A Systematic Review of Computational Creativity Practices Across Disciplines

SSHRC Knowledge Synthesis Report

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Key Messages

This project examined the application of artificial intelligence to the modeling, support and generation of "creative" output across application domains of music, literary narrative and visual arts. We engaged in a systematic review that identified a corpus of 287 research studies across these application areas. Focusing on the most compelling emergent trends in the domains of music and narrative, we identify the following four key messages:

1.1. Canada has established an importance presence in the area of Computational Creativity, and room exist to amplify and diversify this strength.

1.2. Research backgrounds are a strong determinant of the presence (or lack thereof) of human-centred evaluation approaches.

1.3. Interdisciplinarity is key both across traditional departments and within departments who are designed to cross art/science/technology divides.

1.4. The diversity of both programmers and human evaluators is not well-researched beyond the issue of expertise within the given application domain.

Executive Summary

Over the past several years, Artificial Intelligence has become a dominant narrative in popular and public discourse as well as an increasingly active area for technological research and development. A sub-domain that presents a particularly challenging set of problems and prospects is that of Computational Creativity, focused on the modeling and generation of machine output that may be considered creative in and of itself. We posit that this area is of particular and critical importance to assess for two reasons:

- It presents research wherein a machine agent is expected to "break" rules and veer from any human-led expectation. As agents become more self-sustaining this has critical implications, both philosophical as well as practical, regarding expected integration of this technology into society and policy that must contend with this.
- It presents a clear case wherein the framing of agent-based systems, and the s between what "truly" exists in code and what is purported to exist has the potential to be quite large. This is both given the intuition-centric nature of artistic practice itself, as well as because in many cases designers simply do not fully know the operations and behaviours of a given system, due to their often high level of opacity.

This report is a modest first step towards engaging with AI through the lens of this sub-domain of computational creativity, with a specific goal of analyzing the intersections of:

- The actual modeling approaches of researchers.
- The language they tend to use in describing and framing their systems.

- The level of attempts made at diversity and inclusion in this research stream.
- The level of integration of this inclusion in the design process itself.

Following a systematic literature review approach, we analyzed countries in which research occurred, departmental involvements, the specific methods employed and how human involvement was integrated into the research. We discovered that Canada has staked an important early standing this research field, though this is still centred around a relatively small number of researchers, pointing to an opportunity for diversity in the support of research in the field within Canada. A **knowledge strength** within Canada can be found within the prevalence of researchers who work within interdisciplinary research contexts that, by their design, integrate art with science and technology development. That this is indeed a benefit is predicated on qualitative trends in the data. Namely, across all countries, quantitative evaluations of system output (rather than human reaction) correlated strongly with traditional departments of origin focused on Engineering and Computer Science. These studies tended to use general machine-learning based approaches that would learn pattern without context. At the other extreme, authors from traditionally-identified fine arts departments were more likely to avoid evaluation of any kind, making arguments about the goal of art-making being an end in it's own right. Interestingly, articles that either presented interdisciplinary collaboration across such departments, **or** departments that themselves were framed as existing between art and technology were more likely to take up the issue of evaluation as a primary point of discussion. This tendency resulted in an avoidance of strict definitions of creativity, and rather a focus on a mixture of qualitative

and quantitative human reactions, involving methods from psychology and the social sciences. This set of research from the corpus was also much more strongly associated with models that were built upon ecological and social-interaction approaches to artificial intelligence. This suggests a tendencies in two directions: approaches in which the behaviours of algorithms themselves lead design/assessment criteria within a closed system on the one had, and approaches in which computational agents are regarded as actors within a network involving human subjects, with this larger set of interactions being framed as an open and interactional system. In light of these trends, we **recommend attention** be paid to the interdisciplinarity of research teams, with **equal focus** being placed on cross-domain teams and well as emergent research centres whom are inherently inter-domain. Again, we note a relative strength within Canada with respect to this latter model.

Finally, we maintain concern over potentials for encoding bias within AI systems. backgrounds of designers or evaluators are hard to assess from the scholarly literature. A **knowledge gap and area for future improvement** would be to encourage studies to seek information from evaluators that would reflect their "insider" status, and thus criteria such as programming knowledge, relationship to authors, and manner in which they were recruited would be valuable. Similarly, in an attempt to understand more deeply the diversity of individuals who are shaping artificial intelligence research, backgrounds on evaluators (both in training as well as assessing system) with respect to gender, class, ethnicity, training and ability would be extremely helpful to encourage at the research reporting stage. We believe that future research on this topic is warranted, and that it should similarly begin from a focus on primary (and primarily scientific) texts while also considering the growing body of popular, non-academic texts circulating online.

I. Context

This report presents a systematic review, across disciplines, of research arising in the past ten years in the area of computational creativity[1]. This research topic, broadly speaking, is concerned with the application of artificial intelligence (AI) to endeavours that are usually associated with human creative acts (McCormack, J. and d'Inverno 2012), and which includes artistic, philosophical and cognitive science research-creation. This report examines recent research results in this field with respect to the specifics of technological developments as well as the framing of the research that has emerged within the field on the part of active researchers. This examination is done with consideration of the larger ethical, economic and social implications of this lively field.

Undoubtedly, we as a society are entering uncharted waters regarding the injection of machine agents into our daily lives. Theorists and practitioners vary widely on the ethical and social impacts that we might expect from this developing strand of human innovation, ranging from utopian and futuristic expectations of Ray Kurzweil that the human race will transcend its own biology (Kurzweil 2014) to dystopian worst-case scenarios presented by Stephen Hawking and Elon Musk (Luckerson 2014), who stress the need for humanistic awareness and care in AI research. The range of predictions, speed of development and clear potential for computational agents to change our world with either a positive or negative valence means that public policy needs to directly address AI research *as it is being conducted,* reflecting on larger trends from social, ethical and culturally-situated perspectives. In fact, some scholars believe that our progress is accelerating at such a rate that systems might soon attain superintelligence, surpassing

1 https://en.wikipedia.org/wiki/Computational_creativity

the capabilities of human intelligence and thereby altering the course and dominant role of our species going forward (Bostrom 2014). This underscores the imperative nature of considering emergent trends in AI development, from a variety of perspectives, in the course of developing relevant public policy.

This project proposes to focus specifically on the area of AI-based models of creativity, as one of the most cutting-edge and quickly changing areas of research, having potential for impact beyond its current areas of application. Within the larger field of AI research, computational creativity presents one of the most challenging problems and prospects within the larger field of AI: defining and capturing the essence of human creativity. The very concept of novelty in creation suggests the breaking of rules and the creation of new ones, challenging the very core principles of procedural and algorithmic thinking that is the basis for modern computation. This is nowhere more true than in the area of human artistic creation, and as such presents a canonical case study in the field. Indeed, large research communities have developed around domain-specific approaches to computational creativity, recognizing these challenges.

The goal of this project has been to identify common emergent themes that can be seen as manifestations of more general trends in artificial intelligence research on which to build, and any domain-specific tacit assumptions that might lead to knowledge gaps in the field when viewed more widely. Informed by his past research in musical AI development, the PI has articulated a set of core questions that can be factored into three areas of creativity, training and evaluation, and backgrounds of those involved.

1) **Creativity**: How does creativity tend to be defined within a given application area?

1. Are most systems based upon a general theory of creativity or domain-specific heuristics?
2. What are the predominant scholarly/scientific areas that are being drawn on in order to model/design AI systems? (e.g. Is the design based on cognitive, ecological, perceptual, evolutionary, social, etc. Models?)
3. Are most systems concerned with top-down, bottom-up or combination approaches in their design?
4. How are the basic features that systems learn within a given discipline defined?

2) **Training and Evaluation**: How are outputs being evaluated as being creative?

1. Training: are humans "in the loop" during training? Are most systems trained using supervised or unsupervised learning?
2. Evaluation: How are outputs being validated as being "creative"? Are qualitative human reactions being sought, is some quantitative measure being used, or is evaluation non-existent?
3. Are research conclusions in a given field finding that existing system exhibit "true" novelty, recombinant variation on existing human-creative work, or something else?

Backgrounds: What are the backgrounds of creators and assessors/evaluators?

1. What are the backgrounds of designers and programmers involved?
2. What are the backgrounds of any human evaluators/assessors?

Guided by this set of questions, we proceeded to examine the literature in search of

promising research trends that promote and diverse and inclusive intellectual approach, as well as domain-specific biases or assumptions that may be encoded in the research, and by extension literally have the potential to become encoded within the computational systems that result.

II. Implications

AI research has and will increasingly impact the lives of all Canadians, from filtering online content, engaging in manufacturing jobs, utilization in war, to generating meta-knowledge that will assist in any number of fields from medicine to finance. Even before the extreme scenario of an emergent superintelligence, questioning what tacit assumptions, representations and potential biases are embedded within the algorithms is essential to assess in the course of sound policy development. This is made even more manifest in situations where algorithms are expected to generate novelty and make large leaps of inference based on mechanisms that even their human programmers are uncertain of, with computational creativity being perhaps the canonical case where this holds true by its very nature. Further, and as the past twenty years has demonstrated, technological progress does not develop at a linear rate, and in fact appears to be rapidly accelerating. As such, it is important and very timely to assess emerging trends across application areas, and to identify the most promising trends that are enhancing *human* creativity and prosperity from diverse cultural perspectives, as well as potential knowledge gaps in this regard.

