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Toward a Unified Theory of Digital Games

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Abstract Since digital games and their scientific study are quite new, many questions concerning the fundamental nature of these phenomena remain. Two often-cited attempts to clarify the fundamental components of games include the Mechanics–Dynamics–Aesthetics Framework and the Elemental Tetrad. This theory development paper attempts to reconcile these two frameworks into a single, clear and cohesive account of the kinds of elements that constitute games. The proposed theory not only includes all of the elements from its source frameworks but also introduces two refinements: (1) it differentiates game mechanics from narrative mechanics; (2) it distinguishes three types of narratives—stories told by the developers through the game, stories that emerge from gameplay and players' interpretations of game stories. The proposed theory should be useful for teaching game design fundamentals, as a coding scheme for qualitative data analysis and to analyse game design challenges. Subject to further clarification and extension, the proposed model may provide a basis for a general theory of digital games.

Keywords Game · Mechanics · Dynamics · Aesthetics · Emergent narrative · Embedded narrative · General theory · Theory development

1 Introduction

What is a game? What are games made of? What is the relationship between games and narratives? What is a mechanic, and what are the different types of mechanics? What is the relationship between games and emergence?

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To address these questions we propose developing a unified theory of digital games. Many scientific communities produce, build consensus around and emphasize unified or general theories. Physics has its Standard Model. Biology has the Theory of the Cell and the Theory of Evolution. Sociology has Structuration Theory. Criminology has the General Theory of Crime. General theories facilitate communication by defining a common language, form the foundation of a field's educational materials and weave disparate theoretical contributions into a consistent whole.

Developing a general theory of digital games is especially appropriate at this time for three reasons—(1) game studies is increasingly being recognized as a legitimate academic discipline; (2) lack of central theory impedes further increases in perceived academic legitimacy; (3) sufficient foundational research now exists to facilitate a substantial reconciliation. Any theory produced will likely be refined as digital games and our collective understanding of them develop; however, attempting to formulate a general theory is likely to produce conceptual breakthroughs. Consequently, the purpose of this paper is to develop a general theory of digital games to address the following research question.

Research Question: *What foundational classes of elements constitute digital games?*

Here, *game* has two meanings: (1) a set of interconnected elements (i.e. a system) for structuring play; (2) an event wherein one or more players interact with the play-structuring system. For example, chess refers to both a chess set (board, pieces, rules) and two people playing with the chess set. We consequently distinguish between game artifacts and game experiences to maintain clarity. A *game element* is anything that is "found in most (but not necessarily all) games, readily associated with games, and found to play a significant role in gameplay" (Deterding et al. 2011, p. 12); for instance, quests, grinding and challenge. A *class*, meanwhile, is a set of shared properties that support useful inferences (Parsons and Wand 2008). By foundational classes, we mean simply the classes that are most important for defining and understanding games.

Furthermore, *theory* refers to a system of ideas intended to explain, describe, analyze or predict a set of interconnected phenomena (Gregor 2006; OED Online 2015) and is not limited to mathematical laws or causal relationships (cf. Van de Ven 2007). A *general theory* is a theory that applies across a diverse domain of phenomena. General theories often unify or reconcile existing theoretical work, as is the case here.

This paper focuses on games deployed at least in part through digital technologies. Digital games (also called video games and electronic games) appear to have important differences from non-digital games (e.g. field sports, card games, board games). However, it is not clear a priori whether these differences are fundamental or coincidental. Developing a general theory of digital games and later generalizing it to non-digital games is one way to explore this issue.

We next review the game studies literature focused on The Mechanics–Dynamics–Aesthetics Framework, The Elemental Tetrad and the relationship between games and narratives. We include some grey literature here and throughout

the paper due to game studies' relative youth as an academic discipline. We then describe our theory development methodology, followed by a comprehensive account of the proposed theory. As this is a theory development paper, we subsequently provide a conceptual evaluation of the proposed theory, but leave empirical evaluation to future work. The paper concludes with a discussion of the theories' limitations and suggestions for empirical evaluations and extensions.

2 Literature Review

Some existing research explores the fundamentals or foundations of games. Salen and Zimmerman (2004) argue that games are "intrinsically systemic" (p. 50) and comprise objects, attributes, internal relationships and an environment—similar to prior definitions of systems (e.g. Churchman 1971). Rouse and Ogden (2005) contrastingly argue that the foundations of a game are technology, story and gameplay. This illustrates the dual meaning of game discussed above—gameplay (experience) involves the interaction between the player and the game (artifact). Rouse, however, does explain how these foundations interrelate or elaborate on the environment in which the game is situated.

Like Salen and Zimmerman, the Triadic Game Design Theory (Harteveld 2011) provides lenses for examining *serious games*. Serious games, games that are designed to achieve objectives other than entertainment (Michael and Chen 2006), are associated with "a range of perceptual, cognitive, behavioural, affective and motivational impacts and outcomes" (Connolly et al. 2012, p. 661). Triadic Game Design Theory posits that serious games inhabit three different *worlds*: (1) *meaning* refers to how the player interprets the game; (2) *reality* refers to the domain in which the game is situated, and (3) *play* refers to the game experience. Each world has aspects, criteria, theoretical disciplines and people. The theory attempts to explain how the worlds interact to affect the efficacy of a serious game; however, it does not propose specific relationships between the aspects, criteria, disciplines and people in each world.

