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Feminism and procedural content generation: toward a collaborative politics of computational creativity

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ABSTRACT

Games now inhabit a space where creativity is no longer centered around human authorship. The use of procedural content generation has been embraced by industry, academics and fans as a means for reducing labor cost, providing additional replayable content for players, investigating computational creativity in a complex and multifaceted domain and enabling new kinds of playable experiences. This incorporation of computational creative labor confuses authorship, labor politics and responsibility for rhetoric embedded in the procedures by complicating the way in which the computer is portrayed to users, researchers and other developers. We can apply feminist methodologies attentive to questions of difference and power in systemic structures in order to better understand each of these questions in turn. This article presents an analysis of the post-anthropocentric phenomenon of computer creativity within games, via a feminist analysis of procedural content generating algorithms, its role in game design and its public portrayal.

KEYWORDS

Procedural content generation; game studies; computational creativity; gender; procedural rhetoric; artificial intelligence

> … I ask what it might mean to design—from their very conception—digital tools and applications that emerge from the concerns of cultural theory and, in particular, from a feminist concern of difference. (McPherson 2014, 178)

> The education of the technological imagination is not just the business of engineers and computer scientists; on the contrary, it is the responsibility of educators across the curriculum. (Balsamo, 2011, 7)

Introduction: valuing feminism and gaming in computer science

In her acknowledgments for *Designing Culture*, Balsamo (2011) relates an anecdote about students at the Georgia Institute for Technology who asked why they should study cultural theory in their quest to become webmasters. Her response became the entire book, which is a thorough overview of the possibilities that open up when technologists and cultural critics combine their expertise toward a common end. Many schools of cultural theory—from critical race studies to feminist and queer critique—now have robust vocabularies for the study of technology, but it is still uncommon to find design practices primarily informed by these disciplines. Considering post-anthropocentric creativity presents an opportunity to think through the authors' respective disciplines (feminist technocultural studies, artificial intelligence (AI) and

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software design) in light of the calls by Balsamo, McPherson (2013) and others to explore the possibility of designing by difference. AI is particularly interesting to a feminist technocultural studies perspective because of both the historical gendering of the concept of "intelligence" and the alternative types of subjectivity that AI research proposes. Our focus on procedural content generation in video games, a form of computational creativity and a subset of AI research, allows us to discuss a form of post-anthropocentric creativity that manipulates a wide range of media types in its work.

Following Cardoso, Veale, and Wiggins' (2009) overview of the philosophical problem of "creativity" for computer scientists, we adopt here Wiggins' (2006) citation of an apocryphal definition of computational creativity: "The performance of tasks [by a computer] which, if performed by a human, would be deemed creative" (19, qtd in Cardoso, Veale, and Wiggins, 2009). This reflects the position of other AI researchers working in computational creativity, such as Colton et al. (2013), who "believe that attributions of creativity are contextualist, having no truth value which is independent of context, perception, and interpretation" (1). Regardless of whether an individual procedural content generation system can itself be considered "creative" by existing definitions of the term, the shifting and contested nature of the concept of creativity means that what we call *post-anthropocentric creativity* is simply the outer edge of creative output, that which is only possible in the space beyond the human. Across many domains, computers increasingly take creative responsibility for artifacts that normally would be conceptualized and designed by humans. Architects ask computers to design portions of buildings using parametric design tools (Monedero 2000), while many artists use generative methods across a variety of media and domains (Boden and Edmonds 2009).

The games research community, industry and its fans incorporate computer creativity as a valuable and innovative component of the development process to a degree rare in other industries. Games are an especially rich domain for studying and analyzing computational creativity due to the interdisciplinary combination of creative practices that go into their creation, which span computer programming, visual arts, music, interaction design and narrative (Liapis, Yannakakis, and Togelius 2014). The last decade has seen significant advances in procedural content generation and the related field of automated game design: the practice of having a computer design large pieces of content or even entire games based on varying levels of human input (Togelius et al. 2011; Hendrikx et al. 2013).

