Evolution and Digital Game Studies

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ABSTRACT
While a great variety of fields are addressed in the discussions concerning digital game studies, the natural sciences are rarely among them. We do see references to evolution and biology when we look at new directions in the technical structuring of games, as genetic programming bestows artificial characters with a greater impression of intelligence [1, 2, 3]; but this domain is not discussed in the critical dissemination of player behaviour.

If evolution and biology are valuable references for generating artificial intelligences within a digital game, perhaps it is time we consider the significance of such forces for the players engaging the game. As sociobiology pioneer Robert Trivers reminds us: "Natural selection has built us, and it is natural selection we must understand if we are to comprehend our own identities. [4]" Why are the cognitive tools we have inherited for thriving in the Pleistocene era so good at engaging, and being drawn to achieving goals in the fictional pixilated world of digital games?

This paper will argue that evolution can play an important role in digital game studies by offering a functionalist explanation to topics such as behaviour, gender, learning, development, and prediction under uncertainty. In building this case, we will examine the history of play research and discuss its dual-lineage: one largely informed by evolutionary biology, and another that is more concerned with play as a cultural artifact. From there, we will consider the potential for Evolutionary Psychology (EP) as a valuable interlocutor for digital game studies. In particular, this field's approach to addressing *judgement under uncertainty* lends astonishing insight into how core features of digital gameplay may indeed be triggering innate behaviour. In conclusion, we will present our own experiments being conducted at Victoria University of Wellington, which will provide an example of how Evolutionary Psychology may inform research conducted in digital game studies.

Author Keywords
digital gaming, play, psychology, evolution

THE LINEAGES OF PLAY STUDIES

Over the past 30 years, digital gaming has leapt dramatically from the arcade, to the living room, to the desks of academics trying to configure this phenomenon into some form that fits with their research programmes. This is mainly due to the fact that digital gaming, like nascent cinema a hundred years ago, is viewed as a new territory and still available for shaping [5, 6]. Exploring this theme, the current literature provides a very broad range of theories, typologies and speculations addressing: what designates play [7, 8], how games can be interpreted [9, 10, 11], and how they are the solution to the contemporary education dilemma [12, 13, 14]. The most cited digital gaming texts make this especially salient through two premises: 1) game play is inextricably bound to culture, and; 2) culture is tacitly divorced from biology [6, 8, 10, 11, 12, 15] (with exception of the proximal discussion about gaming and RSI, etc.).

In their book Rules of Play, Katie Salen and Eric Zimmerman have an entire unit dedicated to culture. They quickly formulate what can be viewed as a cultural relativist position (a position that distances itself from the natural sciences), ending with several quotes from Clifford Geertz [15] who is well known for his anti-nativism [20, 30]. Despite all of the possible definitions introduced by Salen and Zimmerman, nowhere are we presented with a consideration that culture emanates from (or is even related to) biological origins. Many other digital gaming researchers share a similar stance.

The most notable predecessor of such thinking in digital game studies is Johan Huizinga, whose work focuses mainly on play as a splendid and pervasive cultural regulator. But a much different theme, one that points to play's evolutionary origin, is alluded to on the opening page of his seminal work Homo Ludens: "Play is older than culture, for culture, however inadequately defined, always presupposes human society, and animals have not waited for man to teach them their playing. [16]" Unfortunately Huizinga doesn't elaborate on the ramifications of this introduction. But he didn't have to: plenty of evolutionary play theorists have.

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The most famous evolutionist, Charles Darwin, has some brief mention of play in the Descent of Man [17], but it was Karl Groos who would later build a functionalist account of play inspired by evolution through natural selection. Groos identifies precise play mechanisms that pair with developmental processes, exemplifying play as a preparation for future activities in life. Play, Groos reasons, not only prepares for physical feats, but mental challenges as well. His first book, Play of Man, is organised by varied themes that all define play as preparation for adulthood: playful use of the sensory apparatus, playful use of the motor apparatus, playful use of the higher mental powers, etc [18]. While his ideas regarding play have since morphed into newer and more nuanced theories, it is interesting to consider Groos and Huizinga as the fountainheads of the dichotomous lineages of play research.