This report will be of potential interest to policy-makers tasked with developing legislation that must determine boundaries of machine authorship (e.g. Intellectual property)

intent and liability. It will further be of potential interest to funding bodies who must determine the value of investments in computational creativity research with respect to the field's impact on promoting democratic access to technologies that benefits all Canadians. Rather than point to generalizable claims about artificial intelligence research as a whole, we instead point to promising trend within the field and identify potential "blind spots" that would benefit from closer inspection.

III. Approach

In reading the literature, it became quickly clear that the research has been fairly application-driven, and focused on challenges very specific to the cognitive and sense modalities of a given creative task. In addition to the domain of musical AI development, it becomes quickly clear that computationally creative systems are being developed in the domain of the visuals arts (Romero et al. 2007), narrative in theatre and games (Magerko et al. 2010; Hodon et al. 2012) and in the realm of creative writing (Gervás et al. 2006). In order to assess the balance of attention required across domains, we drew upon research from Loghran and O'Neil (2017), which analyzed domain-specificity of all publications appearing in the International Conference on Computational Creativity, a central interdisciplinary gathering point for research in the field. Reviewing this study affirmed the intention from the proposal to examine three domains of application: music, visual arts and literary narrative. Working from this, the domains were divided amongst the PI and two graduate research assistants hired to engage in the review process. We report here on the domains of music and narrative, as these are currently the most

complete analyses and thus currently provide the most insights.

Systematic Review: Overview

In light of the goal of discovering emergent narratives and trends related to research and dissemination of software systems, we decided to base our systemic review on the model presented by Sarka and Ipsen (2017), whose study focused on social media usage trends, including how it is used to share knowledge. This in turn follows a five-step approach outlined by Denyer and Tranfield (2009). These steps are as follows:

1.1) Formulating Questions

1.2) Locating Studies

1.3) Study Selection and Evaluation

1.4) Analysis and Synthesis

1.5) Reporting and Using the Results

The first step, formulating questions, was determined at the proposal stage. These three questions, each having sub-questions, were articulated in section I.

Locating Studies

In preparation for the systematic review, the team reviewed the variety of sources aggregated via the well-maintained Wikipedia page for Computational Creativity. Of particular relevance to this

initial process was the collection *Computers and Creativity*, edited by Jon McCormack and Mark d'Iverno (2012). In addition to being a canonical text in the field, the centrality of the question of defining creativity and the various models that have been applied to this task (e.g. social, psychological, ecological, evolutionary, technological novelty, etc.) within this collection rendered the text central to the team's organization of content. In aggregating sources, special attention was paid to the links and complimentary concerns of outlined in the final chapter of *Computers and Creativity*, "Computers and Creativity: The Road Ahead," wherein the authors outline questions they anticipate being increasingly central to the study of computational creativity in the near future. Many of the issues McCormack and d'Iverno allude to in "Computers and Creativity: The Road Ahead" recall fundamental queries about the interpretation(s) of "creativity" that inform emergent computationally-creative systems, as well as the way in which AI-based technologies are designated as creative. This meta-focus on methods for identifying, evaluating, and categorizing artworks remained a traceable theme and topic for evolving interdomain research between the team (i.e. as distinctly applicable in the different fields of visual art, music, and narrative).

Building upon this initial background study and the PI's proposal, the research team began by collecting sources based on a variety of search terms relevant to domain-specific materials. These included "computational creativity," "artificial intelligence," "AI," "computational agent," "machine agent," "machine learning," "cognitive modelling," and "cognitive systems," in combination with "creativity" and/or "arts." As a result of this initial phase of resource gathering, conversations were generated within our team that helped clarify importance of noting reference--or a lack thereof--to topics of heuristics; agency; skill set; training; accessibility;

diversity amongst computationally creative arts practitioners, evaluators and/or audience; and domain-specific definitions of creativity. After comparing initial search results, we began searching the same databases using for domain-specific terminology, e.g. “narrative,” “storytelling,” “automatic writing,” “interactive storytelling,” “writing,” “literature,” and “open-source narrative.”

Responding to the need to establish equivalency across the tri-domain research structure, the individual team members began to search and then catalogue information using the search terms “computational creativity” <and> narrative <or> music <or> (visual <and> arts). Based upon a team evaluation of the most efficacious search methods, search fields were then limited to four databases: Google Scholar, ACM (Association for Computing Machinery), IEEE (Institute of Electrical and Electronics Engineers) Xplore, and the complete proceedings of each ICCC Conference.

Study Selection and Evaluation

It should be noted that, in several cases, ACM, IEEE, and ICCC sources appear as results on Google Scholar, we began with Google Scholar searches, filtering each subsequent database search to avoid redundancies. In order to focus on contemporary trends, search results were limited to 2008-2017, and after aggregating hundreds of sources per domain each researcher culled their findings to approximately 100 sources based upon inclusion and exclusion criteria laid out in table 1.

Inclusion criteria	1. Papers in peer-reviewed journals, conference papers, working papers, workshop proceedings, editorials, and reviews
	2. Papers must have Creation, Evaluation or Analysis of a Computationally Creative System as the main focus (specific one(s) or hypothetical one(s) as a "thought experiment")
	3. Selection of papers will be 2008-2017
	4. Theoretical papers, empirical papers, and review papers, either qualitative or quantitative
Exclusion criteria	1. Papers related to topics where the focus is not music, narrative, visual arts
	2. Focus on systems that are not autonomous (i.e. algorithms that are used as more of an instrument or a support tool..)
	3. All studies in any other language than English

Table 1: Search Criteria

Analysis and Synthesis

The shortlisted sources were then analyzed based on both quantitative and qualitative features. In an effort to glean a comprehensive understanding of the state of recent and contemporary scholarship, we collected data on the source type (i.e. conference paper, workshop paper, or peer reviewed journal publication), source provenance (i.e. country of publication and, where applicable, affiliated university department), as well as central theme and findings of a given text. This was coupled with the information defined by the sub-questions, resulting in the analysis template shown in table 2.

Area	Category	Rationale
Descriptive	Authors	Names of authors
	Title	Complete title
	Year	Year of publication
	Publication source	Where published
	Country/ies	Country research conducted
	Department(s)	Departments of authors
	Paper Format	Conference, Journal, Etc.
Thematic	Theme	Focus of the research
	Findings	Main findings
	Other	Other relevant information
Creativity	Theory	General or domain specific?
	Frameworks/Models	Theoretical Frameworks Used
	Top-Down/Bottom-Up/Both	Driven by rules or driven by data?
	Features	Input data for system(s)
Training & Evaluation	Humans in loop?	Do humans interact with system during training?
	Un/Supervised?	What type of machine learning is happening, if any?
	Creativity Validated?	How do authors validate system is creative?
	Conclusion of System?	What are claims about system's creativity?
Background	...of Programmers?	Demographics of CC system programmers
	...of Evaluators?	Demographics of any human evaluators

Table 2: Template used for extraction and analysis of data.

Domain-Specific Considerations: Lessons from Narrative

In collecting sources prior to the analysis and data extraction stage, attention was paid to existing definitions of narrative proffered within texts. In many cases, the theoretical foundations of

authors' interpretation of narrative definitions and frameworks were either not articulated or not associated with a specific cultural milieu or medium. For example, although several sources () reference a well-known systematic analysis of the foundational components of Russian folk tales (Propp 1968) as a basis for the design of narrative-recognition systems, the same sources tend not to acknowledge the more foundational approaches to narrative genre assignation and codification that such interpretive schemas derive from. This lack of critical deconstruction of existing narrative genre designations is further evidenced through widespread delineations between "narrative," "storytelling," "poetry," and "lyric-writing" within the analyzed sources. As a result, although many recent developments in the field of automatic writing and narrative evaluation purport to create novel textual results, the genres of literature that these systems are working within are seemingly limited, to reinforcing existing literary genre divisions. In cases of bottom-up (i.e. event-driven) and/or human-supervised machine learning contexts, concepts of narrative originality--or comparable measures of success, e.g. suspense-driven plot ("A model of suspense for narrative generation," Doust and Piwek) or emotional intensity ("The affective storyteller: using character emotion to influence narrative generation," Kaptein and Broekens) --therein reflect relatively traditional, mostly Western Eurocentric canonical, interpretations of narrative structure, purpose, and effect.

Within the domain of narrative, the lack of information about computational narrative systems's usages of top-down versus bottom-up modeling, as well as frequent omissions of information regarding whether system learning was supervised or unsupervised, was noted. Relatedly, as noted above, narrative theory was frequently invoked by scholars working within a scientific subfields of computational research frameworks (i.e. the prevalence of sourced derived

from scientific rather than humanities faculties amongst the shortlisted sources and amongst the ICCC presenters, specifically) within reference to specific narrative frameworks such as one might encounter within literary studies or criticism. We can point to this as an implicit **knowledge gap** regarding the interpretation of narrative and literature within the field of computational creativity, specifically within science-oriented research settings. In an effort to categorize narrative findings according to a provisional framework that would offer more topic specificity, we again drew upon (Roísín Loughran and Michael O'Neill, 2017) domain overview of computational creativity research , to evaluate narrative focus (e.g. "Story," "Design," "Literature," "Poetry," etc.) in the process of filtering articles.

