New Product Creation as a Constructivist Process: Videogames as Acts of Creativity and Rational Thinking

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Abstract

This paper examines the new product creation process in videogames - a product that incorporates large quantities of creative talent and effort. Using various secondary and primary (interview and ethnographic) data, we identify three main characteristics that are involved in the creation of videogames: inspirations are significant in their creation, they are constructed from a wide variety of cultural and other influences, and they have evolutionary aspects. These three aspects are interrelated. We also demonstrate that the creation of videogames involves a large variety of types of creative thinking processes. However, rational thinking processes, defined as problem-solving, planning and other processes, are also needed, as well as processes at the group level. This provides us with a new kind of framework for identifying and understanding products, especially ones that are constructed from cultural and many other influences, or that involve the convergence of technologies as well as other kinds of inputs.

Keywords: creativity, videogames, product development, ideation

Suggested track:

A. Knowledge creation and innovation

1. Introduction

We propose a view of products and their creation that treats them as the result of a series of creative ideas and rational thinking. This view may be consonant with the rise of new products and services that are differentiated as much by "content" as by technology, and by the aesthetic qualities they fulfill rather than just their function. This also allows us to avoid discussing products in traditional terms such as branding, cost and quality differential, and functionality, all of which tend to be homogenizing in their treatment of product characteristics. To do this, we will incorporate concepts from the literature on individual creativity, and will construct a framework for explaining how a particular product's model (where "product model" refers to, for instance, a particular movie or videogame title) is differentiated as its characteristics vary from other models, each constituted from different influences, including past models. In this paper, we will focus on videogames, which are widely acknowledged by their developers to be demanding of high levels of creativity. In this paper, we will demonstrate how videogames are constructed from different influences and with the use of various forms of creativity and thinking processes. We will describe a framework that represents an alternative perspective on product development. Three literatures may be of relevance to this study. Each provides a partial view of the overall idea embedding process, thus an integrated framework is required to provide a way of describing how "thought impacts on artifacts".

1.1. Conventional Views on Product Development

The conventional view of products is provided by the field of new product development, but in this field, the understanding of how new products are conceptualized tends to be obtained through rational perspectives such as marketing, and the specifications or requirements analysis stage of new product development. New product development (NPD) studies usually do not examine how creative ideas are formed or embedded into products, or the precise nature of the products being created (and therefore, how they differ from one another), or the types of thinking that ensue during the NPD process (see for example, Brown and Eisenhardt [1995]). Among the rare occasions where the literature has done this are the examination of the brainstorming process within highly creative firms and groups (Sutton and Hargadon, 1996), and more recently, the examination of the ideation phase within new products (Goldenberg et al. 2001). These tended to reflect on the ideas that occur at the front end of product development, and not throughout the development process. Studies of the videogame product development

process and its various aspects have been done (e.g. Tschang, forthcoming), but these do not look at the ideation (i.e., initial conceptualization) phase.

This notion that products are composed of more than simply the assemblage of designs and rules – i.e., what we term the "rational view' of products – could be challenged based on various earlier historical studies of invention, and more recently, the knowledge management literature. In their seminal work on knowledge management, Nonaka and Takeuchi (1995) discussed instances of how new products were formed by product teams' observation processes, and through the recombination of existing ideas within the organization. However, no theories or models of product development that fully embrace a knowledge-based view have been proposed. In part, this is because the knowledge management literature has focused largely on the transfer of knowledge within organizations, and less on the creation and implementation of new ideas, i.e., the development of new products.

The third literature that has relevance for our study is the creativity literature within psychology.[1] Cognitive psychologists often subscribe to various cognitive thinking processes, or classical stages models that include the stages such as preparation, incubation, illumination, and validation (Lubart, 1991). In relation to this are various systems and other complete perspectives on creativity that seek to illustrate how the different aspects of individuals' lives can impact on their creative ability or acts (e.g. Gruber, 1974). We will draw these perspectives for important elements to develop our emerging framework, but in recognition of the fact that the literature stops short of addressing industrial products.