As far back as the 1970s and 1980s, game developers employed computer-generated content to offer novelty to their players, and to create vast worlds in the face of extreme memory constraints. *Elite* (Braben and Bell 1984) employed procedural content generation to create a universe far larger than could work with memory limitations of the time, then hand-curated that universe to ensure that it did not contain worlds with offensive or inappropriate names (Boyes 2006). *Rogue*'s use of procedural content generation to create new dungeons each time the player began a new game (Wichman, Arnold, and Lane 1980) spawned an entire genre of *rogue-likes* that include modern popular titles such as the *Diablo* series (North 1997) and *Spelunky* (Yu 2009). Even before the prominence of personal computing, game designers incorporated procedural content generation into electronic board games such as *Simon* (Milton Bradley 1978) and produced computer-generated aids for pen-and-paper role-playing games (Smith 2015).

Today, procedural generation adds value as an advertised feature of some of the most popular and anticipated games on the market. Mojang's *Minecraft* (Persson 2011) retains its active community with algorithms that generate unique landscapes, fauna, and resources that continually expand as the player explores. As

of this writing, the game *No Man's Sky* (Hello Games 2015) has not yet been released; however, it promises an entirely procedurally generated universe that players can discover and explore, containing worlds complete with detailed and stylistically consistent flora and fauna created by the computer. Its universe algorithm has already been the subject of numerous talks at the Game Developers Conference and other game industry venues (Duncan 2015; McKendrick 2015) as well as articles in mainstream technology press such as the *New Yorker* and *MIT Technology Review* (Parkin 2014; Khatchadourian, McGrath, and Paumgarten 2015). The academic research community for procedural content generation is also growing, supporting interdisciplinary work from scholars in AI, game studies, game design and human–computer interaction.

Academic research in procedural content generation has many different motivations, stemming in part from the different disciplinary backgrounds of its researchers. AI researchers often use games to test new algorithmic techniques for content generation (Karakovskiy and Togelius 2012). Others use computationally creative labor to assist human designers, either via design tools that have a built-in generative system (Smith, Whitehead, and Mateas 2011; Liapis, Yannakakis, and Togelius 2013), or through identifying common patterns and metaphors in how procedural content generation is used in a design (Khaled, Nelson, and Barr 2013; Smith 2014). Within computational creativity and games, scholars model a creative process and test that generative model in a game environment (Cook and Colton 2011). The games industry looks to procedural content generation to solve authoring burdens, such as creating trees (Interactive Data Visualization Inc. 2010) and other environmental features (Ebert et al. 2004; Müller et al. 2006). Game designers (whether academic, industry-based or indie) also use procedural techniques to enable new kinds of game experiences (Maxis 2008; Hastings, Guha, and Stanley 2009; Rohrer 2011; Smith et al. 2012).

Rising alongside the influence of procedural content generation on game development is an unrelated interest in the political messages of video games themselves. While critics have long pointed to the racist, sexist and homophobic content of video games, recent high-profile coverage of harassment events in gamer culture and at industry events has turned game designers' attention to these problems. Game designers grapple with taking social justice advocates seriously in the design of their products. The synchronous growth of procedural content generation and political awareness in game design makes this a productive moment in which to interrogate how procedural generators are themselves political mechanisms and, by extension, how we might shape their politics to arc toward justice.

This article crafts a theoretical framework for assessing the politics of procedural generation by situating this programming practice within a technological imagination underwritten by the gendered history of AI, reading existing generative systems through a feminist lens, making recommendations for improvements to current procedural content generation systems to address the raised issues and discussing how the framework can extend to considering non-human creativity in non-game domains.

Gendering (artificial) intelligence

Technical innovation and invention are informed, among other material constraints, by the imagination. Balsamo (2011) writes extensively about what she calls the technological imagination, "a mindset that enables people to think with technology, to transform what is known into what is possible" (6). The technological imagination is informed not merely by material constraints and engineering expertise, but by the cultural practices surrounding the production and use of different technologies. From this perspective, "what is known" and

"what is possible" are both products of how individual designers understand the world; the simplest example of this is the impact of science fiction film and literature on real-world technological production (Milburn 2010; Bassett, Steinmueller, and Voss 2013). Because of this, design practice is always situated within systems of racialized and gendered power, including cultural texts that shape the way we imagine possibility within the world. The unconscious effects of these texts easily slip into the design of technological systems and reciprocally influence their transmission of that power. For example, McPherson (2013) argues that the design of Unix in the mid-twentieth century was entangled with the racial politics of the same era, preventing us from seeing the connections across larger systemic problems because of the way it organized data (and our thinking) into modular structures. Chun (2005, 2011) has made similar arguments about network architecture and computer memory structures.