Reporting and using the results

We describe this in detail in the following section.

IV. Results

Music

The researcher within this domain first examined the prevalence of countries within the final set of studies – this information is depicted in table 3.

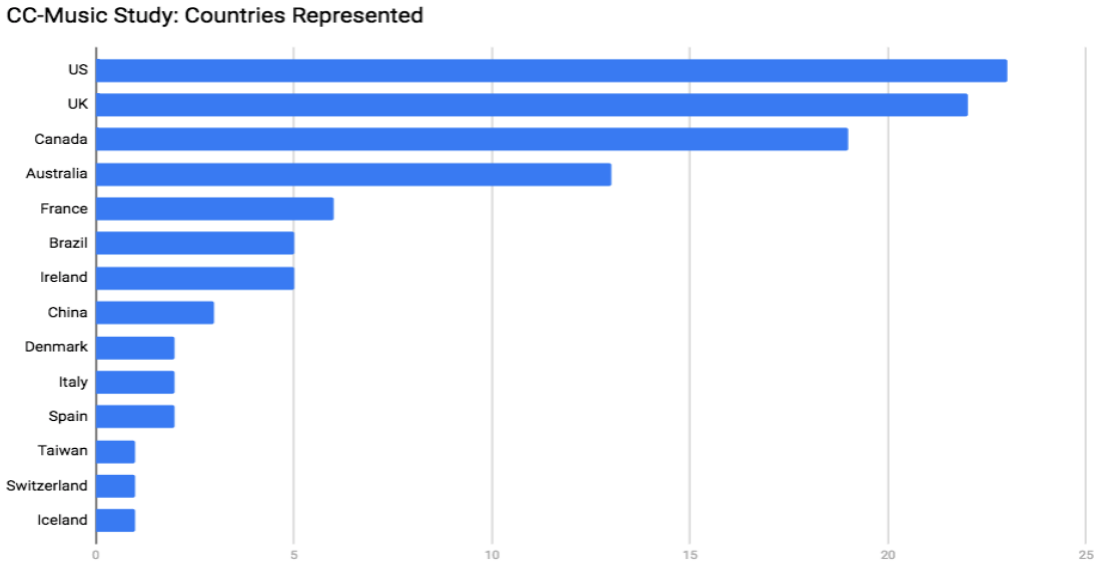

Table 3: Countries of origin for computational creativity research in music

From this we can see that Canada represents well in comparison to larger nations such as the U.S., and that four countries: US, UK, Canada and Australia are the strongest contributors to this domain. That said, taking a closer look it becomes apparent that a large number of the sources

from Canada originate with a small number of researchers, pointing to an *opportunity for diversity in the support of research in the field within Canada*. The benefit of this can be further understood via another qualitative trend in the data:

In general across all countries, quantitative evaluations of system output (rather than human reaction) correlated strongly with articles in which people tend to make strict claims about what "creativity" is for their given systems. Further, the departments of origin tended to be Computer Science or Engineering. These articles tended to use general machine-learning based approaches that would learn pattern without context, and referenced music-theoretic models as exemplars of what the "goal" should be. At the other extreme, authors from traditionally-identified fine arts departments were more likely to avoid evaluation of any kind, making arguments about the goal of art-making being an end in it's own right. Interestingly, articles that either presented interdisciplinary collaboration across such departments, or departments that themselves were framed as existing between art and technology were more likely to take up the issue of evaluation as a primary point of discussion. This tendency is to focus on avoiding strict definitions of creativity, and rather to focus on a mixture of qualitative and quantitative human reactions, involving methods from psychology and the social sciences. This set of research from the corpus was also much more strongly associated with models that were built upon evolutionary, ecological and social-interaction approaches to artificial intelligence. This suggests a tendencies in two directions: approaches in which the behaviours of algorithms themselves lead design choices as well as assessment criteria within a closed system on the one had, and approaches in which computational agents are regarded as actors within a network involving human subjects, with this larger set of interactions being framed as an open and interactional system. In terms of

an area of promise to amplify and support in the future, this would suggest that supporting projects that either integrate traditional arts/technology collaborators or which originate with departments that have art/science/technology as their interdisciplinary mandate would both be worthwhile directions to pursue.

Meanwhile, one clear trend has been that backgrounds of designers or evaluators are hard to assess from the scholarly literature. While this makes sense in the former case as there is not a culture of authors regularly reporting on themselves in this manner, there is room for improvement in the latter case. Studies which presented demographic data almost exclusively focused on musical expertise, a reasonable consideration with respect to assessment. However, a **knowledge gap and area for future improvement** would be to encourage studies to seek information from evaluators that would reflect their "insider" status, and thus criteria such as programming knowledge, relationship to authors, and manner in which they were recruited would be valuable. Similarly, in an attempt to understand more deeply the diversity of individuals who are shaping artificial intelligence research, backgrounds on evaluators (both in training as well as assessing system) with respect to gender, class, ethnicity, training and ability would be extremely helpful to encourage at the research reporting stage.

Narrative

The outcome of narrative-specific research leads the researcher to contend that significant focus within AI-led narrative systems developments have been inspired by utility within gaming or digital content creation based on open-source contexts. To a significant extent, discussions of literary aesthetics, affect, or novelty have been elided within the analyzed sources. The researcher

conjectures that this may, in part, reflected the utilitarian aims of most described usages of computationally-derived narrative, e.g. expediting a creative (script, lyrics, poem, etc.) or technical (email response, etc.) writing within the appended source list.

Discussions of virtual narrative scenarios, such as encountered through online gaming, VR experiences, etc., tend to draw on the language of *interactivity* (e.g. “, whereas automated, machine-led systems for narrative generative tend more frequently to refer to *improvisation* (e.g. “MEXICA-Impro: A Computational Model for Narrative Improvisation,” “Towards Lifelong Interactive Learning For Open-ended Embodied Narrative Improvisation,” and “Improvisational Computational Storytelling in Open Worlds”).

Sources based upon conference proceedings figured centrally in research findings within the narrative domain, leading the researcher to infer that increasing knowledge clusters may be predicted based upon conference foci and individual and institutional participants and affiliated research networks.

In very few cases was explicit information on tech-commercial investors or interest alluded to within sources; however, the cross-appointments of many leading computational creativity experts between university research settings (notably including labs) and commercial sectors, such IT and AI firms, at least raises the question of potential ethical lacunae and transparency issues.

Existing knowledge within the field of computational narrative tends to focus on factors such as reader or user “enjoyment” or emotional engagement (“ without closely defining these criteria. For example, in “ Richard Doust and Paul Piwek explore suspense-building as a narrative device crucial to the development of coherent and compelling plot. In a different sense, articles

exploring reader/user experiences of novelty when encountering computationally-derived narratives (e.g. as profiled in narrative-domain sources: “Such interpretations of plot and reader preference are rarely contextualized relative to standard literary analytical categories, such as tone and genre. As a result, critical observations about systems’ purported success within the field of automated narrative generation are sometimes obscured by minimal attention to key literary devices such as allusion, allegory, imagery, metaphor, foreshadowing, vernacular, voice, and narrator. As such, a recommended **area for further attention** would therefore be the cultivation of more mixed qualitative and quantitative analyses of designer intent and theoretical engagement with the domain field, as explored from an art-making critical framework. Discussions of system efficacy or utility are somewhat difficult to validate or otherwise appraise in the absence of more rooted interdisciplinary analysis.

V. **State of Knowledge**

Again, during the process of aggregating and analyzing sources, it was noted that information was difficult to find pertaining to available demographic data, specifically information on which demographics tend to be, versus tend not to be, involved with computational creativity scholarship. This gap was first identified by the team during the pre-selection phase of this project and was confirmed throughout the analysis phase. In response, the team decided to prioritize quantitative data collection, whenever possible, on demographic information provided within sources about the identities of system creators, evaluators, and audiences. Cognizant of the nuance and ethical sensitivity that would necessarily underlie a

comprehensive evaluation of diversity within the field of computational creativity, the research team elected not to attempt to quantify data on criteria that was not self-reported, beyond the categories related to regional and departmental affiliations.

In some cases, researchers did note an existing body of theoretical analysis--frequently drawing upon modes of intersectional critique - concerning the lack of diversity within computational arts and scholarship. We note that that frequently, said critical sources might exist outside of strictly technological and/or scientific scholastic fields. During the preliminary research phase, we noted the growing body of popular, non-academic texts circulating online as sites of significant theoretical exegesis on the relationship between computational arts accessibility issues and factors such as gender, race, sexuality, socioeconomic status, educational disciplinary background, site of research, interpretation of research field, etc.