Recent work in marketing and product development has attempted to apply select concepts from this literature to better inform product development. However, most of this work tends to confine new product development to "front end" processes, i.e., processes at the product definition stage. For instance, Goldenberg et al (2001) develop a taxonomy of new "product defining" models. In the absence of real world data, either experiments of qualitative "content analysis" may be needed. For instance, Goldenberg et al (2001) developed a novel test this for their framework by using it to examine a source book on historical inventions (an approach that we partially adopt in this paper).

[1] This includes to a lesser extent, the managerial cognition perspective within the management literature (e.g. Glynn [1996]).

2. A Framework for Situating Creativity in Artifacts

2.1. The Broader Study and Circumstances of Videogames

We will first examine how creativity is situated in the artifact. We examined various sources of secondary and primary data that we have at hand. We will first examine a historical source of how games were developed, and will later confirm the findings with our own primary interviews with videogame developers, and ethnographic observations of videogame project teams at work. Our ethnographic work consists of approximately three months of (mostly full day) visits to three studios spaced out over three years, of which about two months were conducted in one studio in Boston (labeled as *Boston1*), and another month was conducted at two studios, one in the San Francisco-Bay Area (*SF*) and one in Boston (*Boston2*). This was performed over a two year period from February 2003 to February 2005 – partly in order to capture different phases of the product cycle. We have also conducted interviews with over 30 other developers, mostly designers, from a variety of different studios.

Our observations were initially informed by two disciplinary perspectives: individual creativity and team-based work. We iteratively examined the data and revised the framework until we arrived at a perspective of what makes videogames unique, and of what their key characteristics were.

The main characteristic of videogames that influences how we characterize their production is that they involve multiple types of input, and that their "output" is typically measured in terms of the "game play" they produce (i.e., form of interactive experience to the user), although they also have visual (e.g. content like art and story etc.) and other aesthetic qualities which are important to the overall playing experience. Given that users have to be engaged typically for as many as 15 to 30 hours of full playing time, these experiences are linear to some degree (i.e. a sequential or narrative quality to the content), as well as increasingly customized (i.e. each user has a different playing experience), and "emergent" (i.e., unexpected results can occur within the game, depending on the unique interactions each user has with the game). While games differ from one another to varying degrees, the user interface and game play interactions do not differ that much from one game to another, especially as the different genres have solidified. There are three main kinds of developers: game designers (who focus on game play), programmers, and content developers (consisting mainly of artists and animators, but increasingly, sound designers and writers as well).

Various creative thought processes are involved in producing a game that is significantly different from all others. In this way, at the level of the artifact, we have found that videogames have three main interrelated characteristics:

- The uniqueness and "innovativeness" of videogames is often characterized as having arisen from the inspiration of their developers. These inspirations can take many forms such as the occasional "aha" moments that occur in other scientific discoveries, but in the case of videogames, it is more a gradual dawning and crystallization of the main concept – a phenomenon that Gruber (1974) first showed for the case of scientific discovery. We call this the *inspired* nature of videogame development.

- Videogames are constructed from various influences, including various other media, and past videogames' features. Related to this is the idea that production involves an "addition" process, such as the addition of features, specific content (e.g. characters, background settings, and cultural references) and so on. We call this the *constructivist* nature of videogame development.

- Videogame creation involves evolution. This is in part a conscious decision to mitigate the uncertainty of videogame development (and consumer acceptance of the product). A significant amount of adaptation is also needed in the course of developing a product with high degrees of uncertainty. Wrong choices are sometimes made, and these have to be reversed or changed late in the project. Evolution also takes place across products, as a certain type of videogame is improved over time by technology enabling better content and more immersive experiences, as developers learn from playing other newer videogames, and so on. All of these cause videogame development and the innovative trajectory of videogames to have an *evolutionary* nature.

There may of course be other ways and facets to describing videogames and their development, but we believe that these three concepts provide an appropriate means for accounting for the impacts of creative acts over the full lifecycle of a videogame, including the *beginnings* or seed ideas*,* the gradual *construction* or building phase, and the resulting *change and growth* in the course of a game's development*.* In this sense then, the set of characteristics represents a complete and mutually exclusive set of categories. We will later also illustrate how this framework is also consonant with a taxonomy of videogame types that treats them as constructed artifacts, as the inspirational creations of individuals, and as "evolutionary" products

that evolve both within the space of their development, and across different videogames. The framework will also help situate, explain and integrate phenomena occurring at the individual, group and artifact levels.