Some research focuses specifically on educational serious games. For instance, Amory (2007) divides educational games into three spaces: (1) *the game space* includes the game and the player; (2) *the problem space* includes the educational domain in which the game is situated; (3) *the social space* includes ways for people to interact. He further identifies different layers of the game space. The *actor layer* includes the players while the *elements layer* includes sounds, technology, and backstory. These combine to create the visualisation layer, which includes story, plot, reflection, relevance and the "rhythm" of the game. The Experiential Gaming Model (Kiili 2005), meanwhile, attempts to explain how games create learning. It posits that games provide challenges that can act as learning experiences. The model further posits three interacting processes: a challenge bank, an ideation loop where players generate solutions and an experience loop where players implement their ideas. Ideally, rapid feedback from the game triggers reflection, focuses player attention and promotes learning.

Two further commonly cited systemic frameworks for understanding digital games are The Mechanics–Dynamics–Aesthetics Framework (MDA) and The Elemental Tetrad (Tetrad). MDA (Fig. 1) posits that a game comprises mechanics, dynamics and aesthetics (Hunicke et al. 2004).

> Mechanics describes the particular components of the game, at the level of data representation and algorithms. Dynamics describes the run-time behavior of the mechanics acting on the players' inputs to the game and the results of this player interaction in the game over time. Aesthetics describes the desirable emotional responses evoked in the player, when she interacts with the game system. (Hunicke et al. 2004, p. 2)

Mechanics, dynamics and aesthetics represent three different lenses through which to view game design. From the designer's perspective, mechanics produce dynamics, which then produce aesthetics.

Tetrad (Fig. 2) posits that a game comprises aesthetics, mechanics, technology and story (Schell 2008). Aesthetics describes "how your game looks, sounds, smells, tastes, and feels" (p. 42). Schell defines mechanics as "the procedures and rules of your game" (p. 41) and discusses six mechanics—"space", "objects", "actions", "rules", "skill" and "chance". Space is where the users engage with the game (both virtual worlds and physical space). Objects are tools used by the player to advance in the game. Actions are how the player interacts with objects. Rules govern the game environment. Skills are physical, mental and social abilities used by a player to progress. Chance refers to the randomness and uncertainty that exists in games. Schell is inconsistent here—space, objects, actions, skill and chance are not procedures and rules. Technology refers to the tools and systems used to implement or deliver the gameplay. The same mechanic (e.g. space) may be implemented using many different technologies (e.g. cardboard game board, mobile phone screen, game console).

Schell also discusses two methods for delivering stories through games. In the *string-of-pearls* method, the player experience oscillates between interactive gameplay and storytelling. For example, the *Mass Effect*, *Walking Dead* and *Call of Duty* series use intermittent cut scenes to build narrative. In the *story machine method*, the game is designed to produce interesting sequences of events, which may be perceived as stories by players. For example, the *SimCity*, *Microsoft Flight Simulator* and *Sid Meier's Civilization* series provide play environments where interesting sequences of events are likely to unfold. However, Tetrad does not address how these stories interact with the other concepts; therefore, we extend our literature review to investigate how the narratives manifest in digital games.

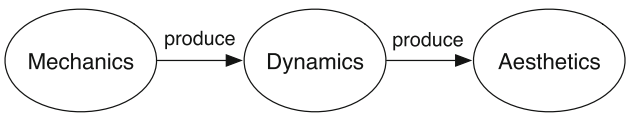


Fig. 1 The mechanics dynamics aesthetics framework (adapted from Hunicke et al. 2004)

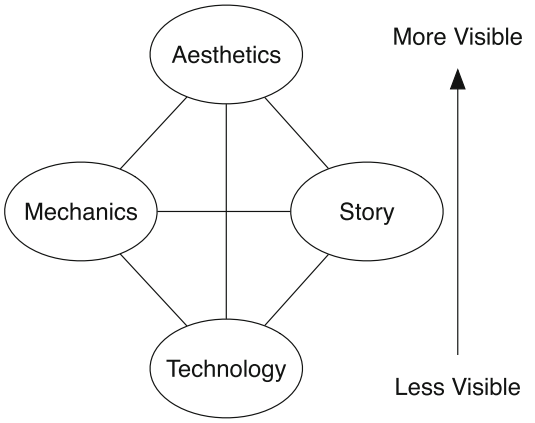


Fig. 2 The Elemental Tetrad (adapted from Schell 2008)

2.1 Narrative in Games

Stories are an important part of digital games (Carlquist 2013); however, there is no consensus as to the precise relationship between narrative and games. For example, Aarseth (2001) argues that "[games] are complex systems based on logical rules" and are therefore distinct from narratives in other media such as film and text. In contrast, Murray (1997) views all games through a narrative lens and Schell (2008) argues that *story* is a fundamental component of games. Juul (2001), meanwhile, argues that "many computer games contain narrative elements" but some do not, and games certainly do not convey narratives in the same way as movies and books. Unlike in other media, narratives in games can be contradicted by the player (Juul 2001).