We believe that future scholarship could efficaciously draw on these sites of non-traditional scholarship in tandem within existing peer-reviewed data to develop more incisive analyses of issues of knowledge and resource gatekeeping within and beyond computational creativity practices and associated academic disciplines. In anticipation of the emergence such cross-disciplinary studies (i.e. as the fields of computational creativity and attendant popular and scholarly commentaries develop), we observe the necessity for more extensive research engaging questions of accessibility and latent biases within emergent techno-cultural trends in tandem with assessments of the framing provided by primary scholarly sources. Indeed, our literature review aims to contextualize existing resources *with a specific focus on primary (and primarily scientific) texts* written by programmers and designers as an initial phase of this process, towards the ultimate goal of relating these findings to such popular and secondary texts. We propose that

discovering latent concept framings within these system-design focused texts first, and relating to public discourse second, is the clearest path to better ascertaining critical discursive blindspots in the field. By identifying emerging narratives at the source, it is our hope that subsequent mobilization of the results of such identifications may lead to research toward increased and equitable access to computational arts resources.

VI. Additional Resources

We present the full list of sources examined within the appendix.

VII. Knowledge Mobilization

With respect to amplifying existing areas of holisitic and inclusive development, supporting research that originates within contexts that have integrated art/science/technology approaches as their mandate would be a suggested avenue to pursue, in addition to promoting more interdisciplinary art/technology collaborators across traditionally-defined departments. We suggest supporting works that make explicit their often tacit presumptions about novelty and creativity from the AI perspective, and who make attempts to integrate this from both the design as well as evaluation perspective. Reporting on, and making efforts to, integrate a diverse set of non-expert human evaluators is another area that is seemingly underreported within the field. With respect to uncovering hidden biases that might be encoded within computational agents, taking further steps to examine informed public critique would provide another perspective to balance the analysis of primary scholarly sources.

VIII. Conclusion

The musical research on computational creativity within Canada is identified as an area of strength relative to the field, and one that can be amplified through considerations of diverse methodologies and approaches that foster interdisciplinary thinking. In the context of computational creativity scholarship that focuses on narrative, the research conversations have hitherto been oriented around story development, principally for the purpose of deriving coherent and engaging story content for human users. A mixture of machine and human-led programming models have been employed for the purpose of training machines to create content that is either perceived as human-created or significantly engaging for a human user. Within the same field, a relative lack of focus has been placed on ascertaining the cultural value of these kinds of innovations as related directly to the development of literary/narrative skill, effect, and novelty. In other words, prevailing system development foci seems to have been oriented toward the production of narrative content for the purpose of technological novelty rather than aesthetic or readerly value. That said, an increasing attention to genre-specific modalities of text assemblage within emergent narrative AI systems portends increasing specification and nuance within resulting cultural formats.

In general, the diversity of developers, practitioners, and evaluators remains a pressing question at the time of writing this report and we believe that further inquiry into the nature of interdisciplinary systems development and scholarship would necessarily involve a more comprehensive process of self-identification amongst contributing scholars in order to develop a holistic appraisal of the state of diversity. The relative lack of explicit attention to this issue within the analyzed texts further portends, we believe, the potential value in consulting popular or

non-traditional sources as a means of measuring broader public and expert opinion regarding linked accessibility issues. At the same time, this should be built up on a systematic analysis of primary scholarly texts such as we have provided here. We hope that this will provide a basis for future inquiry into this area, having wide-ranging implications beyond the intersection of art and technology development.

References

Bostrom, Nick. Superintelligence: Paths, dangers, strategies. OUP Oxford, 2014.

Denyer, D., and D. Tranfield. 2009. Producing a systematic review. In The Sage Handbook of Organizational Research Methods, ed. D.A. Buchanan, and A. Bryman, 671–689. London: Sage.

d'Inverno, Mark, and John McCormack. Computers and Creativity. Springer, 2012.

Kurzweil, Ray. The singularity is near. Gerald Duckworth & Co, 2010.

Doust, Richard, and Paul Piwek. "A model of suspense for narrative generation." (2017).

Gervás, Pablo. "Reviewing Propp's story generation procedure in the light of computational creativity." In *AISB Symposium on Computational Creativity, AISB-2014, April 1-4 2014*. 2014.

Gervás, Pablo, Raquel Hervás, and Carlos León. "Generating Plots for a Given Query Using a Case-Base of Narrative Schemas." In *ICCBR (Workshops)*, pp. 103-112. 2015.

Gervás, Pablo, Birte Lönneker-Rodman, Jan Christoph Meister, and Federico Peinado. "Narrative models: Narratology meets artificial intelligence." In International Conference on Language Resources and Evaluation. Satellite Workshop: Toward Computational Models of Literary Analysis, pp. 44-51. 2006.

Imabuchi, Shohei, and Takashi Ogata. "A story generation system based on Propp combined with a conceptual dictionary." In *Natural Language Processing and Knowledge Engineering (NLP-KE), 2011 7th International Conference on*, pp. 359-362. IEEE, 2011.

Imabuchi, Shohei, and Takashi Ogata. "Story generation system based on Propp theory as a mechanism in narrative generation system." In *Digital Game and Intelligent Toy Enhanced Learning (DIGITEL), 2012 IEEE Fourth International Conference on*, pp. 165-167. IEEE, 2012.

Jacob, Mikhail. "Towards Lifelong Interactive Learning For Open-ended Embodied Narrative Improvisation." In *Proceedings of the 2017 ACM SIGCHI Conference on Creativity and Cognition*, pp. 502-507. ACM, 2017.

Kaptein, Frank, and Joost Broekens. "The affective storyteller: using character emotion to influence narrative generation." In *International Conference on Intelligent Virtual Agents*, pp. 352-355. Springer, Cham, 2015.

Li, Boyang, and Mark O. Riedl. "A Phone That Cures Your Flu: Generating Imaginary Gadgets in Fictions with Planning and Analogies." *Intelligent Narrative Technologies* (2011).

Lllano, Teresa, Christian Guckelsberger, Rose Hepworth, Jeremy Gow, Joe Corneli, and Simon Colton. "What If A Fish Got Drunk? Exploring the Plausibility of Machine-Generated Fictions." (2016).

Loughran, Róisın, and Michael O'Neill. "Application Domains Considered in Computational Creativity." In Proceedings of the Eighth International Conference on Computational Creativity, ICCC, Atlanta. 2017.

Luckerson, Victor. "5 Very Smart People Who Think Artificial Intelligence Could Bring the Apocalypse. Time Magazine. December 2, 2014.

Magerko, Brian, Casey Fiesler, Allan Baumer, and Daniel Fuller. "Bottoms up: improvisational micro-agents." In Proceedings of the Intelligent Narrative Technologies III Workshop, p. 8. ACM, 2010.

Martin, Lara J., Brent Harrison, and Mark O. Riedl. "Improvisational Computational Storytelling in Open Worlds." In *Interactive Storytelling: 9th International Conference on Interactive Digital Storytelling, ICIDS 2016, Los Angeles, CA, USA, November 15–18, 2016, Proceedings 9*, pp. 73-84. Springer International Publishing, 2016.

Mateas, Michael, Peter A. Mawhorter, and Noah Wardrip-Fruin. "Intentionally Generating Choices in Interactive Narratives." In *ICCC*, pp. 292-299. 2015.

y Pérez, Rafael Pérez, Santiago Negrete, Eduardo Peñalosa, Rafael Ávila, Vicente Castellanos-Cerda, and Christian Lemaitre. "MEXICA-Impro: A Computational Model for Narrative Improvisation." In *ICCC*, pp. 90-99. 2010.

Propp, V., 1895-1970. Morphology Of the Folktale. Austin :University of Texas Press, 1968.

Porteous, Julie, Alan Lindsay, Jonathon Read, Mark Truran, and Marc Cavazza. "Automated extension of narrative planning domains with antonymic operators." In *Proceedings of the 2015 International Conference on Autonomous Agents and Multiagent Systems*, pp. 1547-1555. International Foundation for Autonomous Agents and Multiagent Systems, 2015.

Romero, Juan J., and Penousal Machado. The art of artificial evolution: a handbook on evolutionary art and music. Springer Science & Business Media, 2007.

Sarka, Peter, and Christine Ipsen. "Knowledge sharing via social media in software development: a systematic literature review." *Knowledge Management Research & Practice* (2017): 1-16.

Vuono, Vincent. "Interactive Storytelling via Intelligent Agents." (2008).

1. REFERENCES

[1] A. Abe. The possibility of the literary work generation by computer. In *Computational and Cognitive Approaches to Narratology*, pages 76–90. IGI Global, 2016.

[2] K. Agres, J. Forth, and G. A. Wiggins. Evaluation of musical creativity and musical metacreation systems. *Computers in Entertainment (CIE)*, 14(3):3, 2016.

[3] T. Akimoto and T. Ogata. A consideration of the elements for narrative generation and a trial of integrated narrative generation system. In *Natural Language Processing andKnowledge Engineering (NLP-KE), 2011 7th International Conference on*, pages 369–377. IEEE, 2011.

[4] T. Akimoto and T. Ogata. A visual interface for a collection of computer-generated narratives. *Information Engineering Express*, 1(4):43–52, 2015.