These three concepts are also interrelated. In this paper, we will look primarily at the concept of constructivism, highlighting its relations with the evolutionary and inspired concepts. Constructivism is associated with one particularly dominant view of the product that relates to being composed of different influences or "inputs". The notion of constructivism first surfaced in educational pedagogy, where it was entertained as a cognitively-related mechanism for explaining how the young could create knowledge from different sources (see [Bruner 1986, 1990] for early thought on this). Indeed, it is supported by a variety of related cognitive thought. For instance, at the cognitive level, it has been proposed that background cognitive mechanisms such as *conceptual blending* underlie the ability of the mind to fuse together disparate areas of thought into new thought patterns and concepts (Fauconnier and Turner, 2002).

What Does Constructivism Mean for Product Development?

We adopt constructivism as the linchpin of this proposed view of game inspiration, since it provides a compelling model for describing how games are developed – one that allows the referencing of other media, popular and historical forms of culture, and of other games. That games as artifacts contain so many references to other domains suggests that it impossible to view games as products independent of other products. These influences appear in games by way of the ideas that designers and other developers have had. Constructivism is flexible enough to accommodate the new ideas that can surface during product development. At the same time, we must also recognize that games have their own innate trajectory, as informed by technological advances which tends to affect game play possibilities, and as shown by how game play is forced to conform to particular categories by market expectations and developer intentions.

Constructivism can also be associated with how "innovative" the end product itself is. The often-typified distinctions used to describe innovation are: incremental versus radical innovation, and component versus architectural innovation. We can see constructivism involved in three of these – incremental, combinative, and radical, but to varying degrees (Henderson and Clark, 1990).

2.2. Characterizing Constructivism and Creativity

In order to make a useful theory out of the concept of constructivism, we need to connect it to the acts of knowledge creation – be they cognitive or otherwise. We posit that creativity can be directly related to constructivism in the following ways:

- Creativity is used to create the main concept of a videogame. This can occur in different ways, such as the designer's inspiration, or the group brainstorming process. This usually occurs at the idea conceptualization stage.

- Creativity is used to flesh out the details of the game by the addition of further specific information and structure. Because of the constructivist nature, details can be added as needed. This can occur throughout the development process.

- Creativity is used to change the nature of the game – because of project and other rational demands, developers may choose to significantly alter the nature of the product. However, this is also due to the nature of the product, in which the inherent nature and appreciativeness others have of the videogame would only emerge at late stages.

- More focused forms of creativity can also occur in the many "creative" solutions that developers come up with to problems at the implementation stage.

Using this short list as a beginning framework, we coded the relevant pages of a book that had information on how a variety of historical videogames were developed (amongst other things). We examined just under 100 games for which the book described the conceptualization of in some detail.[2] We determined that creative thinking could influence game development in these and in several other ways, as illustrated by examples in table 1. (We actually found multiple coded instances that supported each type of creativity).

[2] There were 95 direct references to different games and their designers (with a few games being designed by the same designer), and four more references to videogame designers independent of games. About half of the coded references were useful.

Table 1. Various Types of Creativity Seen in Videogame Development (Source: DeMaria and Wilson, 2002).

