tools

PLAYER INDUCED VARIABLE CHANGE		Major Decrease		Minor Decrease		Minor Increase		Major Increase	
		Temporary	Persistent	Temporary	Persistent	Temporary	Persistent	Temporary	Persistent
Action	**Freedom**	Loss of big action opportunity	Trading resources in large amounts	Loss of action opportunity	Trading resources *(Buying abilities with XP, items with gold)*	Experimenting with controls	Acquiring minor action skill *(Long jump in Mario)*	Big action opportunity *(Flying cap in Mario)*	Acquiring major action skill *(Rocket jump)*
	Mastery	Loss of big advantage opportunity, Failure to complete a challenge	Inability to complete a challenge, Grinding	Taking a risk, Tactics	Difficulty increase *(Choosing the difficulty level)*	Exploiting advantage opportunity *(Ongoing combo)*	Trained reflexes	Exploiting big advantage opportunity *(Exploiting an enemy's weak points)*	Highly trained reflexes, Known interface metaphor *(Drag and drop)*
	Data	Large resource waste	Inability to complete collection	Resource waste, Reward perceived as too small	Permanent world change *(Broken things, NPC death)*	Resource collected	Permanent world change, Collectible found, XP won	Large resource gain	Rare collectible found, Collection completed
System	**Freedom**	Local resolution	Game over	Sticking to tactics *(Setting up an ambush)*	Purpose, Clear chosen goal	Generating opportunities, Pursuing concurrent goals	Unlocking content	Trying alternative methods	Aimless wandering
	Mastery	Failure of wrong plan	Inadequate mental model	Losing the lead	Opponent's negative feedback *(Opponent catch-up)*, Inefficient rote learning	Exploiting preparation, Taking the lead, Voluntary gameplay mode switch *(Stealth / Kill)*	Completing a challenge, Chunking, Statistical analysis	Lowering difficulty of current challenge *(Choosing the difficulty level)*	Grokking the rules, Exploiting emergent behavior, Winning, Min-maxing
	Data	Costly failure of right plan	Pursuing costly wrong plan	Loss of preparation, Mistake	Forgetting a rule	Preparation *(Buff)*, Opponent's mistake	Ability customization, Learning a rule, Score increase	Loss of understanding	Learning meta-rules, Perceptual breakthrough, Large score increase
Self	**Freedom**	Misunderstanding feedback, Doing tedious tasks	Quit, Grinding, No experimentation	Being stumped by a puzzle, Being unaware of a choice, Being lost in a world	Favorite tools or methods	Speculating, Experimenting	Setting one's own challenges, Playing a role	Planning, Strategy, Taking a shortcut *(Teleporting)*	Making new content, tools or rules, Apophenia
	Mastery	Pareidolia, Misunderstanding the rules, Big recurring mistake	Perceived cheating on the part of the game, Apophenia, Misunderstanding the rules	Recurring mistake	Blind spot	Reactivity, Correct prediction of opponent's choice	Training, Exploring rules and content	Correct prediction of opponent's strategy	Mastering a skill, Learning a pattern (Raph Koster), Obtaining high score, Looking for emergent behaviors
	Data	Losing access to data	Losing data, Violating IP rules	Temporary forgetting data	Forgetting data	Options configuration, Own progress record *(Drawings in Zelda PH)*	Customization (outside abilities), Using metagame data *(Reading a FAQ)*, Things, Achievements	First encounter with content type or rule system	Save game, Journal, Appreciation of IP use
Social	**Freedom**	Cooperation	Alliance, Team play	Short-term cooperation *(Medic in TF2)*	Community etiquette, Pledge	Discussing about experience	Group setting one's own challenges, creating own interpretation or mythology, Roleplaying to an audience	Multiplayer Planning	Betrayal, Sharing new content, tools or rules, Anticonformism *(Non-violent Warrior character)*