[5] T. Akimoto and T. Ogata. Designing a socially open narrative generation system. In *Computational and Cognitive Approaches to Narratology*, pages 91–117. IGI Global, 2016.

[6] C. Ariza. The interrogator as critic: The turing test and the evaluation of generative music systems. *Computer Music Journal*, 33(2):48–70, 2009.

[7] A. Ashida and T. Kojiri. Plot-creation support system for writing novels. In *International Conference on Computer Science, Applied Mathematics and Applications*, pages 107–116. Springer, 2017.

[8] R. Banerji. Maxine?s turing test–a player-program as co-ethnographer of socio-aesthetic interaction in improvised music. In *Proceedings of the Artificial Intelligence and Interactive Digital Entertainment (AIIDE?12) Conference*, 2012.

[9] S. Bell and L. Gabora. A music-generating system inspired by the honing theory of creativity.

[10] S. Bell and L. Gabora. A music-generating system inspired by the science of complex adaptive systems. *arXiv preprint arXiv:1610.02475*, 2016.

[11] T. R. Besold, M. Schorlemmer, A. Smaill, et al. *Computational creativity research: towards creative machines*. Springer, 2015.

[12] J. A. Biles. Performing with technology: Lessons learned from the genjam project. In *MUME 2013 Workshop*, 2013.

[13] T. Blackwell, O. Bown, and M. Young. Live algorithms: towards autonomous computer improvisers. In *Computers and Creativity*, pages 147–174. Springer, 2012.

[14] P. Bodily, B. Bay, and D. Ventura. Computational creativity via human-level concept learning. In *Proceedings of the Eighth International Conference on Computational Creativity*, 2017.

[15] S. Bosley, P. Swire, R. M. Keller, et al. Learning to create jazz melodies using deep belief nets. 2010.

[16] O. Bown. Player responses to a live algorithm: Conceptualising computational creativity without recourse to human comparisons? In *ICCC*, pages 126–133, 2015.

[17] O. Bown, P. Gemeinboeck, and R. Saunders. The machine as autonomous performer. In *Interactive Experience in the Digital Age*, pages 75–90. Springer, 2014.

[18] O. Bown and J. McCormack. Taming nature: tapping the creative potential of ecosystem models in the arts. *Digital Creativity*, 21(4):215–231, 2010.

[19] A. R. Brown. Ripples: A human-machine musical duet.

[20] A. R. Brown, T. Gifford, and B. Voltz. Factors affecting audience perceptions of agency in human computer musical partnerships. In *Proceedings of the 9th ACM Conference on Creativity & Cognition*, pages 296–299. ACM, 2013.

[21] A. R. Brown, T. Gifford, and B. Voltz. Stimulating creative partnerships in human-agent musical interaction. *Computers in Entertainment (CIE)*, 14(2):5, 2016.

[22] A. R. Brown, T. Gifford, and R. Wooller. Generative music systems for live performance. In *First International Conference on Computational Intelligence*, page 290, 2010.

[23] A. R. Brown and T. M. Gifford. Generation in context: an exploratory method for musical enquiry. In *The second international conference on music communication science*, pages 7–10. HCSNet, 2009.

[24] B. Carey. *_derivations and the Performer-Developer*. PhD thesis, University of Technology, Sydney, 2016.

[25] H. Chan and D. A. Ventura. Automatic composition of themed mood pieces. 2008.

[26] J. W. Charnley, A. Pease, and S. Colton. On the notion of framing in computational creativity. In *ICCC*, pages 77–81, 2012.

[27] E. Cherny, J. Lilius, J. Brusila, and D. Mouromtsev. A knowledge engineering approach to computational creativity in sound design.

[28] P. Chordia and A. Rae. Tabla gyan: An artificial tabla improviser. In *ICCC*, pages 155–164, 2010.

[29] E. T. Chourdakis, J. D. Reiss, et al. Constructing narrative using a generative model and continuous action policies. 2017.

[30] C.-H. Chuan and E. Chew. Evaluating and visualizing effectiveness of style emulation in musical accompaniment. In *ISMIR*, pages 57–62, 2008.

[31] A. E. Coca, R. A. Romero, and L. Zhao. Generation of composed musical structures through recurrent neural networks based on chaotic inspiration. In *Neural Networks (IJCNN), The 2011 International Joint Conference on*, pages 3220–3226. IEEE, 2011.

[32] N. Collins. Automatic composition of electroacoustic art music utilizing machine listening. *Computer Music Journal*, 36(3):8–23, 2012.

[33] N. Collins. A funny thing happened on the way to the formula: Algorithmic composition for musical theater. *Computer Music Journal*, 2016.

[34] N. Collins. Towards machine musicians who have listened to more music than us: Audio database-led algorithmic criticism for automatic composition and live concert systems. *Computers in Entertainment (CIE)*, 14(3):2, 2016.

[35] T. Collins, R. Laney, A. Willis, and P. H. Garthwaite. Developing and evaluating computational models of musical style. *AI EDAM*, 30(1):16–43, 2016.

[36] F. Colombo, A. Seeholzer, and W. Gerstner. Deep artificial composer: A creative neural network model for automated melody generation. In *International Conference on Evolutionary and Biologically Inspired Music and Art*, pages 81–96. Springer, 2017.

[37] E. Concepción, P. Gervás, G. Méndez, and C. León. Using cnl for knowledge elicitation and exchange across story generation systems. In *International Workshop on Controlled Natural Language*, pages

81–91. Springer, 2016.

[38] E. Concepción, G. Mendez, and P. Gervás. Mining knowledge in storytelling systems for narrative generation. In *Proceedings of the INLG 2016 Workshop on Computational Creativity in Natural Language Generation*, pages 41–50, 2016.

[39] J. Corneli, A. Jordanous, R. Shepperd, M. T. Llano, J. Misztal, S. Colton, and C. Guckelsberger. Computational poetry workshop: Making sense of work in progress. In *ICCC*, pages 268–275, 2015.

[40] N. Davis. Human-computer co-creativity: Blending human and computational creativity. In *Ninth Artificial Intelligence and Interactive Digital Entertainment Conference*, 2013.

[41] R. De Prisco, D. Malandrino, G. Zaccagnino, and R. Zaccagnino. An evolutionary composer for real-time background music. In *International Conference on Evolutionary and Biologically Inspired Music and Art*, pages 135–151. Springer, 2016.

[42] A. G. de Silva Garza and R. P. y Pérez. Towards evolutionary story generation. In *ICCC*, pages 332–335, 2014.

[43] M. Degli Esposti, E. G. Altmann, and F. Pachet. Introduction to the volume. In *Creativity and Universality in Language*, pages 1–6. Springer, 2016.

[44] K. Déguernel, E. Vincent, and G. Assayag. Using multidimensional sequences for improvisation in the omax paradigm. In *13th Sound and Music Computing Conference*, 2016.

[45] A. Eigenfeldt. Corpus-based recombinant composition using a genetic algorithm. *Soft Computing*, 16(12):2049–2056, 2012.

[46] A. Eigenfeldt. Embracing the bias of the machine: Exploring non-human fitness functions. In *Proceedings of the Artificial Intelligence and Interactive Digital Entertainment (AIIDE?12) Conference, Palo Alto*, 2012.

[47] A. Eigenfeldt. A composer?s search for creativity within computational style modeling. In *Proceedings of the 21st International Symposium on Electronic Art*, 2015.

[48] A. Eigenfeldt. Generative music for live musicians: An unnatural selection. In *ICCC*, pages 142–149, 2015.

[49] A. Eigenfeldt. Musebots at one year: A review. 2016.

[50] A. Eigenfeldt, J. Bizzocchi, M. Thorogood, and J. Bizzocchi. Applying valence and arousal values to a unified video, music, and sound generative multimedia work. In *Generative Art Conference, Venice*, 2015.

[51] A. Eigenfeldt, O. Bown, A. Brown, and T. Gifford. Distributed musical decision-making in an ensemble of musebots: Dramatic changes and endings. In *ighth International Conference on Computational Creativity, ICCC, Atlanta*, 2017.

[52] A. Eigenfeldt, O. Bown, and B. Casey. Collaborative composition with creative systems: Reflections on the first musebot ensemble. In *ICCC*, pages 134–141, 2015.

[53] A. Eigenfeldt, O. Bown, P. Pasquier, and A. Martin. The first musical metacreation weekend: Towards a taxonomy of musical metacreation. 2013.

[54] A. Eigenfeldt, A. Burnett, and P. Pasquier. Evaluating musical metacreation in a live performance context. In *Proceedings of the Third International Conference on Computational Creativity*, pages 140–144, 2012.

[55] A. Eigenfeldt and P. Pasquier. A realtime generative music system using autonomous melody, harmony, and rhythm agents. In *XIII Internationale Conference on Generative Arts, Milan, Italy*, 2009.

[56] A. Eigenfeldt and P. Pasquier. Negotiated content: Generative soundscape composition by autonomous musical agents in coming together: Freesound. In *ICCC*, pages 27–32, 2011.