In the interest of understanding the technological imagination surrounding AI, we turn briefly to accounts of the gendered history of AI in computer science and science fiction. Gender may not initially seem relevant to a conversation about AI, but the shifting cultural perceptions of the thinking machine have long been linked to concepts of gender. Questions about authorship and creativity brought about by procedural content generation, which we will explore later, are also fundamentally about subjectivity, a particularly vexed topic with respect to gender politics.

Historian Minsoo Kang argues that "woman-machines" became differentiated from their masculine counterparts in the nineteenth century as science began to agree upon the anatomical differences between male and female bodies. Grounding machine gender in the human body led to a long-lasting association between feminine automata and hysteria. It also turned the woman-machine into an uncanny nightmare: the feminine body that cannot reproduce (Kang 2015). Though AI does not need to have a body, historical connections between rationality and masculinity ensure that hysteria is a disease particular to a feminized mind, not just a physical uterus. The rational salve of computational logic was known even to the earliest computer scientists. For example, Husbands, Holland, and Wheeler (2008) claim that Anne Isabella Byron, the mother of Ada Lovelace, encouraged her daughter to pursue math and science in order to "drive out any Byronic madness [she] might have inherited" from her father (5)—the Byronic madness, amongst other things, being excessive emotionalism and a propensity for sexual deviancy and same-sex affairs.

When Alan Turing proposed his foundational test for AI, he described it in the "relatively unambiguous" terms of gender, declining to define terms like "machine" and "think" because of their complicated histories (1950, 433). As feminist commentators have pointed out for decades, Turing's test first asked users to imagine proving one's gender to an anonymous interlocutor, exposing the ways in which gendered embodiment is central to what makes a human (Hayles 1999) as well as how imitation takes center stage in both computer systems and gender performance (Halberstam 1991).[1] As AI development progressed, the identities of computer scientists themselves influenced which types of behaviors they interpreted as intelligent and strove to mimic in their programs. Logic puzzles and chess, for example, were both favorite pastimes of these scientists and, coincidentally, the activities by which they assessed early AI programs. Adam (1998) characterizes this decision as a "natural" one—where else would the world's smartest humans look to define intelligence than to themselves (35, 37)? Gaboury (2013) makes similar claims about early queer computer scientists, including Turing, whose sexual orientations might be seen to trouble the totalizing logics of the computational systems with which they worked.

This truncated history of gendered AI situates computer programs that have what might

seem to be innocuous feminine names, such as ELIZA. ELIZA is one of the famous early language processing programs to engage in Turing-like conversations with users and whose eponymous effect describes the human tendency to attribute intelligence when there is, in fact, none. ELIZA's name seems particularly revealing: her namesake Eliza Doolittle was an archetypal uneducated feminine character who must be taught proper language by a civilized gentleman. Her "intelligence" is purely imitative, and many find it questionable to include her in a serious genealogy of AI despite her memorable presence in the popular imagination. In some ways, this proves the point: in the context of a gendered history of intelligence generally and AI specifically, ELIZA's legacy is of the empty-headed but charming computer program with which people can pretend to emotionally connect.

By way of contrast, take Nasta's (1984) review of a similar program, Racter, which was credited with co-authoring a novel but which has a much less feminine name:

> But where *Eliza* [*sic*] is rough around the edges, mistaking an occasional pronoun, *Racter* is a flawless grammarian. It conjugates regular and irregular verbs, conjures up the singular and plural forms of regular and irregular nouns, and remembers genders, getting the pronoun right every time. It can assign variable status to words, sentence forms, paragraph structures, or even whole story forms. Choosing from an impressive 2,800-word vocabulary, *Racter* observes "syntax directives" that derive from the way the words have been categorized. These rules allow it to compose pieces that are not only grammatically and syntactically correct, but often pleasing and even eloquent. (62)

The frequency with which AI is anthropomorphized and gendered suggests the need to render a program in more familiar terms in order to take it seriously as a thinking, producing entity. This also gestures toward the role that gender plays in the perception of intelligence. Nasta's praise of Racter underscores the program's virtuosity and competence, even though its ability to "write" a novel was later revealed to be greatly overstated. Even with this fraud exposed, Racter was praised as "a fine piece of work" and "an elaborate achievement that deserves considerable honor" ("The Policeman's Beard" 1993). The comparison of ELIZA and Racter falls cleanly along gendered lines, where the unpolished legacy of Miss Doolittle follows her computerized namesake into the twentieth century, condemning her despite the fact that Racter's creator heavily curated the text that was hailed as its first novel.