|								
Mastery	Being subjected to griefing	Anticonformism (if shunned) *(Roleplayer on PvP server),* Community feuds	Humiliation, Violating cultural rules or meanings, Low signal to noise ratio	Bad reputation, Failing to attend group activity	Bluff, Deception, Recurring opponent's mistake, Being group tactician	Dominating an opponent, Mentoring, Teaching a skill, Good reputation, Correct response to cultural cue	Psychological warfare, Cooperation, Multiplayer training	Status, Publishing high score, Sharing secret exploits, Team victory, Being a leader
Data	Losing access to community *(Server / matchmaking down),* Trolling	Player association dissolution, Losing community data	Blocking chat channels / users	Player association reorganization, Unmanageable community size / dynamics	Managing social network, Online trading and game objects auctions	Creating metagame data *(Writing a FAQ, Community record keeping),* Achievements, Team achievements	Community event, Rumor, Meme, Past experiences of playing the same game with the same people	Community lore, Community rituals, Roles, Reputation, Relationships, Whuffie, Player association

About these tables

Some items appear in several cells. Complex interactions, like for instance "Being stealthy", have too many concurrent effects on the game variables to fit into two or three cells. They must be broken down into simpler parts if we want to analyze their influence.

If I have chosen to represent these game variables as mono-dimensional numeric variables, speaking of increase and decrease in their values, I have no idea which units I should use for them. Is freedom quantified by counting available choices weighted by their importance or is it a succession of fitness functions rewarding more and more states in the game space? At this early stage, it matters little if we can recognize fluctuations in values and roughly evaluate their relative sizes, which I believe is the case.

Emotions and Game Design Rules

Spurred by Nicole Lazzaro's work on players' emotions, I tried to link game variables and emotions. I came to believe that a given emotion could be associated with the values and variations of one or several variables. If this were the case, this would be a template for a game design rule, a rule explaining how a given emotion can be achieved:
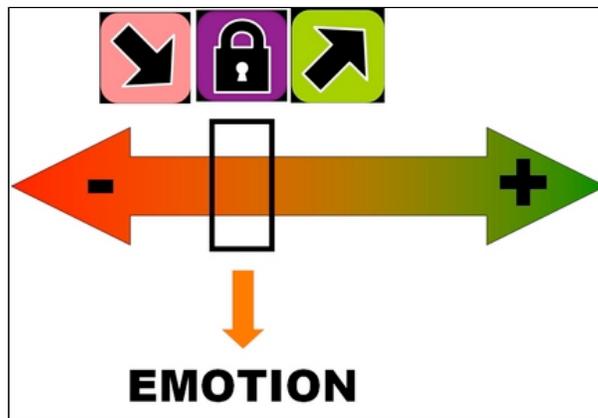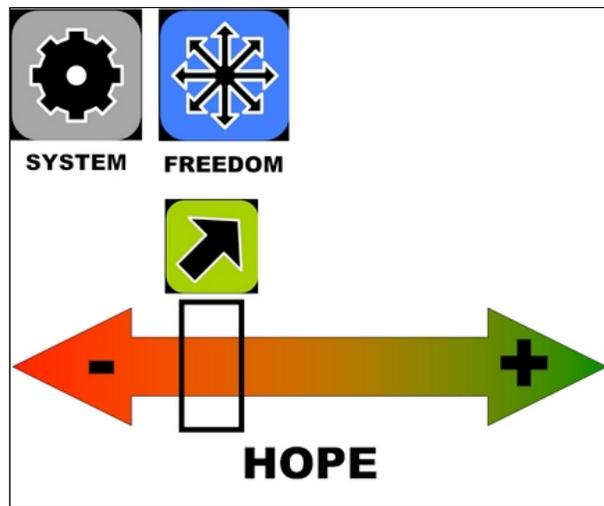

A game design rule template

The two-headed arrow describes the possible values for the variable. The rectangle indicates the range in which a decrease, a persistent value or an increase generates conditions for the associated emotion.

And here are two instantiations of this template:

If you reduce the number of choices a player has at the cognitive level - which means that he may have the tools and plans to face a challenge but is overmatched or doesn't have the opportunity to use them - and maintain him in this state (Low Freedom at the System level), you may drive him to despair. But if you then give him an opportunity (Increase), suddenly there's a way out. Suddenly, there's hope.