TWO DIFFERENT MODELS FOR THE SOCIAL SCIENCES

One has to ask why Groos is so rarely cited in digital game studies in comparison to Huizinga. The evolutionary psychologists John Tooby and Leda Cosmides have been leading critics on the absence of evolution in the social sciences (which includes play research). Their watershed book, The Adapted Mind, soundly chronicles this absence, how it has persisted, and more importantly, why the rift should vanish and resolve into a consilience [19]. The first chapter in this volume of essays implicates the exclusion of evolution from the social sciences at the hands of what the authors define as the Standard Social Science Model (SSSM) – the default mantra for the social sciences of the 20th century [20]. While a complete treatment of this model goes beyond the scope of this paper, a brief synopsis can be given:

- The mind is a blank slate, and humans are socialized exclusively through learning and the ambient environment of a person's culture.
- The content of the mind is unequivocally socially constructed.
- Learning is the reason behind all recognizable, varied form of human behaviour.
- Human nature is infinitely malleable.

As an alternative to the SSSM, Tooby and Cosmides offer the Integrated Causal Model (ICM) [20], of which the core principles are:

- The mind consists of evolved information-processing modules that were produced by natural selection over evolutionary time.
- These modules were evolved to solve adaptation problems in the Environment of Evolutionary Adaptedness (EEA), such as: mate selection, language acquisition, social relations and cooperation.
- In order to be fitness-promoting, these modules must be content-specific (not just empty hardware), and therefore active in generating human culture, such as: behaviours, artefacts, linguistic systems.

The past 20 years have seen rapid deployment of Tooby and Cosmide's model. The ICM (and variations of it) have been used to reveal universal aspects of human language [21, 22], technology based diseases [23, 24], and adaptive benefits of play [25, 26, 27, 28, 29]. And if there are adaptive benefits of play - then there exists what may be the strongest, and certainly the most ancient, motivation for play behaviour.

Considering that the ICM has demonstrated our behavioural legacy rooted in evolution, it seems striking that the SSSM has lingered for so long. Tooby and Cosmides suggest that this is due to the model's immediate, sometimes superficially reasoned, moral appeal [20]. Others supporting this notion include the anthropologist Donald Brown. In his book Human Universals, he describes early 20th century anthropology as largely an experiment in myth making. One of the examples he uses is Margaret Mead's work with Samoans, in which it appears she aligned her research with a personal moral compass, fabricating progressive values to deliver back to the West [30]. New Zealand anthropologist Derek Freeman exposed many of her false conclusions on violence and sexual tension in his extensive research with this culture [31].

PLAY AND EVOLUTION

While there are a number of books that address play and evolution, one of the more thorough (and recent) ones is The Nature of Play in Great Apes and Humans by Anthony Pelligrini and Peter Smith. The first chapter constructs a framework for updating the functionalist agenda for play first laid down by Groos. Most notably, Pelligrini and Smith revise his notion on play as a preparation for adult life, while also noting that some forms of play (play fighting, chasing, even perhaps symbolic play) manifest themselves across species. This is a main point for adherents of the ICM: instead of prescinding humans from animals, we must recognize that we are interconnected with all life forms. Many modalities of play behaviour can be found latticed across different species, especially other mammals and primates. In fact, it is through play that these animals have a certain behavioural plasticity – a special means for creatively exploring the boundaries and potentials of their environment [32].