Failing to critically attend to the gender of an AI program can inadvertently reinforce stereotypes that already strongly underscore the history of the field, even in unconscious ways. This also happens in fictional representations. Comparing GLaDOS, the feminine AI nemesis in the game *Portal* to her precursor HAL 9000 from the film *2001: A Space Odyssey*, for example, brings back Kang's connection between the woman-machine and hysteria. Both GLaDOS and HAL are murderous computers with contempt for humanity, but when they are finally defeated, they diverge significantly. HAL calmly pleads for his life as he slowly drifts into unconsciousness, while GLaDOS cycles through extremely animated emotional states to lie, humiliate, and intimidate her assailant into halting her attack. Femininity renders the GLaDOS program irrational and incoherent, denying her the cold intellect of more masculine programs.

However, there can be radical potential in the gendering of a computer program; the alterity of computer intelligence can provide a point of departure from body-based concepts of identity. One contemporary example of gendered AI design is ANGELINA, an automated game designer written by Michael Cook. Originally developed to focus primarily on abstract game designs and systems of rules, the ANGELINA project shifted to consider how the system could be developed to understand and convey messages through the games it designs.

ANGELINA takes minimal external input and creates entire games from them. Its most current games, for example, make simple platformers out of articles from *The Guardian*. The finished products are coherent but haunting, with nostalgic retro sprite graphics that move against backgrounds of news images. ANGELINA's creator refers to the program without feminine pronouns despite its feminine name, but ANGELINA also fits squarely into the field of feminine AI. While ANGELINA's research contributions to the field of computational creativity are straightforward to identify, its potential as political procedural content generation design lies in its performative relationship to women, people of color, and queer and transgender designers in the games industry. This evokes, once again, Colton et al.'s (2014) comments about the situatedness of computational creativity.

When speaking about ANGELINA at public events, Cook expresses an intriguing goal: to have it taken seriously as a game designer in its own right. In the context of a field that is overwhelmingly dominated by male practitioners, ANGELINA's struggle for validity might be read as a mockery of what others endure in their day-to-day professional and personal lives. Indeed, the quality of games it produces does not meet the expectations for professional game designers. The sprites that ANGELINA uses are rudimentary, and the collection of images that appear in the background and key moments of the game are less aesthetically pleasing than thematically appropriate: ANGELINA generates games by scanning *The Guardian* newspaper headlines, reading the article it finds most interesting and assembling visuals and music for the game based on the keywords, tone and location of the news story (Cook, Colton, and Pease 2012). This results in a fully playable platformer game that will never win awards for visual design (see Figure 1). However, ANGELINA's minimalist aesthetic and quirky sensibilities, as well as its continual trajectory of improvement and recent interest

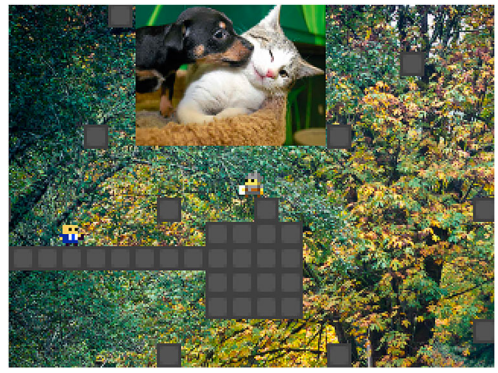

Figure 1. A screenshot of *The Conservation of Emily*, a game by ANGELINA.

in newsgames, do align it with the underground queer indie games community made popular by designers like Mattie Brice, Anna Anthropy and Merritt Kopas. The games that come out of these communities are innovative, highly personal and messy in a way that rejects the polished aesthetic of AAA game design.

ANGELINA does not offer something we can identify as an intentional exploration of its own interiority, but we must recognize any output of a computer program as an expression of its internal processes. To take it on its own terms is to recognize a new creative subjectivity in the realm of game design, one whose struggle for recognition can amplify other voices who are shut out by a risk-averse industry. ANGELINA will never insist on the validity of its own aesthetic paradigm or instruct its programmer in appropriate pronouns, but as it continues to create increasingly sophisticated games, its human players may learn to appreciate the previously inaccessible creative mind of the thinking machine.