A game design rule

If you maintain a balanced difficulty that provides challenging obstacles with appropriate rewards and acknowledgements of the player's successes (High Mastery at the Self level), you can induce a sense of pride in him. Now, offer him an easy way out of a challenge and reward him disproportion ally for taking it (Decrease), and you induce the shame that comes with ill-gotten gains.
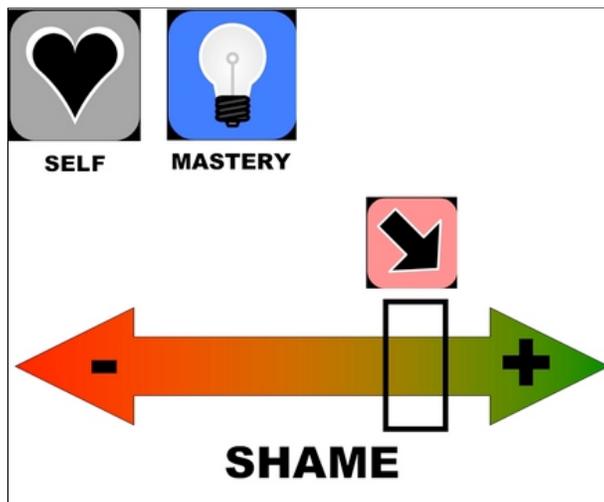
Another game design rule

Of course, such conditions don't guarantee that the player will feel the chosen emotion. They just create a context that is favorable to the expression of this emotion. Knowing that, the game can provide the player with corresponding feedback or cultural cues, like booming music to underline hope, without causing an emotional dissonance.

Here's a table listing some emotions associated with the values and variations of the gameplay variables. As previously, some items may appear in several cells. You'll notice that I use the widest possible definition of "emotions" in order to also cover other mental states, perceptions and feelings.

EMOTIONS		TOO LOW	LOW			HIGH			TOO HIGH
			Decrease	**Stability**	**Increase**	**Decrease**	**Stability**	**Increase**	
Action **Freedom**		Disgust, Inescapableness	Fear, Shock, Buyer's remorse	Claustrophobia, Dread	Suspense, Anticipation of change	Distraction, Slapstick humor (with player's avatar), Buyer's	Awareness, Exhilaration, Appreciation of possibilities, Addiction to	Disorientation	Fear of choice, Paralysis