[57] A. Eigenfeldt and P. Pasquier. Coming together: Composition by negotiation by autonomous multi-agents. *Computational Creativity*, page 221, 2012.

[58] A. Eigenfeldt and P. Pasquier. Creative agents, curatorial agents, and human-agent interaction in coming together. *Proceedings of Sound and Music Computing, Copenhagen*, pages 181–186, 2012.

[59] A. Eigenfeldt and P. Pasquier. Evolving structures for electronic dance music. In *Proceedings of the 15th annual conference on Genetic and evolutionary computation*, pages 319–326. ACM, 2013.

[60] A. Eigenfeldt, M. Thorogood, J. Bizzocchi, and P. Pasquier. Mediascape: Towards a video, music, and sound metacreation. *Journal of Science and Technology of the Arts*, 6(1):61, 2014.

[61] S. Ellis, A. Haig, S. Bringsjord, J. Valerio, J. Braasch, P. Oliveros, et al. Handle: Engineering artificial musical creativity at the ?trickery? level. In *Computational Creativity Research: Towards Creative Machines*, pages 285–308. Springer, 2015.

[62] S. Ellis, G. Naveen Sundar, S. Bringsjord, A. Haig, C. Kuebler, J. Taylor, J. Braasch, P. Oliveros, and D. Van Nort. Creativity and conducting: handle in the caira project. *Computational Creativity, Concept Invention, and General Intelligence*, 1:15, 2012.

[63] A. J. Elmsley, T. Weyde, and N. Armstrong. Generating time: Rhythmic perception, prediction and production with recurrent neural networks. *Journal of Creative Music Systems*, 1(2), 2017.

[64] M. Escarce Junior, G. Rossmann Martins, L. Soriano Marcolino, and Y. T. dos Passos. Blind creation: Emerging music through implicit collaboration. *TEAMAS 17*, 2017.

[65] M. Escarce Junior, G. Rossmann Martins, L. Soriano Marcolino, and Y. T. dos Passos. Emerging sounds through implicit cooperation: A novel model for dynamic music generation. 2017.

[66] P. Galanter. Computational aesthetic evaluation: automated fitness functions for evolutionary art, design, and music. In *Proceedings of the 15th annual conference companion on Genetic and evolutionary computation*, pages 1005–1038. ACM, 2013.

[67] T. Garner and A. Jordanous. Emergent perception and video games that listen: Applying sonic virtuality for creative and intelligent virtual agent behaviours.

[68] P. Gervás. Computational approaches to storytelling and creativity. *AI Magazine*, 30(3):49, 2009.

[69] P. Gervás. Engineering linguistic creativity: Bird flight and jet planes. In *Proceedings of the NAACL HLT 2010 Second Workshop on Computational Approaches to Linguistic Creativity*, pages 23–30. Association for Computational Linguistics, 2010.

[70] P. Gervás. Computational modelling of poetry generation. In *Artificial Intelligence and Poetry Symposium, AISB Convention*, 2013.

[71] P. Gervás. Reviewing proppâĂŹs story generation procedure in the light of computational creativity. In *AISB Symposium on Computational Creativity, AISB-2014, April 1-4 2014*, 2014.

[72] P. Gervás. Empirical determination of basic heuristics for narrative content planning. In *Proceedings of the INLG 2016 Workshop on Computational Creativity in Natural Language Generation*, pages 19–26, 2016.

[73] P. Gervás. An exploratory model of remembering, telling and understanding experience in simple agents. In *C3GI@ ESSLLI*, 2016.

[74] P. Gervás and C. León. Reading and writing as a creative cycle: the need for a computational model. In *ICCC*, pages 182–191, 2014.

[75] P. Gervás and C. León. Integrating purpose and revision into a computational model of literary generation. In *Creativity and Universality in Language*, pages 105–121. Springer, 2016.

[76] F. Ghedini, F. Pachet, and P. Roy. Creating music and texts with flow machines. In *Multidisciplinary Contributions to the Science of Creative Thinking*, pages 325–343. Springer, 2016.

[77] K. Grace, M. L. M. M. Mohseni, and R. P. y Pérez. Encouraging p-creative behaviour with computational curiosity.

[78] S. Harmon. Narrative-inspired generation of ambient music. In *ighth International Conference on Computational Creativity, ICCC, Atlanta*, 2017.

[79] S. Harmon and A. Jhala. Revisiting computational models of creative storytelling based on imaginative recall. In *International Conference on Interactive Digital Storytelling*, pages 170–178. Springer, 2015.

[80] D. Heath, A. W. Dennis, and D. Ventura. Imagining imagination: A computational framework using associative memory models and vector space models. In *ICCC*, pages 244–251, 2015.

[81] D. Herremans and C.-H. Chuan. International workshop on deep learning and music. In *Neural Networks (IJCNN)*, volume 18, page 19, 2017.

[82] R. Hervás and E. Plaza. Experience and creativity. 2015.

[83] R. Hodhod. Pharaoh: Conceptual blending of cognitive scripts for computationally creative agents. 2014.

[84] A. Hugill. Creative computing processes: musical composition. In *Service Oriented System Engineering (SOSE), 2014 IEEE 8th International Symposium on*, pages 459–464. IEEE, 2014.

[85] P. Hutchings and J. McCormack. Using autonomous agents to improvise music compositions in real-time. In *International Conference on Evolutionary and Biologically Inspired Music and Art*, pages 114–127. Springer, 2017.

[86] S. Imabuchi and T. Ogata. A story generation system based on propp combined with a conceptual dictionary. In *Natural Language Processing andKnowledge Engineering (NLP-KE), 2011 7th International Conference on*, pages 359–362. IEEE, 2011.

[87] D. Johnson and D. Ventura. Musical motif discovery from non-musical inspiration sources. *Computers in Entertainment (CIE)*, 14(2):7, 2016.

[88] D. Jones, O. Bown, J. McCormack, F. Pachet, M. Young, R. Berry, I. Asaf, and B. Porter. Stimulating creative flow through computational feedback. In *Dagstuhl Seminar Proceedings*. Schloss Dagstuhl-Leibniz-Zentrum fuer Informatik, 2009.

[89] A. Jordanous. A fitness function for creativity in jazz improvisation and beyond. In *ICCC*, pages 223–227, 2010.

[90] A. Jordanous. Evaluating evaluation: Assessing progress in computational creativity research. 2011.

[91] A. Jordanous. A standardised procedure for evaluating creative systems: Computational creativity evaluation based on what it is to be creative. *Cognitive Computation*, 4(3):246–279, 2012.

[92] A. Jordanous. Has computational creativity successfully made it" beyond the fence" in musical theatre? In *ICCC*, pages 303–310, 2016.

[93] A. Jordanous. Co-creativity and perceptions of computational agents in co-creativity. In *Proceedings of the Eighth International Conference on Computational Creativity, Atlanta, US. ACC*, 2017.

[94] F. Kaptein and J. Broekens. The affective storyteller: using character emotion to influence narrative generation. In *International Conference on Intelligent Virtual Agents*, pages 352–355. Springer, 2015.

[95] Z. Kondak, M. Konst, C. Lessard, D. Siah, and R. M. Keller. Active trading with impro-visor.

[96] B. Kybartas and R. Bidarra. A semantic foundation for mixed-initiative computational storytelling. In *International Conference on Interactive Digital Storytelling*, pages 162–169. Springer, 2015.

[97] B. Kybartas and R. Bidarra. A survey on story generation techniques for authoring computational narratives. *IEEE Transactions on Computational Intelligence and AI in Games*, 9(3):239–253, 2017.

[98] C. Lamb, D. G. Brown, and C. L. Clarke. Human competence in creativity evaluation. In *ICCC*, pages 102–109, 2015.

[99] C. León and P. Gervás. Prototyping the use of plot curves to guide story generation. In *Third Workshop on Computational Models of Narrative, 2012 Language Resources and Evaluation Conference (LRECâĂŹ2012)*, 2012.

[100] C. León and P. Gervás. Creativity in story generation from the ground up: Non-deterministic simulation driven by narrative. In *ICCC*, pages 201–210, 2014.

[101] B. Li and M. O. Riedl. A phone that cures your flu: Generating imaginary gadgets in fictions with planning and analogies. In *Intelligent Narrative Technologies*, 2011.

[102] A. Liapis, G. N. Yannakakis, and J. Togelius. Computational game creativity. In *ICCC*, pages 46–53, 2014.

[103] A. Linson, C. Dobbyn, and R. Laney. A parsimonious cognitive architecture for human-computer interactive musical free improvisation. In *Biologically Inspired Cognitive Architectures 2012*, pages 219–224. Springer, 2013.

[104] C.-H. Liu and C.-K. Ting. Music pattern mining for chromosome representation in evolutionary composition. In *Evolutionary Computation (CEC), 2015 IEEE Congress on*, pages 2145–2152. IEEE, 2015.

[105] L. Liu. When intelligence meets data: game story generation by compositional creativity. *International Journal of Creative Computing*, 1(2-4):274–307, 2016.