Pearce (2004) distinguishes six types of narratives: experiential, performative, augmentary, descriptive, metastory and story system. Augmentary narrative refers to the background, context or lore, which enhances the rest of the story. Metastory is an embedded story that explains gameplay as it occurs. For example, in *Bastion* a narrator provides context for the player's actions as she performs them in the game. Some games explain how the player's actions have shaped the world or changed the story. For instance, in *Diablo 2*, after freeing a man from a cage the game provides dialogue explaining that the man is Deckard Cain and that the player should meet him back in town. Jenkins (2004) combines these into "embedded narratives", which comprise the body of information and narrative elements included in the game by its creators. For example, narrative elements are embedded throughout *Myst*, awaiting discovery by the player. Schell (2008)'s "string-of-pearls" method is a kind of embedded narrative. The "ideal story that the player has to realise using skill" in platformers and linear shooters (Juul 2001) is also a kind of embedded narrative.

Meanwhile, experiential narratives are stories happening to the player as they play while performative narratives are stories that emerge for a spectator as the player interacts with the game. Descriptive narrative refers to the stories that players tell about the game—both their actual play sessions and post hoc reconstructions of

the "ideal story" (Juul 2001). A story system is a "kit of generic narrative parts that allows the player to create their own narrative content." Jenkins (2004) groups these into a single category, "emergent narratives". Emergent narratives are stories created by playing the game. They are not necessarily intended or foreseen by the game's designers but arise when the player interacts with the game. Jenkins likens emergent narratives to "environmental storytelling", where the players' exploration of the game world provides a travelogue of the players' adventures rather than a narrative story told to the player through cutscenes. Schell (2008)'s story machine method produces emergent narratives. For example, the SimCity and Civilization series have little embedded narrative but great potential for the player to create narratives through gameplay. Similarly, many multiplayer games provide an environment in which player interactions are likely to produce interesting narratives.

A single game may exhibit many of these narrative types. For instance, *Bioshock* includes:

1. an experiential narrative that emerges through fighting the monsters in the game
2. a metastory that incorporates the player's actions (e.g. interactions with the non-player character Atlas) into a story about the player-character finding a way home
3. an augmentary narrative about the underwater city of Rapture, told through audio logs found throughout the game world
4. descriptive narratives told through player walkthroughs of the game
5. performative narratives where observers have watched others play

Other games employ nonlinear storytelling. Western role playing games, in particular, are often divided into numerous quests, which may be completed in different sequences. The story experienced by the player therefore depends on the quest order. A more extreme example of interactive storytelling is found in games, including Left 4 Dead and Minecraft, which use procedural content generation. By employing randomness in level or world generation, these games can deliver a different narrative with each session.

Sometimes, a narrative's audience is not the player. For example, in the Youtube video series *Cops: Skyrim*, players use *The Elder Scrolls V: Skyrim* as a medium for short stories satirizing the American reality TV series *Cops.* Similarly, esports (video game competitions) attract non-player audiences who may experience compelling narratives.

2.2 Theories of the Player

Neither MDA nor Tetrad explicitly include players as a theoretical construct; however, a growing body of research investigates the needs, motivations and types of players, as well as how games affect players' mental states.

Games engage players by fulfilling player needs (Przybylski et al. 2010). Game mechanics may support specific needs. For example, choosing character interactions supports the need for autonomy; compelling, believable characters support the need

for relatedness; progressively increasing difficulty supports the need for competence. Players derive from games a wide variety of pleasures including challenge, competition, destruction, discovery, fantasy, fellowship, humor, pride, surprise and wonder (Schell 2008). Games may also satisfy needs shared by most or all people, for instance, the need for "secure attachments to others" (Young et al. 2003) may be fulfilled to some extent by guilds and cooperative play in massively multiplayer online games.

Additionally, players can be classified by a primary need or pleasure. For example, Bartle (2004) classifies players into four types (pleasures): Achievers (challenge), Explorers (discovery), Socializers (fellowship) and Killers (competition/destruction). However, such taxonomies are oversimplified insofar as the same player may be motivated by different pleasures in different contexts (e.g. competing with online friends vs. bonding with children) (Schell 2008). Just as a person can have one global personality and many sub-personalities—self-presentations that activate to cope with different situations (Fall et al. 2004)—a player may enact different play-personas (e.g. healer, explorer, killer, hero, villain) in different games or at different times in the same game (Canossa 2007, 2009). Yee (2006) found that player motivations divide into three main categories—achievement (including advancement and competition), social (including socializing and building relationships) and immersion (including discovery and role-play).

Besides meeting needs, gaming may produce positive changes to players' mental states. Game structures are associated with heightened mindfulness (Gackenbach and Bown 2011)—a mental state of non-judgmental awareness of present circumstances (Bishop et al. 2004). Games are also associated with motivation (Przybylski et al. 2010), engagement (Connolly et al. 2012), immersion (Madigan 2010) and flow (Choi and Kim 2004; Chou and Ting 2003; Voiskounsky et al. 2004)—a mental state characterized by focus, enjoyment and strong performance (Csikszentmihalyi 2000). Moreover, designing levels with increasing difficulty leads to higher arousal while levels with greater variety and narrative framing lead to higher spatial presence (Nacke and Lindley 2008).