Category	Type					remorse	growth		
	Mastery	Discouragement, Hopelessness, Humiliation, Powerlessness	Fear, Desire of revenge, Perseverance	Inadequacy, Loss of concentration, Caution, Nervousness	Gambling impulse, Relief, Hope	Doubt, Rush, Gambling impulse, Feeling challenged, Fear of failure	Confidence, Willingness to take risks, Feeling in control of one's actions, Grace	Fiero, Excitation, Satisfaction, Showing off	Boredom, Pointlessness, Impatience
	Data	Discouragement, Unfairness, Infantilization	Loss, Annoyance, Grief, Regret	Trust in the system to remain simple / understandable, Feeling ignored	Reinforcement through positive feedback	Reinforcement through negative feedback	Agency, Expectation (*Grinding toward level-up*)	Compulsive desire to complete collection, Slapstick humor	Underwhelming success, Infantilization
System	**Freedom**	Loss of trust, Arbitrariness, Feeling manipulated, Despair	Feeling constrained, Perseverance	Fatigue, Feeling fated, Self-doubt	Surprise, Relief, Hope	Purpose, Comfortable routine	Zen, Trust in the system to provide solutions	Forward thrust (*"Living off the land"*), Adapting to conditions without planning, Rush	Fear of choice, Paralysis, Loss of agency
	Mastery	Loss of trust, Disgruntlement, Overwhelmed by complexity, Rage, Stress	Frustration, Self-deprecating humor, Bravery	Feeling of randomness, Feeling stupid	Pleasure of learning, Relief, Hope	Unpredictability, Surprise	Agency, Trust in rules logic, Coherence, Projection, Trust in the system to be fair, Willingness to experiment, Zoning out, Gambling impulse, Caillois' ludus	Feeling smart, Breakthrough, Insight, Meta-humor	Lack of challenge, Predictability, Boredom
	Data	Meaninglessness, Apathy	Self-aggravation	Detachment, Scapegoating	Curiosity	Mystery	Belief in the game world, Empathy, Interest for complexity	Feeling unique, Situation comedy	Confusion, Overwhelmed by complexity
Self	**Freedom**	Apathy, Impatience, Disinterest, Anguish over overwhelming duty (*Micromanagement*)	Stubbornness, Remorse, Caillois' ilinx (Vertigo)	Concentration, Importance, Duty, Involvement, Enjoying the ride, Being carefree, Caillois' mimicry* (*Paracosm*)	Doing the impossible, Curiosity, Being inspired	Purpose, Focus	Comfort, Certainty, Escapism, Creativity, Caillois' paida (*Sandbox play, Garry's mod*)	Feeling lost, Reflection, Transformation, Caillois' ilinx (*Realizing the breadth of the experience*)	Purposelessness, Insignificance
	Mastery	Surrender, Anger	Frustration, Self-deprecating humor	Anticipation of failure, Caillois' alea (if no applicable probabilities)	Vindication, Discovery, Pleasure of finding things out, Self-improvement	Shame (*ill gotten gain*), Laziness (*Choosing an easy path*)	Ambition, Anticipation of accomplishment, Self-esteem, Willingness to learn, Caillois' agon**	Ambition, Authorship, Pride	Inflated ego
	Data	Sense of wasting energy and time	Disorientation from lack of context	Feeling stuck, Unease, Sadness	Anticipation of local resolution, Compassion	Identification, Aesthetic appreciation, Aesthetic rejection	Familiarity, Interest for variety, Immersion, Contentment, Caillois' mimicry* (*Simulation*)	Wonder, Awe, Joy	Obsession, Wastefulness
Social	**Freedom**	Aloofness, Shyness, Anguish over community duty (*Too many friends or social obligations*)	Justice, Peer pressure	Duty, Honor, Righteousness, Involvement, Caillois' mimicry* (*Roleplaying*)	Guilt, Breaking taboos	Feeling Honorable (*Commitment, Doing the right thing*), Egoboo	Belonging to a clique, Caillois' paida (*Nomic, Calvinball*)	Injustice, Being accepted, Caillois' ilinx (*Realizing the breadth of the game as a medium*)	Insignificance, Detachment
	Mastery	Hate	[Observed] Schadenfreude	Anticipation of group failure	Group vindication	Shared shame (*ill gotten gain*), Needing to blame someone	Anticipation of group accomplishment, Dignity, Respect, Superiority, Caillois' agon**	Pride, [Observed] Naches, [Observed] Admiration, [Observed] Appreciation of the fortune of others, Taunting	Contempt, Scorn for opponent

Data	Fanatism through secrecy	Disorientation from lack of connectivity	Anonymity, Isolation, Appreciation of rarity / secrecy / uniqueness	Feeling of human connection (*ESP Game*), Compassion	Affinity, Meta-humor, Appropriation	Belonging, Intimacy, Immersion, Love, Caillois' mimicry* *(Shared fantasy)*	Bragging rights, Completeness *(Great choreography in competitive / cooperative gameplay)*	Feuds, Arrogance, Sectarianism, Fanatism

* Mimicry requires focus, implicit rules and a somewhat applicable knowledge of the mimicked process.
** Agon can practically occur anywhere, even in Too Low Mastery if there is randomness (*Parcheesi*) or metagame factors (*Rock Paper Scissors*).

Emotion Engineering

Using the previous tables, a designer can move backwards in the (interactions / game variables / emotions) loop and design game systems that can induce chosen emotions. This requires three steps.

First, the designer picks the emotions he's looking for in the emotions table and finds out which game variables are involved, as well as the required ranges of values and their variations, if any. If the emotion appears in several cells, he can pick the one(s) he prefers. If he wants to *avoid* an emotion, he must make sure to consider *all* its instances in the table (and, since the table is by no means complete, where else he thinks the emotion could occur while playing his game).

Second, he chooses in the game and player tables which appropriate game systems can generate these values and variations, either from the game's actions or by giving the player opportunities to make these changes.

Lastly, he instantiates the chosen systems within the context of the desired emotion. Since this last part is of course totally dependent on the designer's personal experience, goals and constraints, the examples below try to be as abstract as possible.