The ethologist Konrad Lorenz was one of the originators of this concept of phenotypic plasticity. He rebukes Gehlen's observation of "man as the 'deficient organism'...driven to the production of tools, weapons, clothes and the like, [33]" by carefully outlining the impressive array of non-specialized features found in Homo Sapiens, most distinctively in play. He also considers other organisms whose phenotypic expression is antithetically rigid, and

finds them under much more duress in the ability to respond to environmental fluctuation. [33]. Using Tooby and Cosmides's terminology we can say that play (perhaps even specific forms of play) is an evolved cognitive module: it is species-typical, it matches up with numerous evolutionary task analyses, and it is also seen in varied manifestations across the phylogenic tree.

DIGITAL GAMING AND EVOLUTIONARY PSYCHOLOGY

The above establishes how evolutionary sciences describe play behaviour as an evolutionary adaptation. But now let us move on to digital gaming: How is this new cultural form related to evolution? As mentioned earlier, most discussions frame this phenomenon as a new territory, or uncharted waters. If we are to fully explore the field of digital games, we need to consider the influence of evolution, and in particular, the role of phenotypic expression. Richard Dawkins clarifies that a phenotype is not just the genetic endowment vivified through bodies – it is also apparent in behaviour and in the environment. He uses beaver damns as an example; elaborating why, even though these structures are not a part of beaver bodies, we should still consider them vital to their phenotype [34]. With this lesson in mind, perhaps it is fitting to imagine the emergence of digital gaming as an appendage: something that has come out of culture - culture that is generated by humans - humans with innate behaviours that have been sculpted from over 5 million years of evolution.

And so this ancient lineage has produced a great variety of play behaviour as a flexible means for negotiating all manner of environments, even the unforseen digitally generated ones. Compared to other forms of play, digital gaming typically features dynamics of complex patterns moving through time and space, which alter accordingly to the responses of the player. Ian Bogost emphasizes this procedurality as the core aspect of digital games: whatever the content or story, games are a mode of engagement that are acted through [10]. There are obviously many more elements to a game, but the interactive pattern processing and manipulation in games offers a connective juncture for evolutionary psychology via the larger schema of *judgement under uncertainty*.

JUDGEMENT UNDER UNCERTAINTY

To illustrate how this aligns well with established digital game studies, let us return to Salen and Zimmerman. They dedicated a section in Rules of Play to systems of uncertainty. In it they stress the importance of chance and uncertainty as malleable parameters for game designers to greatly influence the meaning and intensity of games. They also point out that uncertainty is one of the oldest features of games [15]. Mathematician Deborah J. Bennet supports a similar idea in her book Randomness. Through researching the historical origins of randomness, and humans making judgements under uncertainty, she discusses the ambiguous relationship between games and divination for ancient humans [35]. From this point 10,000 years ago, through today, we see that human beings are still greatly motivated by gaining mastery over uncertainty in games, but with a much broader panoply for this fascination to spread its wings. In fact, the work of Wolfram Schultz gives keen insight into the neurobiological workings that beckons this process along via dopamine supply in anticipation of goal achievement [36, 37]: a pea is always kept one shell away from the one upturned in a good game design.

JUDGEMENT UNDER UNCERTAINTY – THE HOT HAND PHENOMENON

Perhaps judgment under uncertainty isn't as imperiously played out today as it was for the hunter-gatherer 40,0000 years ago. In that time, daily decisions tested individual Darwinian fitness, with the high score reward of life for some, and the failing score of death for the vast majority [38]. Conversely, in contemporary life we witness judgment under uncertainty when flipping through television channels, surfing the Internet [39], and quite focused in digital game play [15].

In contrast to our ancestral environment, an innate cognitive mechanism for pattern prediction may be well fooled by artificial environments. This is the central theme to the work of H. Clark Barrett and Andreas Wilke. Their writing addresses a phenomenon known as the hot hand fallacy, so named for the initial research that revealed an inclination of basketball fans to perceive players entering and falling out of winning sequences or hot streaks – even though extensive statistical research indicates this is a false assumption [40]. This fallacy also has other labels. Salen and Zimmerman, for example, address it in their book chapter "The Tendency to Think of Success Chance Events as Additive" [15]. Wilke and Barrett argue that calling hot hand a *fallacy* is a mistake of context, and refer to it instead as the *hot hand phenomenon*.