3 Theory Development Methodology

No widely agreed best way of developing theories—general or otherwise—has emerged. Strategies include:

- Create from experience/memory, e.g. MDA and Tetrad distil the experience of their respective proponents.
- Develop from empirical field studies (Eisenhardt 1989), e.g. Halverson et al. (2006) connect games to educational theory through several case studies of games in learning environments.
- Use grounded theory methodology (Glaser and Strauss 1967), where the researcher alternates between inductive and deductive processes on the same case, context or dataset, e.g. Brown and Cairns (2004) used grounded theory to develop a theory of game immersion.

- Adapt a theory from a reference discipline, e.g. The Technology Adoption Model (Davis 1989) simply adapts The Theory of Reasoned Action (Fishbein and Ajzen 1975) to explain the drivers of technology adoption.
- Synthesize from multiple existing theories, e.g. Fang and Zhao (2010) synthesize a theory of game enjoyment from "a review of media enjoyment theories, personality theories, effects of computer game play, and technology acceptance model" (p. 342).

We adopt a theory synthesis approach. Specifically, since MDA and Tetrad are often used to teach game design and are at least superficially compatible, we attempt to unify them. Adopting this strategy entails several challenges. Deviating too sharply from the source theories (e.g. renaming dynamics as gameplay or referring to game art as mechanics) may undermine development of a cumulative body of knowledge and increase confusion. However, some adaptation and extension is necessary to unify slightly differing concepts (see especially Aesthetics, below). Moreover, working from existing materials may increase status quo effects and focus the theorist on the phenomena targeted by the source theories.

3.1 Evaluation of Face Validity

To solicit feedback and evaluate face validity, we published a brief essay (Ralph and Monu 2014), which was linked to by several game-oriented websites including Gamasutra and Critical Distance, outlining a tentative version of such a unifying theory (Fig. 3). Here, concepts are roughly divided into three levels:

1. Game concepts exist before, during and after play, independent of any particular player
2. Player concepts exist during and after play, in the mind of the player
3. Emergent Player–Game Interaction concepts exist only during play

We then solicited comments from 25 professional game designers and game studies academics (including Jesse Schell and Hunicke et al.) via email and twitter. We briefly explained that we were working on a theory of game design, linked to our essay and asked for feedback. We also presented the theory to and solicited feedback from audiences of 20 software engineering and game studies academics, 22 players (who were neither academics nor designers), 65 undergraduate students with diverse backgrounds and a mixed group of 155 gamers and amateur and professional game developers. This produced a wide variety of predominantly positive feedback, revolving around the following three themes, which led to a sweeping reconceptualization of the proposed theory, discussed in the subsequent section.

1. Emphasizing the role of narrative in game design is widely appreciated. Distinguishing between narratives included by game developers and narratives that emerge from play is appropriate and useful. However, Jenkins (2004) has already made this distinction. Moreover, care should be taken not to imply that

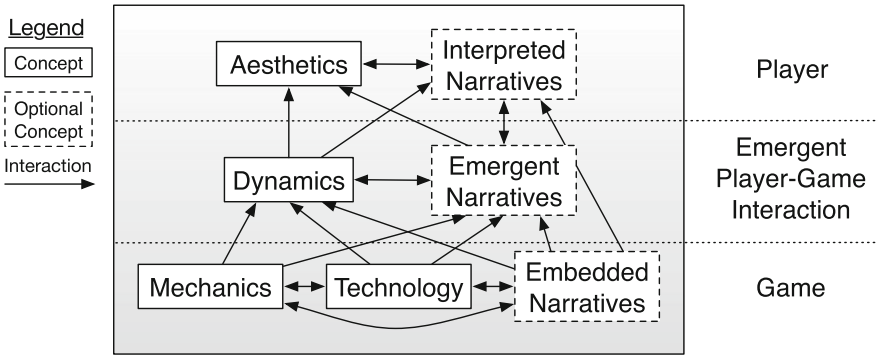


Fig. 3 First attempt at integrating MDA and Tetrad (adapted from Ralph and Monu 2014)

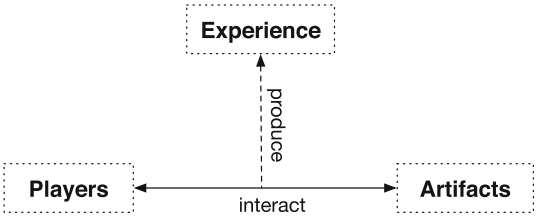
texts have objective, correct meaning. Even the relevance of authorial intent is contested in literary theory and criticism. Furthermore, the theory may be improved by clarifying the relationships between the three kinds of narratives and considering multilinear, nonlinear and interactive narratives.

2. The proposed theory is more comprehensive than its predecessors and may be useful for teaching game design. However, the more nuanced presentation of narrative complicates the unified model and therefore may hinder understanding. Furthermore, special care is needed in defining "aesthetics" since its meaning varies across disciplines.
3. The proposed theory helps to classify and to understand some game-related phenomena (e.g. ludo-narrative dissonance) better than others (e.g. comm chatter, diary entries). Moreover, the theory's layers seem to differentiate concepts of different kinds. For example, technologies exist independently of any particular player while interpreted narratives do not.