Type of creativity	E.g. No.	Example of Developer and Game
Creator's Background	1	**Peter Molyneux, well known developer of "god game" genre** "The idea of being all-powerful is something that has always fascinated me since I was a kid" "I remembered going up in one of those scenic lifts and looking down at all the little people below going about their lives, and this also made me think about using little people, to convey this feeling of power. Upon seeing a landscape engine from Glenn Corpes, I realized this engine would give me the perfect view for the game I had in mind". This game is similar to ...
Inspired *(also example combination of ideas)*	2	**Peter Molyneux, on inspiration for *Black and White* (player trains god-like creatures)** Inspiration came in part from an episode of *Outer Limits* called "Sand Kings," in which a scientist discovers a new species that comes to worship him as a god. The other inspiration came from an electronic pet Molyneux obtained during the final weeks of the Dungeon Keeper project." … he thought if he had become so attached to an egg-shaped piece of plastic, how much more attached might he and other people become to a unique computer creature
Research caused inspiration for idea *(also example of combination of ideas)*	3	**Will Wright, well known developer of the "city sim" genre, *Sim City*** Inspiration began with a pair of books-(1) one on architecture *A Pattern Language-Wright* describes the book as the Western equivalent of the Chinese art of feng shui. *and (2)Understanding Comics* where he came across the concept of levels of abstraction.
Evolution (across games)	4	**Warren Spector, well known designer of a "turn of millennium" conspiracy game** "*Deus Ex* was the next logical step, along an evolutionary path that started with the Underworlds and then Shock and then Thief.
Unanticipated events changed game design (i.e., evolved)	5	**Rand and Robin Miller, developers of *The Manhole*, interactive children's game** Began with the intention of an interactive children's book. Started with the idea of mapping the book medium to interactive, but the first page was so intriguing that we discovered we could go deeper instead of linear. We have no plans when creating it.
Additive ideas	6	**Developed by id studio, well known for its other "first person shooter" games, e.g. Doom** Apogee's Duke Nukem 3D added some elements, especially a really cool character and lots of humour.
Imitated other (games) *(also example of evolution)*	7	**Sid Meier, well known developer, on *Silent Service*, one of the first successful submarine simulators** I remember playing Gato and saying,"Hey, this could be a good game." But in my mind it had copped out in some ways and didn't have the mixture of fun and realism that I thought would be fun. So, we basically stole the idea...
Rational thinking *(also example of **desire to capture experience**, and **combination of ideas**)*	8	**Shigeru Miyamoto, well known Japanese designer, on *Donkey Kong*** I submitted several different ideas for Donkey Kong. As for the name, i just wanted to create an English name meaning "silly gorilla." As i consulted with my dictionary, there was the word 'donkey' for 'silly'. Since apes were oftern called "kong" in Japan back then, I mixed them together. One of the things i really wanted to realize on Donkey Kong was that players could move the character around and jump all over the screen for the very first time in the history of arcade games but there were technical restrictions. To evade technical restraints, i came up with a very rational design for the original Mario character. When we were making Donkey Kong, we did not incorporate all the ideas I had initially conceived; so when we developed Donkey kong Jr., we included some of the unused ideas from Donkey Kong.
Desire to capture an experience	9	**David Riordan, on *It Came from the Desert* - one of the first "cinematic" games** I was thinking what kind of game I'd do. Something cinematic. I'm a big fan of the movie *Then*. So I asked Bob,'What about a bug movie?' And he answered,'Why not?' My original design was way too big. I wanted the feeling that the ants were coming and things were happening where you were not. We thought we were heading to a time when we could really make movies."

The table shows only illustrative statements for each of the types of thinking that we have classified (to span as many possible situations as we could identify), and in fact, there are multiple statements in the source to support each type of creativity. However, there is already sufficient evidence in this illustrative set to show the *constructivist* nature of games. Specifically, statements relating to how ideas were added onto other ideas (#6), and how ideas were combined with others (#2, #3 and #8) illustrate constructivist thinking. References to other media such as books (#3), movies in (#9), and other games (#5) also support a constructivist view of games, since it is by referencing other media, that games can be developed.

The evolutionary and inspirational natures of game development are also observed in table 1. While #2 and #3 directly show how inspiration was acquired, many of the other examples also implicitly refer to inspired forms of thinking. The evolutionary nature of games is directly shown by #4, although the fact that Sid Meier took another idea and improved on it significantly (#7) also demonstrates evolution across games. In addition to this, games can evolve during their development, as #5 shows.

We also found that the creative side of game development is also balanced by a rational side, which includes the need to plan the implementation, to consider resource limitations, to integrate features in a consistent way, and to consider technological and other limitations. Rational forms of thinking are present in the table, more explicitly in #9, but also in how constraints were dealt with in #8.

Complementary Views from Other Data

We have also sought to confirm these types of statements with other sources of data to see if the same categories and quality of references to each category was consistently made. Our first check was a similar coding done on 20 separate semi-open ended interviews (found on various game information websites) with these and other designers. We also confirmed these observations with our ethnographies of three studios, including interviews with individuals that we had made as part of the ethnography.

