

# *Creativity Ex Machina*

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**Abstract:** We praise our machines for their consistency, their speed and their precision, but rarely for their creativity or their insight. Yet why should we? Creativity is a very human-centric concept, after all, and the popular imagination has good reasons for placing humans and machines at opposite ends of the creativity spectrum. If we want our machines to exhibit the kinds of behavior that humans call *creative*, we shall just have to build (or teach) our machines to think more like we do. Yet the converse is also true: humans can often be more creative by choosing to act like machines, by emphasizing selection over generation and algorithms over intuitions. In the fertile middle ground between human and machine creativity, a new generation of creators is setting out to be creative in new ways: these *meta*-creators do not generate the products of creativity directly, but build autonomous systems to generate *for them*. As modern inheritors of the techniques championed by the Dadaists, the Surrealists and the beat poets, these systems explore new worlds of decidedly odd but beautifully resonant combinations. Such systems elevate themselves from mere generators to true creators only when they go *beyond* generation, and shoulder the artist's responsibility for selection, self-criticism and filtering too.

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## INTRODUCTION

Creativity is a concept in flux. All too often we put creativity on a pedestal, as though the very concept were itself a product of human artistry, carved from the enduring marble of received wisdom. Yet any notion that the linguistic tender of words like “*creativity*” and “*art*” is backed by a resolute gold-standard at the level of conceptual structures and formal definitions is itself just a convenient fiction. If we feel that we know creativity when we see it, our experience with art – the most paradigmatic domain (along with science) in which we perceive creativity – shows that the most creative art is that which causes the most people to shout “*That’s not art!*” or “*my five-year old could have done that!*” (e.g. see Hodge, 2012). For the reality belies the fiction, and our collective concepts of creativity and art are constantly being reshaped by new cultural, societal and technological forces. Each new century presents new challenges to our shared understanding of art, and by proxy, to creativity more generally (Sawyer, 2006). In the 20<sup>th</sup> century, three challenges in particular have cumulatively chipped away at our human-centric ideal of creativity, and opened up the possibility that machines can be more than tools in the hands of a creator, and be truly intentional, autonomous creators in their own right.

The first of these challenges was launched by Dadaist and artist-provocateur Marcel Duchamp (Kuenzli and Naumann, 1989). In 1917 Duchamp submitted a urinal to an exhibit of the *Society of Independent Artists* in New York. Cheekily titled *Fountain* and adorned with a signature of its supposed maker, “*R. Mutt 1917*”, Duchamp’s contribution is what artists call a *readymade* (Taylor, 2009), a “found” object with perceived merit that an artist chooses and presents as a work of art. While the Society initially rejected Duchamp’s *Fountain*, denying that it was any kind of art at all, it has since found lasting fame as one of the most influential artworks of the 20<sup>th</sup> century. Yet Duchamp had a much larger goal than the artistic rehabilitation of the much maligned urinal: his goal was to challenge cozy conceptions of what does and does not constitute artistic creativity. Duchamp’s *Fountain* asks us to view a piece of porcelain toilet-ware not just as an object with its own aesthetic value, but as a signifier for something larger: the artist’s power to decide on what constitutes art itself. Duchamp

(1917) anonymously defended *Fountain* in an article for the art journal *Blind Man*, arguing that: “*Whether Mr. Mutt made the fountain or not has no importance. He CHOSE it. He took an ordinary article of life, placed it so its useful significance disappeared under the new title and point of view - created a new thought for that object.*” Duchamp reimagined the artist as primarily a creator of meanings, and in doing so he dissolved the seemingly indissoluble bond between artifact generation and creativity. Before Duchamp, artists were expected to generate and to select, to skillfully produce and to critically filter. After Duchamp, creators were free to apply their selective aesthetics and critical filters to the skilled outputs of others, such as the artisan *J. L. Mott of 5<sup>th</sup> Avenue*, from whom Duchamp bought his urinal and to whom he playfully alludes with the signature *R. Mutt* (the initials R.M also denote *Ready-Made*).

The second challenge of the 20<sup>th</sup> century came from the “beat” writers Brion Gysin and William S. Burroughs (Burroughs, 1963; Lydenberg, 1987). Looking to the world of visual art to spur innovation in the world of literary creativity, Gysin believed that literary art lagged at least 50 years behind its visual sibling, and that recombinant techniques from the latter, such as collage, should be vigorously explored by exponents of the former. Dadaist-style word games, such as *exquisite corpse* – in which words are combined without regard to their context in an effort to trump the mind’s love of cliché – had long been popular as a parlor game amongst surrealists, but Gysin and Burroughs were to take these games to the next level with their randomized textual collages. These writers sought more than a conscious disavowal of cliché; they sought a radical means of escaping the deep-hewn ruts that unconsciously inhibit one’s spontaneity and creativity. As Burroughs put it, one “*cannot will spontaneity*” into being, but one can “*introduce the unpredictable spontaneous factor with a pair of scissors*”. The scissors here alludes to the *cut-up method* pioneered by Burroughs and Gysin, in which a linear text is sliced, diced and randomly re-spliced into new texts that give rise to new and unexpected meanings. The purpose of the method is two-fold: not only does it aim to create new combinations from old, it consciously aims to subvert existing idioms and to disrupt the mind’s unconscious efforts to group frequently co-occurring words and ideas into familiar gestalts.