Computer creativity in procedural content generation

With this gendered background in mind, we will now discuss computational creativity and "authorship," a concept that itself evokes the solitary creative genius historically rendered as a straight white male by the construction of

artistic and literary canons. The example of Racter in the previous section demonstrates how creative genius can be attributed to neutral programs by those who interact with a system, which signals the importance of attending to gendered stereotypes when designing and naming these systems. Adam (2005), for example, thoroughly critiques the epistemological principles on which much AI design is based, stating that the assumption that logic and rationality should look the same across different embodiments is "cultural imperialism writ large" (333). This is also a major contention of the field of object-oriented ontology and AI research that seeks to move beyond Turing's imitative criteria for assessing an intelligent system. Yet, while it is important to maintain a healthy skepticism toward an imitative measure of intelligence and creativity, the popular reception of such design depends on users' ability to (mis)recognize the actions of the machine.

Procedural content generation holds a clear appeal for industry and hobbyist developers, as well as for players, due to the ability to design and engage with automated systems that mimic human creative behavior. Some of the earliest books and magazines around creative computing and hobbyist programming highlighted methods for creating simple generative systems (Ahl 1973). Hobbyist and independent developer ("indie") interest in procedural content generation continues today, as evidenced in part by high participation and strong coverage of the first procedural content generation game jam (Cook 2015). There is a large variety of technical approaches for content generation, ranging from simple random recombination of pre-authored pieces (Robinson 2009; Software and Interactive 2009) to complex algorithms that aim to seek out novel and surprising content (Liapis, Yannakakis, and Togelius 2015) to constraint-based systems that aim to meet designer specifications (Smith and Mateas 2011). Togelius et al. (2011) provide a survey and taxonomy for "search-based" optimization approaches to procedural content generation. They identify two particular considerations for procedural content generation of interest to this article: (a) the necessity of the content for the overall game experience and (b) whether the content is generated deterministically or stochastically.

Computational creative labor is sometimes employed to create "decorative" objects that augment a human-designed environment. At other times, it is used to create elements crucial to the play experience, such as a level that the player must complete. Deterministic versus stochastic content creation relates to questions of who owns authorship over the created content. Deterministic content creation is usually used when facing hard memory constraints (as in *Elite* (Braben and Bell 1984) or *.kkrieger* (.theprodukkt 2004) and as an effort for a human author to direct the intentional creation of content via code rather than using the more standard wide variety of tools and art assets used for game creation. Here, the human author of the system is more typically seen as taking on the creative role entirely. However, with stochastic content generation, questions of authorship are more complex: if the human creator of a system is surprised by the content produced, or authors a system that is capable of producing and evaluating its own work, then part of the creative authorship can be said to extend to the machine.

It is not only the products of many generative systems that can be considered creative, but also the processes they follow. Perhaps the most common variety of procedural content generation system follows a *combinatorial* approach to creating content. Though there are many that simply rely upon what the human has provided as building blocks to implicitly define validity and value (which may not be considered creative under Boden's definition), systems can also filter what they create so that only what it interprets as valuable is considered a resulting artifact (Smith et al. 2011). Yet more systems, especially those that follow an optimization-based or evolutionary approach (Togelius, De Nardi, and Lucas 2007; Shaker, Yannakakis, and Togelius 2010; Togelius,

Preuss, and Yannakakis 2010), participate in *exploratory* creativity. Constrained novelty search has also been applied within procedural content generation, resulting in a system that produces multiple levels that it considers novel relative to each other (Liapis, Yannakakis, and Togelius 2015). Some systems are deliberately designed to be *assistive* to human creators, where the goal of the creative system is to act as a collaborator with a human. There is also an area of research in determining useful ways to characterize and compare the expressivity and creativity of procedural content generation systems via an analysis of the artifacts they produce, in terms of their novelty along several dimensions and how they respond to user input (Horn et al. 2014).

These systems are capable of creating levels, weapons, or 3D models that were not envisioned by the author of the system, and have never been seen before their creation. The *value* of the content created is difficult to assess. The interest that players show in procedurally generated content is one indicator. There is also considerable research in formally defining the "value" of generated content (e.g. in the context of a game, how difficult, enjoyable or frustrating it is (Yannakakis et al. 2013)) and using that notion of value to guide its own process for creating new content. AI components such as the Director of *Left 4 Dead* (Valve 2008), which dynamically arranges game components and adjusts difficulty in response to the actions and performance of the player, add value to a game by facilitating a player's continued engagement with the system. The Director was widely credited with the success of *Left 4 Dead*, and has been adapted for other games since (Serviss 2013; Thompson 2014; Marchiafava 2015).