Through the coding of the second source of interview data (later confirmed by our own interviews (a few with the same designers), we were able to build up a more accurate perspective on how designers think. Amongst other things, this supported and complemented the three aspects of inspiration, constructivism and evolution which we seek to develop:

- Prior background and motivation was an important factor for many designers, and could lead to significant sources of inspiration. Will Wright noted for instance:

  "Curiosity about the world. That's what draws me into these other fields. I'm always trying to figure out the way the world works."

  I think that every designer needs to find their own center, their own inspirations… Usually, it's fairly controversial work…between established fields…[which]… I have found to be some of the richest sources of inspiration for the game ideas themselves."

  "Some of these ideas don't make sense to me initially but then incubate in my head for a long time. Some of the ideas I've worked on have actually been in the back of my mind for 5 or 6 years before I actually did anything about them. Other ones…well, I'm not sure that I'll really give them up. I wouldn't think of it so much as knowledge of human behavior as it is being willing to sit back and observe with an empty mind. I think of it as contemporary anthropology."[3]

  It is worth noting that designers were able to leverage on their talents, regardless of what area they are in. These can include the ability to build a strong narrative, the ability to model and build worlds, and the ability to design solid (i.e. fun to play) game play.

- In support of the constructivist view, developers are directly inspired by references to other sources. At one extreme, Rand Miller noted that:

  "When we go through our creative process, we don't go into a white room with a white sheet of paper and close the windows. That's ridiculous. What we do is fill our minds with what other people have done. We put pictures on the walls. We look at magazines. We look at pictures of incredible places. We get inspired—and "inspired" seems to mean bringing something out of something else, not out of nothing"[4]

- Games and therefore, their evolutionary path, embody many aspects. Thus, evolution may simply involve deepening one or more facets of the game:

[3] http://www.gignews.com
[4] http://www.cornerstonemag.com

> *"The decision to create Asheron's Call 2 ("AC2") was an easy one. The Asheron's Call franchise has so much to offer - a plethora of interesting characters, creatures, stories, and an incredibly rich world. The original title just barely scratched the surface of the mythos behind the property, and everyone at both Turbine and Microsoft felt enthusiastic about stretching the story beyond the original title. There was just so much there that we still wanted to tell. So, the decision to do AC2 was straightforward. The more challenging question was whether we wanted to iterate by creating new content with the same technology or create a new and innovative game; we have chosen to do the latter. This meant that AC2's historical roots are in the franchise, but the content and features are truly from the next generation."*[5]

Our ethnographies also supported these three aspects in substantial detail. In the studios SF and Boston1, developers that were brainstorming new products or during the implementation (i.e. full development stage) were observed making numerous references to other movies and games (i.e., being inspired by a variety of sources). Their new games also tended to reflect what they had learnt how to make before (i.e., evolutionary), and their game concepts were essentially a combination of past games, new references and other games (i.e. were constructivist in nature).

3. How Does Constructivism Occur in Projects?

Beyond Individual Creativity: Multiple Forms and Levels of Thinking

The problem in trying to understand how constructivism occurs is that we need to account for the various ways in which thought occurs. While knowledge management perspectives on different types of knowledge (e.g. tacit and explicit) can provide a way to address this, we found that the framework of March (1991) - which effectively classifies thinking into creative and problem-solving types – could be more practical for understanding the type of work that goes on in game development. In practical terms, both individual and group processes are possible and necessary means by which new knowledge are created.

Table 1 also hints at the distinction between the creative and the rational. In the work of game development, rational thinking would consist mainly of problem-solving, planning and other pre-meditated and rule-based forms of cognitive processes. As table 1 showed earlier, different

[5] http://rpgvault.ign.com

types of creative thinking can occur in the process of defining a game. In the terms of cognition, these forms of creative thinking might involve insight, inspiration, cognitive leaps, analogy, metaphor, and triggers for illumination. These leaps of discovery are often posited to involve more base cognitive mechanisms such as identity, conceptual blending, and imagination (Fauconnier and Turner, 2002). As table 1 showed, in practice, actual creative thought is even more highly variegated and contextual, and may rely on spurious issues such as the conditions of an individual's background, one's likes and dislikes, and chance encounters with people and thought.[6] We refer to all of these as inspired-creative forms of thinking (to distinguish them from the rational forms of thought).