The hot hand phenomenon derives from the evolutionary adaptation acquired over thousands of generations from hunting and gathering - activities where natural resources tended to be clustered. With contemporary phenomena such as basketball games, slot machines, stock markets or TV shows like Let's Make a Deal, the hot hand phenomenon proves less fruitful. In such situations, people tend to project patterns into the environment that are simply not there. What this boils down to is a *positive recency effect*: the tendency to perceive clusters in data that is in fact not clustered, but is diffusely or randomly populated [41].

Evolutionary psychologists posit that humans are successful, even to a bizarre degree [42], at predicting under conditions that are similar to their ancestral environment. Wilke and Barrett form the hypothesis that such success is due to the fact that we have an innate disposition to make hot hand decisions. If we imagine the ensemble of objects and events important for survival in the EEA, we envision resources that *did* occur in clusters: berries, fresh water, hiding places from predators, game animals, etc. Random acts were the exception to the rule [41].

To demonstrate their hypothesis, Wilke and Barrett conducted a series of experiments that aimed to illuminate the hot hand phenomenon. The experiments were conducted through a computer game with simple rules governing a prediction task. The game was designed to provide natural conditions for the hot hand phenomena to operate in space and time. Here we have our tie-in to digital gaming: The interactivity of this experimental instrument led the researchers to refer to it as a game [41]. This is no superficial observation, for it is the procedural mechanics of this experiment that separate this mode of investigation from other statistical cognitive tests, like those made famous by Kahneman and Tversky in the 70's and 80's (guessing the number of beans in a jar, coin flips, etc.) [43, 44].

The independent variable in the experiment was the content of images appearing in the sequential frame: berries and nests (items that would be familiar in the EEA), and parking spots and bus stops (resources of our contemporary environment). While parking spots and berries are clustered, bus stops and bird nests tend to be dispersed [41]. Figure 1 depicts the 2x2 design of these experiments.

	clustered	**dispersed**
natural	berries	nests
artificial	parking spots	bus stops

Figure 1: The design of Wilke and Barrett's hot hand experiment is based on this 2x2 plan.

A simple interface allowed users to make decision as to whether the next image would be a hit or a miss based on the currently displayed image. After making 100 guesses, a dialog appeared on the game screen, allowing participants to respond to survey questions.

This experiment was performed cross-culturally with test subjects in Germany, a group of students at UCLA and another group of Shuar hunter-horticulturalists living in Ecuador. At the conclusion of the experiment, Wilke and Barrett's hypotheses were convincingly verified: 1) Hot hand is a default assumption; 2) Hot hand is triggered by searching for quantifiable resources items; 3) The effects of discovering hits and misses are differentiated emotionally and motivationally; 4) participants can learn away from using hot hand assumptions. The conclusion drawn from these findings counter those established by hot hand *fallacy* research, which proposed hot hand as a glitch in human reasoning. Instead, hot hand is an evolved cognitive module, which is beneficial when deployed under the proper conditions. In the modern era it is something that must be unlearned, so that it is not improperly applied to activities like gambling or stock market investments [41]. This point illuminates how evolution can inform digital game studies.

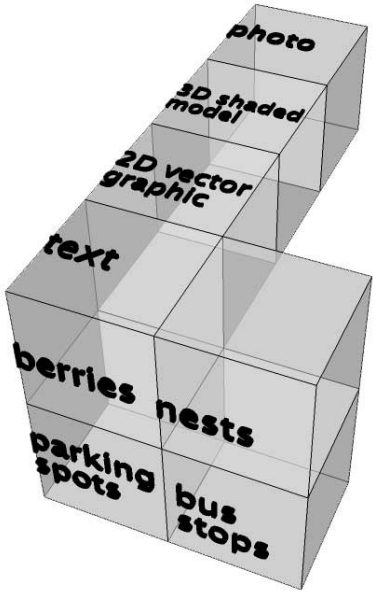

Figure 2: The design for our game incorporates a dimension for image type.