Let's look at how to apply this method to three complex emotional states, each composed of several "atomic" emotions: inducing nurturing instinct, flow, or the sensation of being hunted.

Each of the instantiations of game systems shown in italics is only one of the possible choices a designer could make.

Nurturing Instinct

Nurturing instinct = Empathy + Agency + Comfortable routine + Surprise + Naches

Empathy (Persistent High Data at the System level): Consistent behaviors from game entities (*Player can understand the creatures and anticipate their behaviors*), Emergent behavior (*Creatures are complex enough to seem intelligent and aware of the interactions*), Preparation (*Player's actions take some effort which increases their perceived value*), Ability customization (*Creatures respond differently to customized tools, as is they have tastes and preferences*), Learning a rule (*Creatures are complex enough that the player must spend time to learn their behaviors*), Score increase (*Creatures give positive feedback when pleased*).

Agency (Persistent High Data at the Action level, Persistent High Mastery at the System level): Permanent world change (*Player's actions change the creatures, Mistakes can hurt them*), Collectibles (*Customized tools, Rare behaviors, Rare creatures*), XP (*System level track of progress and effort needed*), Resources (*Put the emphasis on the cost of interaction and the player's commitment*) (*Treats, Meds*), Voluntary gameplay mode switch (*Player can choose the creatures' activities*), Lowering difficulty of current challenge (*Slow rhythm, No pressure, No insurmountable challenges*), Iconic / Symbolic content with clear affordance (*Tools' and activities' functions are clear, one per tool or activity*), Positive & negative feedbacks (*Creatures show the player whether an interaction is pleasing or not*), New long-term goal (*Creatures express needs that take a lot of effort to satisfy*).

Comfortable routine (Decrease when High Freedom at the System level): Guidance / Clear goal (*Creatures' needs generate challenges, Challenge solution is often obvious; it requires investment, not skill*), Simulation conventions (*Whether inactivity is perceived by the creatures, Whether challenges can be concurrent, etc.*), Clear chosen goal (*Player can work toward a specific change in the creature*) (*Creature evolution, Creature training*), Local resolutions (*Medium-term challenges with little impact on global change, Mistakes can be corrected*).

Surprise (Increase when Low Freedom at the System Level, Decrease when High Mastery at the System level): Unlocking content / Inconsistent or random behaviors (*Breaks the routine's monotony*) (*Rare events, random or with rare conditions*), Easter eggs (*Reward experimentation with creatures*).

Naches (Pride for one's child's or mentee's accomplishments) (Increase when High Mastery at the Social level): Mentoring (*Player can give goals and progress feedback to the creatures*), Cooperation (*Creature skill acquisition requires a tight feedback loop with the player*), Correct response to cultural cue (*Creatures display signs of effort when learning, Creatures' skill acquisition is punctuated by joyful behavior on their part*), Teaching a skill / Recurring opponent's mistake (*Creatures have disabilities that they can overcome through being taught*).

Flow

Flow = Exhilaration + Confidence + Coherence + Forward thrust - Boredom

Exhilaration (Persistent High Freedom at the Action level): Action opportunities (*Limited constraints on move set, Short-term athletic*

skill challenges), Resource gain (*Steady flow to feed preparation or positive feedback - see below*).

Confidence (Persistent High Mastery at the Action level): Affordance (*No ambiguous stimuli*), Highly trained reflexes / Kinesthetic isomorphism (*Player can play without thinking about the controls*), Advantage opportunities (*Player can identify which sequences of moves can solve local challenge*).

Coherence (Persistent High Mastery at the System level): Consistent behaviors from game entities (*Player can predict next game state and react accordingly*), Positive feedback (*Reward local successes with easy challenges, power increase or score multipliers*), Hints (*Warn the player of imminent danger*), Opportunities for exploiting preparation (*Short-term tactical combos*), Voluntary gameplay mode switch (*Player can use favorite tactics*), Opportunities for taking the lead (*Player catch-up*), Opportunities for exploiting emergent behavior (*Chain reactions, Player can provoke opponent's mistakes*).