Given the complex interplay between these forms and levels of thinking, we have illustrated four possible *modes of thinking* in table 2. This represents, in stylistic terms, the influence of individual and group work in both rational and inspired-creative forms, much in the same way that March (1991) describes explorative and exploitative processes at the organizational level.

Table 2. Four Modes of Thinking in Game Development

Level\Thinking	**Rational**	**Inspired-Creative**
Individual	Individual problem-solving – used to solve problems	Individual inspired thinking – used to create new ideas to start or add to a game
Group	Group problem-solving – used to coordinate efforts, solve problems that individuals cannot solve	Group brainstorming – used to create a new game (in the absence of individuals)

It is in the interaction of these four modes that the development of games takes place. In the earlier days when games were developed by one or two individuals, or in the case of exceptional creators like Will Wright, the role of individual thinking was much more dominant (as highlighted in table 1). However, given that current day games are developed by larger teams of 20 to 100 employees, the influence of group work on that process has to be accounted for. As we will show, individual thinking still has its place in current day games, especially for the seeding of a concept.

From table 2, it would be apparent that table 1 largely only reflects the category of individual inspired-creative thinking processes. In fact, the sources from which we drew our examples for table 1 (as well as the supporting evidence) actually reflect the picture that the industry's

[6] For instance, as the statements in the table point out, background or interests (be they formal or informal) are considerable forces influencing which topics designers pick.

publicizers (e.g. publisher's public affairs or game reviewing websites) often seek to paint: that game design is the purview of a select group of "star" designers. In reality, many developers we spoke to recognized that while there is a tendency to highlight "star" or "visionary" designers, and while some stars do actually deserve their recognition for the singularity and uniqueness of their ideas, most of the game development teams need to work "without stars" (and in fact, the most creative thinkers do not best fit the team environment). Herein lies the paradox of game design. Without strong design vision, a game would probably not gain fame as a unique design. But strong design vision and leadership is not the only thing that makes games, and (as we will show), some game development teams can exist without "visional designers".

While table 1 suggests that some of the more important game ideas do not involve rational thought processes, in an effort to confirm or reject this, we need to examine if there is complementary evidence to confirm the broader issues in table 2. We examined the results of our interviews with designers, and our observations from ethnographies of three studios, to better illustrate where ideas for games actually came from, and how they help constitute the game ideation process. We summarize some of the more relevant findings as follows:

- Some game designs are actually the work of small teams working together to define a game. To circumvent their lack of a visionary designer, some teams like SF studio's use of a "cabal" approach, which involves using a small team to brainstorm ideas for new titles. However, such brainstorming could still require *a single individual to provide a starting idea*[7], e.g. with a proposal (which could be either simple or detailed). This would eventually be developed by the group into a fairly sophisticated and unique game. Again, courtesy of the constructivist nature of games, the combination of varied ideas would almost certainly lead to a game that is not exactly like any other. (The notion of snowflakes not looking alike, and yet sharing similar structures, could apply here).

- Game designs can come about as a result of rational thinking, inspired thinking, or a combination of both. Some may be the result of mainly rational thinking, e.g. the case of evolutionary designs, where the simple extension of technologies or game play capabilities may be all that is required.

[7] In such brainstorming sessions, the ownership of ideas is not important, as some line game designers that we interviewed simply could not remember who had come up with the ideas for the games that they had participated on, or noted that those ideas had come about from a fairly rational decision in the first place, e.g. some rough market analysis on the part of the publisher or the team leader to meet certain market preferences for games. In this sense, such games would start to resemble many other products.

- One example of rational evolutionary thinking was of how studios thought about features in new games: studio SF relied on its knowledge of its own past products and similar major features that it had put into its past games, and the capabilities of its game "engine" (or the core software code that runs the game), in order to propose new games or to advertise its capabilities to publishers. Boston1 studio also thought in a similar way by extending the type of game (simulations of construction activities) it had done in two-dimensions to one in three-dimensions.

- One example of inspirational but "constructivist" and evolutionary thinking was that of studio SF relying on brainstorming groups to generate new ideas. The contexts observed were quite traditional or were past concepts reformulated with new game play features.