4 Proposing a General Theory of Digital Games

MDA classifies game elements into mechanics, dynamics and aesthetics; Tetrad classifies game elements into mechanics, technologies, stories and aesthetics. However, defining game as both an artifact and an experience (see above), we posit that game experiences emerge when game players interact with game artifacts. This suggests a different set of game element classes—game players, game experience and game artifacts (Fig. 4; Table 1). To arrive at the proposed theory, we re-

Fig. 4 Abstract model of games



organize the classes from MDA and Tetrad, separate game mechanics from narrative mechanics and divide story into embedded, emergent and interpreted narratives (Fig. 5; Table 2).

Specifically, by including one class (e.g. dynamics) within another (e.g. experience), we posit *composition* relationships (e.g. experience has dynamics).

Table 1 Definitions and examples of game element classes

Class	Definition
Artifacts	Elements related to artificial objects and systems used to structure play (cf. Deterding et al. 2011)
Players	Individual, human or non-human agents who use game artifacts to structure play
Experience	Elements related to events, behavior and meaning that emerge from player–artifact interaction

Non-human agents refers to non-human participants in a game who are not part of the game artifacts. For example, the algorithms that control one's opponent in a single-player game of Starcraft are part of the game artifacts, not players; however, in the Student Starcraft AI Tournament, the bots submitted by students are non-human players because they are relatively independent from the game artifacts

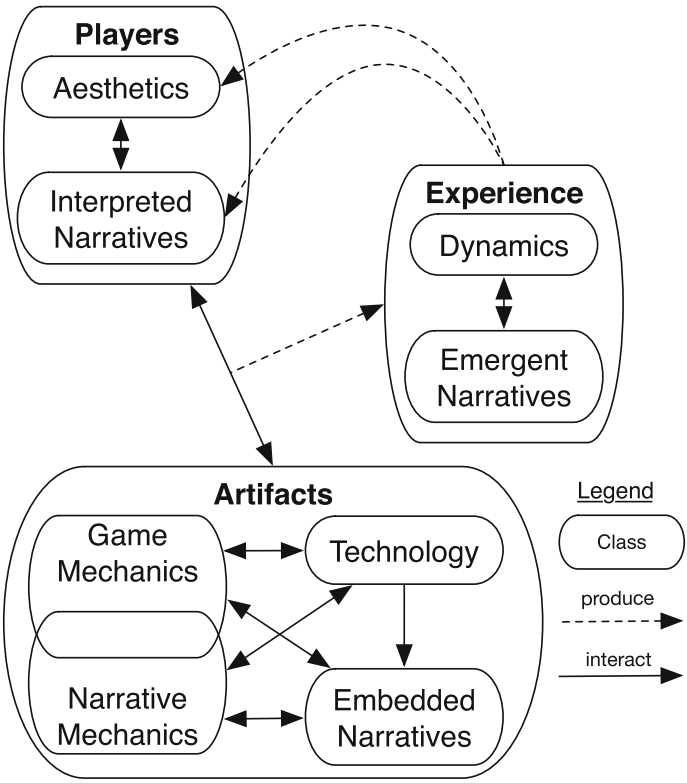


Fig. 5 Unified theory of digital games. Note: Inclusion of one class within another indicates a composition relationship

Table 2 Definitions and examples of game elements

Element	Definition	Example(s)
Game mechanics	Elements used by game developers to create and manipulate challenges for players	Turn, quest, puzzle, object, space, rule, pause, reward, friendly fire, randomness, combo, level, skill, items, timer, decision point
Narrative mechanics	Elements used by game developers to advance the plot of the game	Comm chatter, audio log, video log, dialogue, quest, puzzle, moral choice, codex entry, decision point, graffiti, overheard gossip
Technology	Tangible and intangible artifacts used to deliver game elements or play the game	Tablet, smart phone, display, console, gamepad, mouse, keyboard, speakers, headphones, game engine, programming language
Embedded narratives	Stories told by developers to players through narrative mechanics and gameplay	Snake's story in the *Metal Gear Solid* series, as understood from cut scenes and the ideal sequence of events implied by its levels
Dynamics	Emergent behavior of both the game and the player during player–game interaction	Twitch gameplay, strategic gameplay, grinding, difficulty, balance, player versus environment, immersion, competition, cooperation
Emergent narrative	A meaningful sequence of events that emerges during player–game interaction	The infamous Leeroy Jenkins fiasco in *World of Warcraft* (Warner 2007)
Aesthetics	The emotions evoked by a game	Abnegation, challenge, competition, drama, exploration, expression, fantasy, fellowship, horror, humor, puzzle, sensation
Interpreted narrative	A player's mental representations and interpretations of a game's intended or emergent narratives	a player's interpretation of *The Wolf Among Us*' ambiguous twist ending

Artifacts includes technology, embedded narratives and mechanics because they exist independently of any particular player or game experience. Experience includes dynamics and emergent narratives because they emerge from player–artifact interaction and cease when interaction ceases. Aesthetics and interpreted narratives are organized under players because they exist only in the mind of the player, and while they are produced by the game experience, they may continue to exist within the player after the game experience ends. For example, a game console exists whether or not it is turned on, while grinding exists only while the player interacts with the game; however, the unnerving feeling of a horror game may persist long after we switch off the console and go to bed. The remainder of this section elucidates each of the proposed theory's elements.