HOT HAND AND DIGITAL GAME IMAGES

Inspired by this research, we immediately thought of ways to connect the hot hand phenomena to digital game studies. Our solution was to extend Wilke and Barrett's experiment in a way that more precisely applies to a formal aspect of digital games. This formalism is the type of visual representation on a computer. Wilke and Barrett's experiment used photos, but on a computer this is only one mode of image representation. Pixel graphics and 3D-renderings are also common representation styles. In fact, if one borrows Antonio Damasio's description of how a mental image is neurologically materialized in the brain, even text can be considered as an image [45]. From this reasoning we decided to explore this area by investigating what range of computer graphic representations correspond to the same mental image for successfully triggering the hot hand phenomenon.

Consequentially, our design expands the 2x2 grid with a third axis. In addition to the grid of natural/artificial, clustered/diffused elements we added a range of the same resources represented by different forms, including text. This range reflects the common formats of gaming genres: text, 2D vector graphic, 3D rendered model, and photographic representation (see Figures 2 and 3). Our version of this experiment was created with Adobe Flash and programmed with ActionScript 3.0 (see Figure 3). In an

attempt to diffuse culture-specific influences, we will be conducting this experiment with respondents from Argentina, Japan, India and the USA.

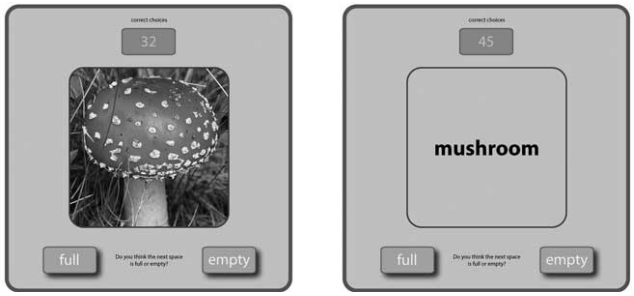

Figure 3: – Our hot hand game/instrument varies image type (instead of content as in Wilke and Barrett's).

How is cluster prediction active in digital game play?

Our hypothesis is that the type of image, be it photo, text or icon, will produce similar hot hand data that closely follow Wilke-Barrett's results. We anticipate this form of plasticity in image operation acts in support of the hot hand belief through the ability to coalesce multiple representations into a single internal mental image. If this is true, then it may also be the case that such forms of translation, from environment to conscious judgement, are a useful component of play plasticity (as described by Lorenz and Pelligrini [32, 33]) and are particularly exploited in digital game play.

CONCLUSION

In conclusion, digital game studies do not currently provide a broad enough account for digital game play, especially considering the lack of links to evolutionary sciences. Evolutionary Psychology is one field that can lend valuable insight into digital gaming behaviour through research programmes such as prediction under uncertainty. In addition to the hot hand phenomenon described in this paper, other approaches such as intention from motion cues [46], and 'fast and frugal' heuristics [47] are other promising points for reference and/or collaboration. The authors believe that the natural sciences can contribute greatly to the research of digital game studies. It is not beneficial for the advancement of digital game studies to continue as an SSSM model. [20]. On that note, we would like to quote Steven Johnson, who emphasises consilience of the sciences:

"There is no good reason that progressive politics couldn't be built on top of a comparable chain: Neuroscientists explain how the brain's underlying electrochemical networks function; evolutionary psychologists explain how and why those networks create channels of 'prepared learning'; sociologists explain what happens when those channels come together in large groups of individual minds; political theorists and ethicists explore the best way to structure society based on those patterns of group behaviour, and the individual needs and drives contained within them. [48]"

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