Burroughs and Gysin built on the revolution launched by Duchamp in 1917, showing that not only does a creator *not* have to manually produce the key elements of their own works, whether linguistic objects or artisanal products, these elements need not be treated with the reverence traditionally given to an artistic output. Great violence could be done to them, and key decisions about their use and alignment could be made randomly, so as to exult in the sheer combinatorial possibilities of a domain. If the cut-up method is a vehicle for creativity, it is an off-road jeep, allowing a driver to veer off the trails blazed by other writers and to explore the negative space that is implicit in what has already been written (see e.g. Lydenberg [1987:44], who refers to the *Negative Poetry* of the cut-up method). As writer William Gibson (2005) put it, “*Burroughs was interrogating the universe with scissors and a paste pot.*” Yet as imagined by Burroughs and Gysin, the cut-up method is a vehicle that requires a human driver, someone to purposefully filter its outputs, to choose what is surprising but meaningful and to reject what is random and unusable.

The third challenge then, which has its roots in the 20<sup>th</sup> century but which is only forcefully asserting itself now, is the notion that any algorithm, such as the cut-up technique, might contain its own autonomous driver for deciding what is a meaningfully creative output or what is an innovative direction to pursue. Just as Artificial Intelligence (AI) is on the verge of giving us fully autonomous, driverless cars, AI is also close to giving us recombinant algorithms that can make their own creative decisions. When William Gibson met William Burroughs and asked whether the pioneer of the cut-up technique had yet embraced the new possibilities offered by modern computers, Burroughs disdainfully replied “*What would I want a computer for? I have a typewriter.*” (as reported in Gibson, 2005). The third challenge to our human-centric sense of creativity suggests that our tools can be more than mere tools, and more than mere generators to be guided by human hands. Computers are so much more than typewriters. The new field of *Computational Creativity* (CC) allows *meta*-creators to place their own creativity into their tools, to produce outputs that can delight *and* surprise us (see Wiggins, 2006, Veale, 2012). Moreover, CC allows our machines to follow their own creative trajectories, to diverge from the paths identified by their creators in much the same way that good students step out of their teachers’

shadows to find their own paths and their own voices.

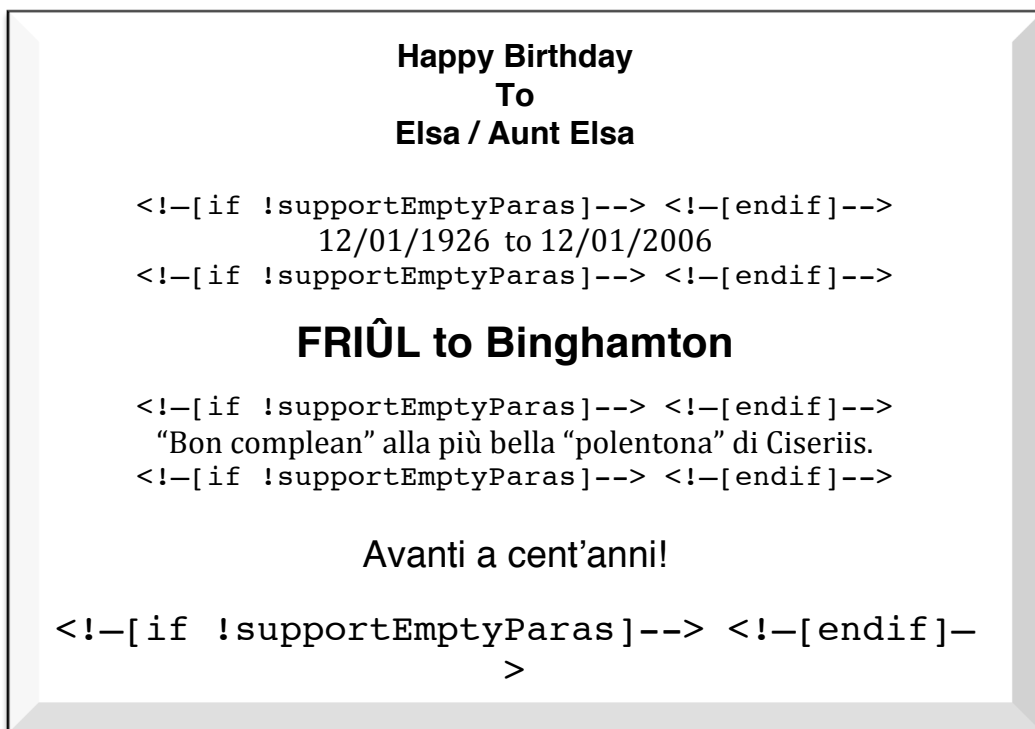
This chapter thus explores the core principles and techniques of CC as they relate to linguistic creativity. I begin in the next section by providing a more solid grounding of CC as a new sub-discipline of AI, before adopting a more specifically linguistic perspective in the sections to follow. By describing CC systems old and new – this review is necessarily selective – as well as those yet to be constructed, I aim to motivate why anyone would want the field of CC to thrive, and to show how CC systems can foster *more* rather than *less* creativity from the humans who work with them and create through them.