4.1 Game Mechanics and Narrative Mechanics

The proposed theory differentiates two overlapping types of mechanics. We define game mechanics as elements used by game developers to create and manipulate challenges for players. Game mechanics include quests, turns, randomness, levels

and non-player characters. Narrative mechanics, in contrast, are elements used by game developers to advance the plot of the game. Narrative mechanics include comm chatter, diaries, decision points, and cut scenes.

Narrative mechanics and game mechanics are not mutually exclusive. For example, in *Mass Effect*, the player acquires a non-player character ally named Wrex. During a confrontation late in the game, the player's dialogue choices determine whether Wrex survives the confrontation. This advances the plot of the game as Wrex's fate is a significant plot point and has numerous narrative consequences in *Mass Effect* and its sequels. However, losing Wrex also makes the game more challenging as he is no longer available for subsequent missions. This dialogue option is therefore both a narrative mechanic and a game mechanic.

In some games, moreover, practically all gameplay may be seen as narrative mechanics. For example, in *Brothers: A Tale of Two Sons*, the player guides two boys through a fantastical landscape, solving physical puzzles. The story of the brothers' journey is primarily told by allowing the player to guide the brothers on their way. Many of the puzzles are simply determining how to continue the journey. While the game does use some cut scenes, much of the story is delivered through guiding the brothers.

However, we depict game mechanics and narrative mechanics as overlapping because so many games use substantively different techniques to challenge their player and to advance their plots. For example, non-interactive cutscenes (i.e. cutscenes without quick time events) advance the plot without challenging the player while mini-games (e.g. pool, darts and bowling in *Grand Theft Auto 4*), often challenge the player without substantively contributing to the plot.

4.2 Technology and Dynamics

Mechanics are delivered via numerous technologies from virtual (e.g. the game engine) to physical (e.g. a console), from simple (e.g. speaker cables) to complicated (e.g. the Internet), from new (e.g. the Oculus Rift) to old (e.g. the alphabet). While playground games (e.g. tag; hide and seek) may be played with minimal technology, all digital games are delivered through technologies. Including technology is one reason the proposed theory is initially restricted to digital games.

Dynamics refers to the emergent behavior of both the game and the player(s) during player–game interaction. Dynamics include artifact behaviors (e.g. lag), player behaviors (e.g. grinding), player–player interaction (e.g. competing) and artifact–player interaction (e.g. exploits). Some mechanics encourage specific dynamics; for instance, catch rates, probabilistic item drops and fetch quests encourage grinding.

4.3 Aesthetics

Hunicke et al. (2004) define *aesthetics* as "the desirable emotional responses evoked in the player, when she interacts with the game system" (p. 2) and identify eight:

1. Sensation—game as sense-pleasure
2. Fantasy—game as make-believe
3. Narrative—game as drama
4. Challenge—game as obstacle course
5. Fellowship—game as social framework
6. Discovery—game as uncharted territory
7. Expression—game as self-discovery
8. Submission—game as pastime

Further aesthetics have been identified, including

9. Competition—game as dominance (Portnow 2012).

This use of aesthetics is problematic not only because it conflates the emotional responses the game actually evokes with the emotional responses the game should evoke, but also because the meaning of *aesthetics* varies across domains.

We considered several alternatives to *aesthetics*. In literature, the feeling engendered by a work is often called mood or atmosphere (Cuddon 1998). In psychology, affect refers to an emotional reaction to something (Nathanson 1992). We also considered replacing aesthetics with less technical terms including *feel* and *vibe*. However, common game aesthetics including challenge do not accord with literary moods or psychological affects, and it is not clear that feel or vibe would be any less confusing. Moreover, due in part to the influence of MDA and Tetrad, labels including fantasy, discovery and expression are increasingly recognized as "game aesthetics" and deviating too much from established vernacular may hinder the consensus the proposed theory aims to facilitate.

We consequently define aesthetics—in the domain of digital games—as "the emotions evoked by a game". Aesthetics, therefore, are player-specific; different players may appreciate different aesthetics from the same game. For example, some players view role-playing games as "playing the story" (Carlquist 2013) while others ignore the story and focus on challenges. Like dynamics, aesthetics emerge from player-game interaction; however, while dynamics are predominantly observable by outsiders and are therefore linked to the game experience, aesthetics are not and are therefore related to the internal interpretation of the game experience by the player. A game may evoke multiple aesthetics, some more intensely than others (Hunicke et al. 2004).

Aesthetics is related to player types, genres and style. Each of Bartle's (2004) player types, for example, are associated with a desired aesthetic: explorers with discovery, achievers with challenge, socialisers with fellowship and griefers with competition. Many genres are similarly distinguishable by the aesthetics they emphasize, for instance, graphic adventure games largely emphasize drama while first-person shooters emphasize challenge and competition. Aesthetics also depend on a game's style, i.e. the culmination of many interconnected micro-design decisions including visual appearance, mechanics, balance and level design. (Here we use style to indicate the way the game is, while Aesthetics indicates how the player feels about it.)