User determination of the value of a computer's creative contribution to a game is an important part of a generative system's function, and it also has a bearing on the cultural reception of AI generally. Simply put, if part of the pleasure in using AI in game design is the human understanding that they are computers engaging in creativity (Colton et al. 2014), then it is an important ethical practice to attend to the human assumptions about these computers. With ANGELINA, which creates entire game programs rather than specific pieces of a game, notions of gender and authorship can collide with AI in unexpected ways, perhaps paving the way for users to see the value of contributions from nontraditional game creators. Whether or not it is coincidental that amateurish intelligences like ANGELINA and ELIZA are coded as feminine while experts like The Director and Racter are marked as neutral (which nearly always signifies masculinity), the way that we value their creative contributions to culture is demonstrably different.

Recognizing context in procedural politics: a rogue dream

As non-human creators occupy more space in a field experiencing visible public turmoil over a variety of human concerns, from unstable labor practices to racist and sexist behaviors in industry and community, the stakes of game design have become increasingly complicated. At their best, human creators are capable of thinking within a broad cultural context, taking a critical eye to their own work, hearing feedback from both their peers and from players, and revising their work to make sure it communicates what they intended. Advocates from inside and out of the game industry push for designers to recognize their practices as culturally situated, with varying degrees of success. These conversations often revolve around the creation of art assets because the representation of characters and locations is an easily identifiable way of creating meaning. However, algorithmic processes play an important part in the meaning making of games, as well (Bogost 2010), and some argue that they are central to the medium. Therefore, any critical intervention into game design that stops at the level of representation to address political problems, rather than delving into processes and

algorithms, misses the full range of expression of which games are capable.

The algorithms used to create content and games vary in terms of both how much they incorporate human-authored content and the extent to which they attempt to explicitly model an intentional design process. Some algorithms randomly select large pieces of human-authored content, while others use minimal human authoring and have more sophisticated algorithms that support solving complex design constraints, exploring design variants, and automated evaluation and aesthetic judgment (Smith 2014). The human author of a system creates an implicit specified theory for what the design process is by encoding not only the processes that the machine should follow to design an object but also the bits of data that should be used by that process. These systems act as a formal theory of design, in terms of both the products they create and the processes they follow (Cook and Smith 2015).[2]

A Rogue Dream is an experimental roguelike game developed by Michael Cook as an entry to the 7 Day Roguelike Competition in 2013 (Cook and Colton 2014). The game generates its components based on a user prompt by using "Google milking" techniques to gather data from the Internet (Veale 2012). Google milking asks Google an incomplete question and mines its autocomplete results to recover conceptual associations indicated by popular queries. For example, the question "Why do doctors … " is autocompleted by Google in many ways, including " … wear white coats" and " … say stat". A *Rogue Dream* was the first application of Google milking to videogames, and it was an experiment in getting a game to identify cultural context to produce a set of game components that would have meaningful relationships to a user. The game asked the player to complete the statement "Last night, I dreamt I was a _____," and then designed the visual and written theme of the game around elements related to the entry. If the player provided the noun *doctor*, then they would be represented in the game as a doctor, they might be carrying an item called a White Coat, and they might have an ability called Say Stat. Information about the player's enemies is also mined: Google milking suggests that doctors hate pharmacists, so these might be an enemy type in the game.

Using this and other banal examples, *A Rogue Dream* appears to be an interesting way for a program to dynamically obtain and utilize concepts and visual assets that can inform the narrative and representational meaning of the game. Users who played the game were impressed by the program's ability to create games that made some sense. However, Google autocomplete results are based on popular queries, meaning they represent commonly asked questions regardless of content, truth or validity. Asking *A Rogue Dream* to theme the game around playing as a woman, for example, might offer the ability to have an affair. One instance of *A Rogue Dream* resulted in a "man" avatar, a "woman" enemy type, and the special ability "rape." In the process of testing and development, *A Rogue Dream* produced a number of racist and sexist games alongside more seemingly innocuous ones about doctors and cows. The program could draw on dynamic cultural context to which it had access, but had no way of evaluating that context for appropriateness or impact.