- Regardless of how a game is designed, a fair amount of project control, i.e. "rational" thought, is needed in order to develop a game effectively, and without letting creativity get out of hand. A number of rational thought processes were observed at the group level in both studios Boston1 and SF - made well into the development stage - in order to help shape the product to be "playable". In another example, after brainstorming ideas for new game designs, studio SF dealt with a proposed features list in a practical or "rational" way, by adding and taking features away from the list as needed in order to ensure that their limited human resources could actually make the game. (This is a common practice sometimes known in the industry as "feature cutoff" (Tschang, forthcoming)). All this generally reflects a tension between inspired and rational thinking. Inspired thinking may lead to numerous new ideas to be included, but a rational process needs to be engaged to make the game doable.

Due to the nature of the ethnographies, we could not detect (independent) individual creative thinking or individual rational thinking. Thus, between all the data sets, we have now found evidence to support three of the modes of thinking shown in table 2. It should be clear however that there is a substantial amount of work done by individuals over the course of their work that qualifies as "rational" thinking.

Constructivism and Evolution

In sum, it appears that there are relations between the different modes of thinking, as well as between the three aspects (i.e., constructivist, evolutionary, and inspired) of game development. We will examine one of these connections in detail: that of how constructivism is associated with the evolution of the artifact.

Evolution clearly takes place because of the additive way in which features are added to, or removed from, the videogame. There is ample evidence that many videogames are evolutionary, as witnessed by the fact that most can be classified within established genres. At the same time, evolution can be a means by which a truly great game comes about.

Furthermore, such evolution could also be a highly rational process involving rational "planning" or premeditated thought. This was the case with the studio id, which built a successful franchise for "first person shooters" by continually improving its three-dimensional graphics technology. Similarly, Rockstar Games developed three versions of its *Grand Theft Auto* game, but the third version achieved the greatest success and industry honors, in part because by then, the three-dimensional and other technologies enabled Rockstar to make a highly immersive and open-ended game (where players could literally "go anywhere" and "do anything"). In another example, Boston1 was developing a three-dimensional "urban simulation" game, which also allowed much greater degrees of immersion.

Thus, the addition of "fairly rational" technological features enable new game play elements and aesthetic improvements, adding to the set of other creative elements, including contexts, stories, and visuals. This might suggest that games may possess both the rational features of other products as well as the more aesthetic (i.e. hard to quantify) qualities of experienced and entertainment goods.

4. Conclusions

In this paper, we have shown that new product ideation for videogames can be construed to have inspired as well as evolutionary and constructed elements. However, ideation goes beyond creative thought. We have also shown that actual videogame development processes incorporates modes of not only creative but also rational thought and group processes – all of which need to be taken into account if a fuller understanding of creative products' ideation is to

be understood. We have also illustrated that there is a wide variety of types of creative thought alone, and that a variety of sources and modes of thinking need to be explored if the true sources of inspiration are to be uncovered.

In doing this, we have moved towards a theory of product ideation that better accounts for some of the important characteristics of games, and that also illustrates characteristics of products not discussed before, in either the product development or the creativity literature. While there has been prior work suggesting that product development processes need to be more adaptive, such as by incorporating experiential and overlapping product development processes, this stops short of discussing the evolutionary perspective that we described.

The constructivist model that we have proposed is perhaps the more unique perspective, and one that should doubtless be explored more in order to further our understanding of our videogames and their kindred products are developed. There are implications for how we should view innovation. In normal innovative terms, a breakthrough game like *Grand Theft Auto 3* would only be considered as an architectural or incremental innovation, but in our "new language", it could be said to have achieved a certain level of immersion to be a true constructivist innovation because it has undergone sufficient constructivist change (i.e. embedded source material) and undergone sufficient evolution to be considered as such.

Finally, we should note that the fact that the "simple" addition of features can lead to unique products should not be a surprising matter, given the combinatoric possibilities across the set of all possible features. The real question is whether the simple addition of (creative or technological) features can lead to an acknowledged creative product that is the fusion of many others, or simply the "rational" combination of features or elements found from other games. This is where the difference between "art" and simple "combinatorially-generated art" lies. Given the inspired quality that some games can have, it should be no surprise that games also have this dichotomous quality.

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