Forward thrust (Increase when High Freedom at the System level): Alternative methods / Concurrent goals (*Player can use favorite tactics*), Generating opportunities (*Even if caught off-guard, player can maneuver so he can fall back to favorite tactics*), Safeguards (*Player can recover from near defeat*).

Avoid Boredom (No Excess Mastery at the Action or System levels): Difficulty increase, Complexity increase, Involuntary gameplay mode switch, Random behaviors (*Sustained level of perceived difficulty at the Action level, Use semi-random temporary increases in difficulty to keep the player on his toes*) (*Waves of enemies, One unpredictable enemy type, Periods of low availability of tactical resources*).

Being Hunted

Being Hunted = Dread + Unpredictability + Caution + Anticipation of failure - Hope

Dread (Persistent Low Freedom at the Action level): Linear path (*Limited number of significant path choices, Limited number of hiding places*), Temporary loss of ability (*Being slowed down by a wound*), Resource loss (*High cost for being caught*), Limited opportunities to escape when seen.

Unpredictability (Decrease when High in Mastery at the System level): Negative feedback (*Hunters catch-up, No possible escape*), Inconsistent or random behaviors (*Hunters cannot be tracked or their positions predicted*), Involuntary gameplay mode switch (*Stealth / Flight*).

Caution (Persistent Low Mastery at the Action level): Taking a risk (*Risky portions in main path or secondary path, where the player can be spotted more easily*), Misdirecting affordance (*Traps*).

Anticipation of failure (Persistent Low Mastery at the Self level): Pretend danger (*Ominous noises*), Perceived cheating on the part of the game (*How can they always find me?*), Opportunities for recurring mistake (*Hunters can hear the player when he makes noises*).

Avoid Hope (No Increase when Low in Mastery at the Action level, Freedom at the System level and Mastery at the System level): Can't exploit advantage opportunity (*Hunters show no weaknesses*), Can't pursue concurrent goals (*Fleeing prevents access to resources or means of escape*), Can't exploit preparation (*Hunt can only end by a narrow escape that feels lucky*).

Game Analysis

One can use the game variables table to sum-up the appeal and flaws of a game as they pertain to its systems and the emotions they induce. In the following examples, the darker a cell is, the lower the emotional appeal created by its associated variables. I tried to use common sense when judging this appeal, since some emotions might be desirable in a given context (*Fear in a survival horror game*) and not in another (*Fear in puzzle game*).

Note: That a game has a grayed-out cell doesn't mean that this makes it bad, it is just a consequence of the design choices. For instance, Portal is a short game because it's been purposefully designed as one: its length is part of the overall experience it offers. Some players might still find it too short.

PUZZLE QUEST	Freedom	Mastery	Data
Action	Moment to moment tactics (*Go for damage, mana or permanent resources*)	Combos, Proved match-3 gameplay	Choice of tools (Class, Equipment, Spells), Collectibles (Quests, Unique items)
System	High systems replayability vs. Low content replayability (*There are many*	Varied uses of core gameplay, Advanced tactics (*Spell combos, Spells that don't end the*	Continuous growth: Player can't lose resources, every moment spent playing

	ways to build a great character but you don't adjust your tactics much against different creatures)	*turn)*	is rewarded *(XP & Gold won even if battle lost)*, Leveling compulsion *(Rank spells and purchasable items)*
♥ **Self**	Short gameplay bits, Repetitive encounters	Underwhelming ending	Personal experience not acknowledged *(No achievements like "Longest combo" or "Most Damage")*, Heroic if classic story of conquest
🌐 **Social**	Multiplayer mode	Easy to demonstrate and teach	No unique experiences to share

SUPER MARIO GALAXY	❄ **Freedom**	💡 **Mastery**	⬛ **Data**
✋ **Action**	Two "interact with object" commands (Stomp & spin), Limited use of basic commands	Refined user-friendly controls *(Wall hang)*, Easy to win *(60 stars)*, Hard to finish *(121 or 242 stars)*	Star bits collection (Even if use is limited)
⚙ **System**	Iconic world (No hidden rules) allows clear understanding of possibilities	Iconic world manages to offer surprises, Life gauge adjusted to fit medium-term goal oriented gameplay	Breadth of core gravity gameplay, Very creative and varied levels built around simple constitutive rules *(2D levels, Boss levels)*
♥ **Self**	Series of medium-term goals, Hub structure with large choice, Great non-intrusive camera, Lack of purpose	Variety reduces usefulness of acquired skills *(Few 2D levels, Blue stars hopping, Flying)*	Successful re-imaging of IP elements, Beautiful world, Limited level replayability (Despite comet modes), Mostly irrelevant story, Countdown drives toward completion (May cause frustration)
🌐 **Social**	Player 2 mode	Limited cooperation in 2 players mode, Lack of tricks or secrets to share	No unique experiences to share