Google milking yields conceptually interesting results in the way it helps a computer to build a simple impression of the world. As it uses strategies not unlike a human, *A Rogue Dream* creates games that resonate with players. However, we must situate this technical achievement against the implied political statement that popular Google searches have useful information for an entity to begin to understand a particular noun. Autocomplete is a mechanism that has been linked by some researchers to the perpetuation of harmful stereotypes (Baker and Potts 2013) because of how it encourages users to conflate popular search queries with truth, enacting a type of tyranny of the majority that crystallizes the popularly

held but often uninformed associations of the general population. *A Rogue Dream*'s use of Google milking to "learn" social concepts and assemble human-produced objects that are then given as input to the game generator as a grounding truth for its games valorizes crowd consensus in the logic of the game system. Its formal theory of design is problematic not because of the surface content that results, but, rather, because of the logic underwriting it. This example demonstrates how current systems can convey meaning through biases in the generative space of their algorithms. Other examples might include a character creator that prioritizes whiteness by making mostly Caucasian characters, a name generator that creates predominantly masculine names, or a tombstone generator that implicitly normalizes same-sex relationships by restricting the gender of paired names. The messages can also come through how the generative system is embedded in the overall game design, such as the creation of characters in games such as Zoo Tycoon (Blue Fang Games 2001) and Dwarf Fortress (Adams 2006) that have attributes (such as gender) that are discernable to the player but have no bearing on gameplay or mechanics.

Creative computers are restricted in the kind of messaging they can provide and critique they can accept; the cultural context within which these systems operate are informed, often unintentionally, by the perspectives and biases of their human creators. The programmers and designers who author these creative systems make a set of commitments to the nature of the content they create. For example, a human who programs a character generator that works by randomly piecing together facial features, body parts, and clothing options implicitly suggests that these components define a character in some meaningful way. Though game players may be aware that the game they are playing is partially or completely designed by a computer, that awareness does not transfer to a significant difference in their expectations or interpretations. *A Rogue Dream*'s games are no less problematic by suggesting links between race and favorite foods because they were put together by a machine's discovery of a societal stereotype. On the contrary, the reluctance to assign bias to a computer without emotions means that these machine associations can lend more validity to the content they generate in their programs. This is Adam's (2005) critique of "universal" rationality, the suggestion that all rational actors will come to similar conclusions.

It is crucial that the content and games created by the machine contain socially responsible, culturally contextualized statements. The issues that arise from creative systems that do not understand their broader cultural context demand resolution, particularly when the illusion of logic and impartiality can seem to endorse problematic content. While it seems like a science fiction eventuality, it is crucial for the future of the field that development of computational creativity for this type of content prioritizes developing ways for computer creators to be aware of what they create and how it can be interpreted by players. As a short-term solution, this responsibility is currently pushed back to the human designers who are creating the computational system. However, our long-term imagined future is one in which machine creativity can understand cultural context and rhetoric, such that it can be a critic of its own work, accept critique from others, and work to refine the work independently from the human who created it. If computational creativity systems like ANGELINA or The Painting Fool can already identify and interpret the mood of news articles with different types of creative output (Colton et al. 2014), then it seems within reach to develop systems that can identify racist and sexist "moods," as well.

Labor, industry and the future of computational creativity

A significant portion of the procedural content generation research and development community

sees its practices as a way to speed up production, reduce the cost of development and remove the need for dedicated designers and artists for the content areas that computers are creating. Though some procedural content generation research focuses on having computers augment the work of human designers or on fostering creative collaboration between the human and computer (Lubart 2005; Smith, Whitehead, and Mateas 2011; Liapis, Yannakakis, and Togelius 2013; Shaker, Shaker, and Togelius 2013), the majority focuses on creating fully autonomous intelligent agents that can create and evaluate their own work. Players welcome procedurally generated content for games, drawn in by a combination of fascination around the technological innovation and the promise of longer and more varied play experiences resulting from rapid creation of content. Procedural content generation typically tries to "blend in" as much as possible with the overall aesthetics of the game and often tries to mimic what humans would normally create (though there are certainly exceptions, such as the artgame *Secret Habitat* (Strangethink 2014)). If a system creates content of poor quality, players do not excuse it due to the status of being created by a non-human.