[106] M. Llano, R. Hepworth, S. Colton, J. Charnley, and J. Gow. Automating fictional ideation using conceptnet. In *Proceedings of the AISB14 symposium on computational creativity*, 2014.

[107] M. T. Llano, S. Colton, R. Hepworth, and J. Gow. Automated fictional ideation via knowledge base manipulation. *Cognitive computation*, 8(2):153–174, 2016.

[108] M. T. Llano, R. Hepworth, S. Colton, J. Gow, J. W. Charnley, N. Lavrac, M. Znidarsic, M. Perovsek, M. Granroth-Wilding, and S. Clark. Baseline methods for automated fictional ideation. In *ICCC*, pages 211–219, 2014.

[109] T. Lllano, C. Guckelsberger, R. Hepworth, J. Gow, J. Corneli, and S. Colton. What if a fish got drunk? exploring the plausibility of machine-generated fictions. 2016.

[110] R. Loughran, J. McDermott, and M. O?Neill. Grammatical music composition with dissimilarity driven hill climbing. In *International Conference on Evolutionary and Biologically Inspired Music and Art*, pages 110–125. Springer, 2016.

[111] R. Loughran and M. O?Neill. Generative music evaluation: why do we limit to ?human? In *Proceedings of the first Conference on Computer Simulation of Musical Creativity (CSMC 2016), Huddersfield, UK*, 2016.

[112] R. Loughran and M. O?Neill. The popular critic: Evolving melodies with popularity driven fitness. In *The Fourth International Workshop on Musical Metacreation*, 2016.

[113] R. Loughran and M. O?Neill. Clustering agents for the evolution of autonomous musical fitness. In *International Conference on Evolutionary and Biologically Inspired Music and Art*, pages 160–175. Springer, 2017.

[114] J. P. Magalhaes Martins. Emergent rhythmic structures as cultural phenomena driven by social pressure in a society of artificial agents. 2012.

[115] E. Manjavacas, F. Karsdorp, B. Burtenshaw, and M. Kestemont. Synthetic literature: Writing science fiction in a co-creative process. In *Proceedings of the Workshop on Computational Creativity in Natural Language Generation (CC-NLG 2017)*, pages 29–37, 2017.

[116] M. Marchini, F. Pachet, and B. Carré. Rethinking reflexive looper for structured pop music.

[117] W. Marley and N. Ward. Tightly coupled agents in live performance metacreations. In *Proceedings of the 2015 ACM SIGCHI Conference on Creativity and Cognition*, pages 299–302. ACM, 2015.

[118] T. R. Martinez, K. Monteith, and D. A. Ventura. Automatic generation of music for inducing emotive response. 2010.

[119] M. Mateas, P. A. Mawhorter, and N. Wardrip-Fruin. Intentionally generating choices in interactive narratives. In *ICCC*, pages 292–299, 2015.

[120] A. Matuck and G. F. Nobre. Robots that communicate and make art.

[121] P. Mawhorter. Reader-model-based story generation. In *Ninth Artificial Intelligence and Interactive Digital Entertainment Conference*, 2013.

[122] J. B. Maxwell. *Generative Music, Cognitive Modelling, and Computer-Assisted Composition in MusiCog and ManuScore*. PhD thesis, Ph. D. Dissertation. Simon Fraser University, 2014.

[123] J. McDermott, D. Sherry, and U.-M. O?Reilly. Evolutionary and generative music informs music hci?and vice versa. In *Music and human-computer interaction*, pages 223–240. Springer, 2013.

[124] S. McGregor, M. Purver, and G. Wiggins. Process based evaluation of computer generated poetry. In *Proceedings of the INLG 2016 Workshop on Computational Creativity in Natural Language Generation*, pages 51–60, 2016.

[125] G. Méndez, P. Gervás, and C. León. On the use of character affinities for story plot generation. In *Knowledge, Information and Creativity Support Systems*, pages 211–225. Springer, 2016.

[126] G. Méndez, R. Hervás, P. Gervás, A. Martın, and F. Julca. Exploring creative freedom in real time story generation.

[127] E. X. Merz. Composing with all sound using the freesound and wordnik apis. In *9th Artificial Intelligence and Interactive Digital Entertainment Conference, Boston, USA*, 2013.

[128] E. X. Merz. Implications of ad hoc artificial intelligence in music. In *Proceedings of the Artificial Intelligence and Interactive Digital Entertainment Conference (Raleigh, NC)*, 2014.

[129] J. Misztal-Radecka and B. Indurkhya. A blackboard system for generating poetry. *Computer Science*, 17(2), 2016.

[130] P. Mitrano, A. Lockman, J. Honicker, and S. Barton. Using recurrent neural networks to judge fitness in musical genetic algorithms.

[131] N. Montfort and N. Fedorova. Small-scale systems and computational creativity. In *International conference on computational creativity*, page 82, 2012.

[132] N. Montfort and R. Perez y Perez. Integrating a plot generator and an automatic narrator to create and tell stories. *On Computational Creativity*, 2008.

[133] N. Montfort, R. P. y Pérez, D. F. Harrell, and A. Campana. Slant: A blackboard system to generate plot, figuration, and narrative discourse aspects of stories. In *ICCC*, pages 168–175, 2013.

[134] F. Morreale and A. De Angeli. Collaborating with an autonomous agent to generate affective music. *Computers in Entertainment (CIE)*, 14(3):5, 2016.

[135] D. Morris and J. Secretan. Computational creativity support: using algorithms and machine learning to help people be more creative. In *CHI'09 Extended Abstracts on Human Factors in Computing Systems*, pages 4733–4736. ACM, 2009.

[136] S. Murray and D. Ventura. *Algorithmically Flexible Style Composition Through Multi-Objective Fitness Functions*. PhD thesis, Brigham Young University. Department of Computer Science, 2012.

[137] A. Nagelberg. *MICA: A Hybrid Method for Corpus-Based Algorithmic Composition of Music Based on Genetic Algorithms, Zipf's Law, and Markov Models*. University of Manitoba (Canada), 2014.

[138] C. Nakamura and T. Onisawa. Music/lyrics composition system considering user's image and music genre. In *Systems, Man and Cybernetics, 2009. SMC 2009. IEEE International Conference on*, pages 1764–1769. IEEE, 2009.

[139] M. Navarro, J. M. Corchado, and Y. Demazeau. A musical composition application based on a multiagent system to assist novel composers. In

ICCC, pages 108–111, 2014.

[140] M. Navarro-Cáceres, J. Bajo, and J. M. Corchado. Applying social computing to generate sound clouds. *Engineering Applications of Artificial Intelligence*, 57:171–183, 2017.

[141] J. Nika, M. Chemillier, and G. Assayag. Improtek: introducing scenarios into human-computer music improvisation. *Computers in Entertainment (CIE)*, 14(2):4, 2016.

[142] T. Ogata and T. Akimoto. *Computational and Cognitive Approaches to Narratology*. IGI Global, 2016.

[143] H. G. Oliveira and A. O. Alves. Poetry from concept maps–yet another adaptation of poetrymeâĂŹs flexible architecture. In *Proceedings of the Seventh International Conference on Computational Creativity*, 2016.

[144] B. O'Neill, A. Piplica, D. Fuller, and B. Magerko. A knowledge-based framework for the collaborative improvisation of scene introductions. In *ICIDS*, pages 85–96. Springer, 2011.

[145] S. Ontañón and J. Zhu. On the role of domain knowledge in analogy-based story generation. In *Proceedings of the Twenty-Second international joint conference on Artificial Intelligence-Volume Volume Two*, pages 1717–1722. AAAI Press, 2011.

[146] S. Ontanón, J. Zhu, and E. Plaza. Case-based story generation through story amalgamation. In *Proceedings of the ICCBR 2012 Workshops*, pages 223–232, 2012.

[147] F. Pachet. The continuator strikes back: a controllable bebop improvisation generator. In *The International Conference on Computational Creativity*, page 292, 2010.

[148] K. Parlakgümüs. Generative music composition software systems using biologically inspired algorithms: A sytematic literature review. 2015.

[149] P. Pasquier, A. Burnett, N. G. Thomas, J. B. Maxwell, A. Eigenfeldt, and T. Loughin. Investigating listener bias against musical metacreativity. In *Proceedings of the Seventh International Conference on Computational Creativity*, 2016.

[150] F. Peinado, V. Francisco, R. Hervás, and P. Gervás. Assessing the novelty of computer-generated narratives using empirical metrics. *Minds and Machines*, 20(4):565–588, 2010.

[151] G. Percival, S. Fukayama, and M. Goto. Song2quartet: A system for generating string quartet cover songs from polyphonic audio of popular music. In *ISMIR*, pages 114–120, 2015.

[152] J. Permar and B. Magerko. A conceptual blending approach to the generation of cognitive scripts for interactive narrative. In *Proceedings of the 9th AIIDE Conference*, 2013.

[153] M. Perovšek, B. Cestnik, T. Urbančič, S. Colton, and N. Lavrač. Towards narrative ideation via cross-context link discovery using banded matrices. In *International Symposium on Intelligent Data Analysis*, pages 333–344. Springer, 2013.