PORTAL	❄ **Freedom**	💡 **Mastery**	⬛ **Data**
✋ **Action**	Experimentation rewarded, Little pressure put on the player	Skill challenges *(Shooting while falling)*	Uncluttered world, Rich contextual feedback for most actions

System	Depth of core gameplay	Game is a long tutorial, Perceptual breakthrough, Challenging additional gameplay modes	Unique achievements
Self	Short levels, Quicksave and Instant reload, Portable install, Short game (Low required investment), Linear experience (No meaningful choices / Enjoying the ride), Login required to play	Subtle taunting mixed with constant positive feedback acknowledging progress	Unique tone, Humor, Inside jokes *(References to HL)*, Short game (Small amount of content)
Social	User-created levels support	Tantalizing word of mouth *("You must play to understand"),* YouTube and spectator-friendly, Slow pace allows cooperative problem solving	Memes *("The cake is a lie", Still Alive, Weighted Companion Cube)*

I'm not trying to prove that Portal is objectively a better game than Puzzle Quest. I'm saying that, personal taste aside, Portal provides a more complete experience.

By the way, I believe that the brilliance of Portal doesn't stem solely from its completeness, but also from its elegance. Elegance is a quality of the relations between the cells of the table. Since it's about meta-design rules, it'll be the subject of another article.

From Mendel to Mendeleev

Is this a useful tool? I don't know yet. I hope that like Mendeleev's periodic table of elements, this or a different model will help game designers establish a common language devoid of fuzziness and interpretations. A language that would allow us to better work together, share theories and turn our craft into an art. And like Mendeleev and his table, such a model might even lead us to predict the existence of yet unknown elements, unexplored territories in the game design space.

Gregor Mendel's sheer dedication and patience as well as his scientific rigor are an inspiration to anyone attempting such an endeavor. Mendel worked alone, when game designers are part of a vibrant and well connected community. Somehow, I don't think we'll have to wait seven years to produce a work worthy of his efforts.

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Version History

v 1.0.4 April 23rd 2008: Following Michael Fitch's very thoughtful advice, I have renamed the "Persistent" columns in the emotions table to "Stability." The name much better reflects, as he puts it, the stability-of-state that I want to convey as opposed to the irreversibility-of-change evoked in the game and player tables. I now use a new icon to hopefully lift any remaining ambiguity. Michael's remarks also made me add a couple of sentences to better explain the reverse-lookup process and made me detail my description of Puzzle Quest's experience which, in retrospect, must have seemed quite harsh.

v 1.0.3 March 2nd 2008: Better explained the scope of this work. Thanks to both Bob Bates and Hal Barwood for helping me with this. Changed the references to the MDA framework. Added some emotions: relief, self-improvement, righteousness, being inspired, appreciation of the fortune of others, remorse and ambition. Thanks to everyone I met at GDC who inspired me, gave me feedback, encouragements or puzzled looks.

v 1.0.2 February 17th 2008: Added "Known interface metaphor" and "Apophenia" in player's table. Added "Zoning out", "Egoboo" and "Self-esteem" in emotions. Changed "constituative" to dictionary-friendlier "constitutive". Thanked Jurie Horneman properly. Jurie has been so instrumental in

helping me shape and share these ideas that I can't believe I omitted him. Sorry Jurie :) Fixed some typos, mistranslations and added a few links.

v 1.0.1 February 13th 2008: I had totally forgotten about Puzzle Quest's multiplayer mode. Sorry, Infinite Interactive, I love your game! Thanks to Rich Wilson for catching that.

v 1.0.0 February 11th 2008

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