4.4 Embedded, Emergent and Interpreted Narratives

Different researchers attribute slightly different denotations and connotations to the terms *narrative*, *story* and *plot*; however, for the purposes of this paper, we use these interchangeably to refer to "an account of a series of events, facts, etc., given in order and with the establishing of connections between them" (OED Online 2015). Stories vary by the teller, the tale and the audience (Kearney 2002 ch 1). Simply asking who is telling the story, what is being told and to whom reveals substantial diversity in game narratives (Table 3). Following Jenkins (2004), we group all narratives told by the developers into *Embedded Narratives* and all narratives told at least in part by players into *Emergent Narratives*.

Embedded narratives comprise all the story elements built into a game by its developers; for example, stories told through cut scenes, stories expressed through quests and the web of possibilities in a non-linear game. Embedded narratives includes Juul's (2001) ideal sequence of events, Pearce's (2004) augmentary and meta-story narratives and Schell's (2008) string-of-pearls narratives.

Emergent narratives comprise all the story elements that emerge from player-game and player–player interactions including the order of independent quests in a role playing game, the journey through a procedurally generated world, the events of simulation and drama arising from player interactions in multiplayer games. Emergent narratives include Juul's (2001) actual event sequence experienced by the player, Pearce's experiential, descriptive, performative and story system narratives and Schell's (2008) story machine narratives.

Here, embedded narratives are related to the concept of authorial intent (Cover 2006); however, this does not mean that games have objective, correct meanings. Meanwhile, the label "emergent" links the proposed theory to the concept of emergence in complexity theory (Goldstein 1999).

Stories also exist at the interplay between the mind of the author, the mind of the reader and the actions of the narrated actors (Kearney 2002, ch. 11). We therefore use the term *Interpreted Narratives* to denote player and observer recollections and interpretations of both intended and emergent narratives. Interpreted narratives include Juul's (2001) post hoc reconstructions and retellings of game events. While interpreted narratives are not kinds of narratives in the same sense as intended and emergent narratives, we must consider players' interpretations to understand how narratives interact with aesthetics and other game elements.

Table 3 Examples of stories by teller and audience

Teller	Audience	Example
Developer	Player	Cut scenes in *Metal Gear Solid*
Developer	Observers	*Destiny* non-playable demo at the E3 2013 Conference
Player	Him or herself	Player develops a model of his or her hometown in *SimCity*
Players	Players	Three friends cooperate to survive the night in *DayZ*
Players	Observers	Underdog achieves unlikely victory in *Starcraft* tournament

4.4.1 Interconnections

Changes in game artifacts, such as technology, can affect other game artifacts, experiences and players. For example, *ARQuake* uses haptic feedback and VR technology to turn *Quake* into an augmented reality game (Piekarski and Thomas 2002). The limitations of the AR technology necessitated changing game mechanics including removing both swimming and flying. Similarly, improvements in game audio and video facilitated narrative mechanics including comm chatter, cut scenes and audio logs, and therefore richer embedded narratives. Meanwhile, the development of high-speed internet facilitated the massively multiplayer online game, which lead to richer inter-player interaction and consequently richer emergent narratives seen in *World of Warcraft* and *DayZ*. Similarly, the development of the Wii balance board led to physical balance dynamics in games. More generally, larger displays and better audio and video quality facilitate more immersive, engaging gameplay experiences. A larger screen and surround sound, for instance, enhances the feeling of being surrounded in three dimensional environments. Changes in game engines may be equally powerful, for example, the first person camera angle in the re-release of *Grand Theft Auto 5* adds to the fantasy aesthetic—"everything smutty and shocking and moral-panic-inducing about GTA is significantly intensified in first-person" (Hamilton 2014).

Similarly, changes in the experience affect aesthetics and interpreted narratives. For example, a player may enjoy *Ni No Kuni* for its light-hearted story and sense of progression. However, one aspect of progression in *Ni No Kuni* is grinding to capture more powerful companions. Grinding dynamics promote a submission aesthetic, undermining the light-hearted story and progression aesthetics. The player's interpreted narrative may therefore become decreasingly about the embedded characters and plot and increasingly about repetitive attempts to capture the right companions. The grinding dynamic therefore affects both aesthetics and interpreted narratives and reduces the story- and progression-focused player's enjoyment, engagement and motivation to play.

5 Discussion of Conceptual Framework's Validity

How one evaluates a theory depends on the kind of pattern the theory posits. Variance theories, for example, posit causal relationships, which can often be tested using randomized controlled trials. The proposed theory is not a variance theory but a theory for analysis (Gregor 2006). Theories for analysis are particularly needed in the early stages of studying a phenomenon (Fawcett and Downs 1986). They should be *clear*, *meaningful* and *complete* (Gregor 2006).

To promote clarity, the proposed theory is presented at two levels of abstraction. At the higher level of abstraction, the theory posits that game experiences emerge from one or more players interacting with one or more artifacts used to structure play. At the lower level of abstraction, the theory posits the fundamental classes of game elements. We furthermore defined all of the posited elements in Tables 1 and 2 and provided examples and explanations throughout the paper.

The proposed theory is meaningful insofar as it encompasses and links to concepts that are important to the field of game studies. We have therefore attempted to name elements in ways that are consistent with existing frameworks, discourse and related theories (e.g. emergent narratives references emergence in complexity theory).

To discuss completeness, we conducted a consultation (described above) on the initial version of the theory. Based on this feedback, we made substantial revisions including the following.