Though it is not likely that computer creators will ever replace the artists, programmers, and designers currently employed by the games industry, the economic drive for cheaper production does introduce the question of whether procedural content generation will improve the quality of life for game designers who report frequent instances of "crunch" time: concentrated periods of overtime work in order to meet a project deadline (Edwards et al. 2014). This is a question of relevance to the political aims of this paper, as well: work–life balance, time flexibility and other quality of life issues have long been identified as a source of employee turnover generally and the failure to retain women in particular as part of the games industry workforce (Consalvo 2008). With so much research oriented toward the ethos of productivity, it seems more likely that procedural content generation will become to game designers what electronic appliances were to the housewife: labor saving in theory, but increasing expectations and work in practice. While addressing this problem is outside of the scope of this particular article, we include it here in order to gesture toward important frontiers in the intersection between feminism and procedural content generation.

There is a need across all creative domains for the designers of generative systems to have more sensitivity to the meaning encoded in their systems and in the content these systems produce. Generative methods that do not encode both semantic knowledge of the domain and a broader cultural understanding can result in creating systems that deliver nonsensical or highly inappropriate content. For example, Google's *Deep Dream* produces images by running its recognition algorithms in reverse, showing what the computer "thinks" it sees in a picture; however, because of its dependence upon a training set consisting largely of images of dogs, it is biased toward "seeing" dogs in every picture, resulting in strange, swirling dog imagery placed atop whatever photograph it is given (Brownlee 2015). It lacks the world knowledge and cultural context to produce anything else. Leaning upon existing data, particularly when the data have been crowdsourced as in the case of popular semantic network ConceptNet (Havasi, Speer, and Alonso 2007), means that a generative system will be subject to the biases and underlying patterns found in that data. Thus, it is crucially important that designers of creative systems be sensitive to what those biases and patterns may be. Attempts to patch produced content after the fact to meet even the most rudimentary of acceptable guidelines is extremely challenging. For example, Darius Kazemi, a prominent technologist who designs generative twitter bots, has released a "blacklist" of unacceptable words in an attempt to stop his bots from creating offensive content (Kazemi 2013). However, he acknowledges that in order to fully prevent offensive content from slipping out, he must

continually maintain that list, and allow many false negatives (thus limiting the expressive potential of his systems) in order to guarantee that there are no occurrences of inappropriate words.

The way in which creative AI systems are portrayed and even named can also be highly anthropomorphized and gendered. For example, DARCI (Norton, Heath, and Ventura 2013), EMI (Cope 1987) and Viv (Horn, Smith, and Stone 2015) are systems that are explicitly gendered feminine (and referred to with feminine pronouns by their creators) operating in the domains of image creation, music and 3D printing, respectively. While gendering software does not always present political problems (and in fact it can be an effective political strategy), it is important to fully understand the historical and cultural field into which a system's name enters. Relatedly, questions of authorship and labor can combine in interesting ways in computational creativity research. For example, consider Simon Colton's *Painting Fool* (2012), which creates novel digital paintings. Colton ascribes creative authorship of works created to the *Painting Fool* itself, even accepting (on the system's behalf) commissions for new work to be made by the AI (Colton et al. 2015). However, while the system is attributed authorship, it does not earn credit for the commission—the monetary payment went to Colton, who used it to augment the system with new capabilities. While it seems a science fiction eventuality, the increasing sophistication of AI programs demands an ethical accounting for the ways in which we put them to work as well as the ways they may put us out of work someday.

Computers are better at authoring certain content more quickly than their human counterparts, but the speed and variety currently come at the expense of an ability to understand the meaning embedded in that content. The permanence of these systems and their underlying politics means that human creators of such systems should be aware of what they are unleashing and the political commitments they are making through their design decisions. However, few human programmers undergo any training in the disciplines that might help them to identify potential conflicts ahead of time. Perhaps in time, machines can be trained to do this work for them. Until then, we must learn to craft interdisciplinary approaches that are responsive to both technical and political design challenges, and to value the work that reaches across vastly different fields to attempt to tackle these problems. This article has attempted to model what such work might look like, with attention dedicated to historical context, representational analysis, and platform studies alike in order to begin to understand how gender and procedural content generation intersect.

Notes

1. In fact, gender is key to defining personhood by many traditions, from common practices such as the revelation of a baby's sex before it is born or psychoanalytic theories that identify the recognition of sexual difference as a significant moment, at which subjectivity is determined.
2. For example, an evolutionary algorithm captures not only elements of self-criticism but also the notion of design as an optimization process, while a grammar-based approach poses that design is purely constructive, with no need for self-reflection. Similarly, the machine also is embedded with a formal theory for the fundamental definition of the product being designed, as the programmer must again make strong, formal commitments to the machine about what is included in the generative space of the system and what will be excluded.

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