[154] A. Piplica, C. DeLeon, and B. Magerko. Gestural interactions for interactive narrative co-creation. In *Eighth Artificial Intelligence and Interactive Digital Entertainment Conference*, 2012.

[155] G. D. Poli, S. Canazza, A. Roda, and E. Schubert. The role of individual difference in judging expressiveness of computer-assisted music performances by experts. *ACM Transactions on Applied Perception (TAP)*, 11(4):22, 2015.

[156] J. Porteous, A. Lindsay, J. Read, M. Truran, and M. Cavazza. Automated extension of narrative planning domains with antonymic operators. In *Proceedings of the 2015 International Conference on Autonomous Agents and Multiagent Systems*, pages 1547–1555. International Foundation for Autonomous Agents and Multiagent Systems, 2015.

[157] A. Prechtl, R. Laney, A. Willis, and R. Samuels. Algorithmic music as intelligent game music. 2014.

[158] O. Puerto and D. Thue. A model of inter-musician communication for artificial musical intelligence. In *ighth International Conference on Computational Creativity, ICCC, Atlanta*, 2017.

[159] M. Riedl and C. León. Generating story analogues. In *AIIDE*, 2009.

[160] M. O. Riedl. Vignette-based story planning: Creativity through exploration and retrieval. In *Proceedings of the 5th International Joint Workshop on Computational Creativity*, pages 41–50, 2008.

[161] M. O. Riedl. A comparison of interactive narrative system approaches using human improvisational actors. In *Proceedings of the intelligent narrative technologies III workshop*, page 16. ACM, 2010.

[162] M. O. Riedl. Story planning: Creativity through exploration, retrieval, and analogical transformation. *Minds and Machines*, 20(4):589–614, 2010.

[163] M. O. Riedl. Computational narrative intelligence: A human-centered goal for artificial intelligence. *arXiv preprint arXiv:1602.06484*, 2016.

[164] M. O. Riedl and B. OâĂŹNeill. Computer as audience: A strategy for artificial intelligence support of human creativity. In *Proc. CHI Workshop of Computational Creativity Support*, 2009.

[165] M. Roemmele, A. S. Gordon, and R. Swanson. Evaluating story generation systems using automated linguistic analyses.

[166] R. Ronfard and N. Szilas. Where story and media meet: computer generation of narrative discourse. 2014.

[167] S. Rubin and M. Agrawala. Generating emotionally relevant musical scores for audio stories. In *Proceedings of the 27th annual ACM symposium on User interface software and technology*, pages 439–448. ACM, 2014.

[168] J. O. Ryan, M. Mateas, and N. Wardrip-Fruin. Open design challenges for interactive emergent narrative. In *International Conference on Interactive Digital Storytelling*, pages 14–26. Springer, 2015.

[169] B. Samuel. What comes next? an experiment in interactive narrative. In *Ninth Artificial Intelligence and Interactive Digital Entertainment Conference*, 2013.

[170] R. Saunders, P. Gemeinboeck, A. Lombard, D. Bourke, and A. B. Kocaballi. Curious whispers: An embodied artificial creative system. In *ICCC*, pages 100–109, 2010.

[171] M. Scirea, P. Eklund, J. Togelius, and S. Risi. Can you feel it? evaluation of a ective expression in music generated by metacompose. 2017.

[172] M. Scirea, J. Togelius, P. Eklund, and S. Risi. Affective evolutionary music composition with metacompose. *Genetic Programming and Evolvable Machines*, pages 1–33.

[173] B. Settles. Computational creativity tools for songwriters. In *Proceedings of the NAACL HLT 2010 Second Workshop on Computational Approaches to Linguistic Creativity*, pages 49–57. Association for Computational Linguistics, 2010.

[174] M. Shellard, L. F. Oliveira, J. Fornari, and J. Manzolli. Abduction and meaning in evolutionary soundscapes. *Book Chapter-pgs*, pages 407–428, 2010.

[175] M. Shellard, L. F. Oliveira, J. E. Fornari, and J. Manzolli. Abduction and meaning in evolutionary soundscapes. *NICS Reports*, (1):86–107, 2012.

[176] D. Singh, M. Ackerman, and R. P. y Pérez. A ballad of the mexicas: Automated lyrical narrative writing. In *ighth International Conference on Computational Creativity, ICCC, Atlanta*, 2017.

[177] B. Smith and G. Garnett. Reinforcement learning and the creative, automated music improviser. *Evolutionary and biologically inspired music, sound, art and design*, pages 223–234, 2012.

[178] B. D. Smith and G. E. Garnett. The education of the ai composer: Automating musical creativity.

[179] A. Stockdale. Cluegen: An exploration of procedural storytelling in the format of murder mystery games. In *Twelfth Artificial Intelligence and Interactive Digital Entertainment Conference*, 2016.

[180] B. L. Sturm. The ?horse? inside: Seeking causes behind the behaviors of music content analysis systems. *Computers in Entertainment (CIE)*, 14(2):3, 2016.

[181] C. Sulyok, A. McPherson, and C. Harte. Corpus-taught evolutionary music composition. In *Proceedings of the 13th European conference on artificial life, York, UK*, pages 587–594, 2015.

[182] C. Sulyok, A. McPherson, and C. Harte. Evolving the process of a virtual composer. *Natural Computing*, pages 1–14, 2016.

[183] M. Thorogood and P. Pasquier. Computationally created soundscapes with audio metaphor. In *ICCC*, pages 1–7, 2013.

[184] M. Thorogood and P. Pasquier. Impress: A machine learning approach to soundscape affect classification for a music performance environment. In *NIME*, pages 256–260, 2013.

[185] C.-K. Ting, C.-L. Wu, and C.-H. Liu. A novel automatic composition system using evolutionary algorithm and phrase imitation. *IEEE Systems Journal*, 2015.

[186] P.-L. Vaudry. Narrative generation by associative network extraction from real-life temporal data. 2017.

[187] V. Velardo and M. Vallati. On the stylistic evolution of a society of virtual melody composers. In *International Conference on Evolutionary and Biologically Inspired Music and Art*, pages 249–260. Springer, 2015.

[188] V. Vuono. Interactive storytelling via intelligent agents, 2008.

[189] C.-I. Wang, J. Hsu, and S. Dubnov. Machine improvisation with variable markov oracle: Toward guided and structured improvisation. *Computers in Entertainment (CIE)*, 14(3):4, 2016.

[190] G. A. Wiggins. A cognitive mechanism for spontaneous musical creativity.

[191] G. A. Wiggins, M. T. Pearce, D. Müllensiefen, et al. *Computational modeling of music cognition and musical creativity.* na, 2009.

[192] A. Wilson. factororacle: an extensible max external for investigating applications of the factor oracle automaton in real-time music improvisation. 2016.

[193] Y.-C. Wu and H. H. Chen. Emotion-flow guided music accompaniment generation. In *Acoustics, Speech and Signal Processing (ICASSP), 2016 IEEE International Conference on*, pages 574–578. IEEE, 2016.

[194] R. P. y Pérez. The three layers evaluation model for computer-generated plots. In *ICCC*, pages 220–229, 2014.

[195] R. P. y Pérez. A computer-based model for collaborative narrative generation. *Cognitive Systems Research*, 36:30–48, 2015.

[196] R. P. y Pérez, S. Negrete, E. Peñalosa, R. Ávila, V. Castellanos-Cerda, and C. Lemaitre. Mexica-impro: A computational model for narrative improvisation. In *ICCC*, pages 90–99, 2010.

[197] R. P. y Pérez and O. Ortiz. A model for evaluating interestingness in a computer-generated plot. In *ICCC*, pages 131–138, 2013.

[198] R. P. y Pérez, O. Ortiz, W. Luna, S. Negrete, V. Castellanos-Cerda, E. Peñalosa, and R. Ávila. A system for evaluating novelty in computer generated narratives. In *ICCC*, pages 63–68, 2011.

[199] M. W. Young, O. Bown, et al. Clap-along: A negotiation strategy for creative musical interaction with computational systems. In *Proceedings of the International Conference on Computational Creativity 2010*, pages 215–222. Departament of Informatics Engineering University of Coimbra, 2010.

[200] R. M. Young. Computational creativity in narrative generation: Utility and novelty based on models of story comprehension. In *AAAI Spring Symposium: Creative Intelligent Systems*, pages 149–155, 2008.

[201] B. Zhang and J. Lin. Elements of music based on artificial intelligence. In *First International Conference on Real Time Intelligent Systems*, pages 137–144. Springer, 2016.

[202] J. Zhu. On the role of domain knowledge in analogy-based story generation. *Evaluation*, 2(4):5, 2011.

[203] J. Zhu. Towards a mixed evaluation approach for computational narrative systems. In *International Conference on Computational Creativity*, page 150, 2012.

[204] J. Zhu and S. Ontañón. The sam algorithm for analogy-based story generation. *Artificial Intelligence*, pages 67–72, 2011.

[205] J. Zhu and S. Ontañón. Shall i compare thee to another story?âĂŤan empirical study of analogy-based story generation. *IEEE Transactions on Computational Intelligence and AI in Games*, 6(2):216–227, 2014.