1. Presenting the theory at two levels of abstraction so it appears less complicated
2. Clarifying the types of narratives
3. Distinguishing between game mechanics and narrative mechanics
4. Improving definitions of different types of mechanics and narratives
5. Clarifying relationships within and between the game artifacts, players and experiences
6. Clarifying relationships to existing research, frameworks and theories

Furthermore, the proposed theory should be useful to educators, researchers and game designers. Educators can use the proposed theory to teach fundamentals of game design. Since the theory reconciles MDA and Tetrad, it simplifies teaching insofar as educators can present one framework instead of two, and no longer worry about minor differences between MDA and Tetrad confusing students. During the consultation, several participants indicated that the (initial) framework would be useful for teaching.

Researchers will find the theory useful as a coding scheme for qualitative analysis. For example, if we are analyzing trends in triple-a, console-based, first-person shooter games, we can classify a sample of such games according to their narrative mechanics, aesthetics, etc. This would be more rigorous than an ad hoc analysis and may help reveal specific trends (e.g. increasing use of narrative mechanics other than cut scenes) that would not be obvious given previous analytical frameworks. Organizing observed elements into an a priori coding scheme based on the proposed theory should be quicker and easier than open coding, where original categories emerge from the data.

The proposed theory is also useful for game designers to analyze common design pitfalls including ludonarrative dissonance—a cognitive discomfort caused by misalignment between game mechanics and story (Hocking 2007). Differentiating between embedded and emergent narratives helps to explain very different kinds of ludonarrative dissonance. For example, *Max Payne 3* combines cut scenes presenting a remorseful protagonist with ruthless, gunslinging mechanics. This creates dissonance between the game mechanics and the embedded narrative. In contrast, players of *Destiny* select different classes to suit different playstyles and complement teammates' abilities. While players can select a hunter class specializing in ranged combat, many missions occur in dark and claustrophobic levels that inhibit sniping. This creates dissonance between the emergent narrative of role-playing a sniper and the game mechanics forcing the player to engage enemies at short range. Additionally, the theory helps us generalize dissonance to

other class pairs. Some players of *Civilization: Beyond Earth* who expected an epic narrative of humanity's future instead encountered copious micro-decisions (Tito 2014). The proposed theory helps us identify this as dissonance between an epic interpreted narrative and a management aesthetic. More generally, by providing more specific names for common pitfalls, the theory should facilitate deeper and clearer reasoning.

6 Conclusion and Future Research

This paper provides a tentative account of the foundational classes of digital game elements by unifying two existing frameworks. At a higher level, it posits that game experiences emerge from the interaction between game players and game artifacts. At a lower level, it posits that game artifacts include game mechanics, narrative mechanics, technologies and embedded narratives; game experiences meanwhile include dynamics and emergent narratives, and produce aesthetics and interpreted narratives in players' minds. The new theory improves on previous research in at least three ways:

1. It differentiates game mechanics from narrative mechanics while recognizing their overlap
2. It distinguishes three types of narrative—embedded narratives told by developers, emergent narratives told in part by players and players' interpretations of these narratives
3. It clarifies the meaning of aesthetics and dynamics within game studies

The proposed theory should be useful for teaching fundamentals of game design, developing coding schemes for qualitative analysis and analyzing game design pitfalls including ludonarrative dissonance and aesthetic-mechanic misalignment.

These contributions should be considered in light of several limitations, chiefly, the proposed theory has not yet been empirically evaluated. The feedback collection described above was an informal consideration of face validity rather than a rigorous test of veracity. Furthermore, as in MDA and Tetrad, many of the proposed concepts are defined by their use rather than their intrinsic properties. For example, comm chatter is a narrative mechanic because it is (mostly) used to deliver plot. However, if comm chatter is used to create a challenge—for instance, by presenting an audio puzzle—it is also a game mechanic. Defining objects by their function rather than their nature may affect our analyses and discourse in ways that are not clear or predictable a priori. Furthermore, the proposed theory does not attempt to unpack the player beyond highlighting that aesthetics and interpreted narratives exist in the minds of players.

These limitations suggest several areas for future work. Obviously, we intend to test the theory empirically. The proposed theory posits a set of fundamental classes of game elements. It can therefore be tested by compiling an extensive list of game

elements and mapping the observed game elements onto the proposed theory. The theory is good to the extent that the following conditions hold.

1. Each theory element is supported by at least one observation
2. Observations map onto exactly one theory element (except for narrative and game mechanics, which are hypothesized to overlap)

Just as no number of observations of white swans proves that all swans are white, no list of compatible game elements can prove that nothing has been missed. However, if the proposed theory can accommodate significantly more observations that previous theories (i.e. MDA and Tetrad) it may be considered progress. Furthermore, the theory could be improved by integrating a comprehensive theory of the player (Canossa 2009) including player needs and play personas. Redefining game element classes based on their intrinsic properties rather than functions may also improve the thoery.

In conclusion, we set out to reconcile the Mechanics–Dynamics–Aesthetics Framework and the Elemental Tetrad, both to simplify teaching game design fundamentals and to explore and refine the concepts and propositions of these frameworks. While the proposed theory is not comprehensive and does not answer all of our questions, it represents a substantial advancement over its predecessors. Subject to empirical evaluation, we hope it can be extended to form a general theory of digital games.

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