### COMPUTATIONAL CREATIVITY

Though who push against boundaries should not be surprised when those boundaries push back. Consider the case of Wegman's bakery of New York, which – courtesy of a special printer loaded with food dyes instead of inks – will decorate your cake with any text or digital image you care to provide via email. But technology can often throw the most unexpected of spanners into the works. *Microsoft Outlook*, for instance, inserts unseen HTML tags into its emails, for the benefit of recipients who happen to use the same email client. Those using a different program, such as Wegman's, may not always know what to do with these additional tags, if indeed they notice them at all as content is hurriedly cut-and-pasted from email client to printer interface. The cake shown in schematic form in Fig. 1 is a real product of the unintended bisociation of different email clients, one that garnered entirely the wrong kind of media attention for Wegman's in 2007. In an apologia of sorts, Wegman's explained the bakery's work-flow as follows: "*We just cut and paste from the email to the program we use for printing the edible images. We are usually in such a hurry that we really don't have time to check, and if we do the customers yell at us for bothering them.*"

So while it's tempting to blame the technology, the fault here lies mostly with the technology's human users, and residually with the human clients of its users. Ultimately, the cake of Fig. 1 arises from a lack of engagement with the processes of its production, rather than from the technological nature of these processes. While computers excel at executing a formal process that is grounded in explicit

rules, and can efficiently detect when an input or output fails to meet these rules, they fare less well at handling the emergent properties of unanticipated situations in sensible ways (though Wegman’s human employees fare no better here), or indeed, of recognizing that an exceptional case may be aberrant in a way that is novel *and* apt. Suppose this HTML cake had been intended for Tim Berners-Lee, or more poetically, for a Microsoft software developer; it might then be considered apt rather than inept. Of course, one can always program a software system with ever more rules, to anticipate a richer taxonomy of exceptions with an ever more nuanced set of predetermined responses. However, to the chagrin of AI researchers, who refer to this dilemma as the *frame problem*, new rules often breed new exceptions of their own, and so require even more new rules to fix, in an ever-spiraling bureaucracy of rules that govern rules that govern rules.



**Figure 1.** A genuine example of a birthday cake from Wegman’s Rochester NY bakery, with an unexpected sprinkling of raw HTML courtesy of Microsoft Outlook.

**<b><em>Delicious!</em></b>**

If the problem lies not in the rules but in a lack of engagement with the process of applying the rules, then the solution is not to abolish rules outright, but to

make our rule-based software systems more adaptive and sensitive to real usage data. Suppose that Wegman's bakery were to fully automate their cake creation service, to work unsupervised from a customer's email to a customer's front door. Let's call this hypothetical CC version of Wegman's service *Wegmachine*. Rather than hand-craft a raft of brittle rules, suppose we allow *Wegmachine* to learn and evolve its own rules and its own criteria for aesthetic judgment from a large collection of real cake commissions. Just as human artists hone their skills with years of practice, our hypothetical *Wegmachine* would likewise grow into its job, though at a much faster rate. To augment its corpus of past commissions, a *Wegmachine* might periodically download a stream of relevant images and text from online Christmas cards, birthday cards, Mothers' and Fathers' Day cards, and so on. For any holiday *H* for which one might buy a greeting card or a cake, pictures of representative *H*-cards with corresponding imagery and text can be automatically harvested from the Web and used as further training data. Language models can then be derived from the cards' pithily expressed sentiments, so that our *Wegmachine* can learn what one is likely to say, and what a cake is most likely to express, in diverse contexts, from "*It's a Girl!*" to "*Today You Are a Man.*" Cultural nuances that affect the choice of text or visuals, such as the subtlety of "*Happy Christmas*" vs. "*Happy Holidays*", as well as starker lessons still, such as that few cakes contain raw HTML tags, can be implicitly learned. Using basic image analysis techniques, a *Wegmachine* might even learn to associate clusters of visual features (such as colors, shapes, textures, font sizes and styles, etc.) with specific themes, target groups, ages and genders, since stores helpfully organize greeting cards by occasion, recipient age and gender.

An aptly decorated cake is still a cake that can be enjoyed as such. What then of purely textual creativity, which has only its form and its meaning to offer? Can a machine offer real meaning and real insight in the texts it produces, or must its texts derive their worth from being packaged with something of concrete value? An answer can be found, obliquely, in the following quote from Orwell's 1984:

*"The book fascinated him, or more exactly it reassured him. In a sense it told him nothing that was new, but that was part of the attraction. It said what he would have said, if it had been possible for him to set his scattered*

*thoughts in order. It was the product of a mind similar to his own, but enormously more powerful, more systematic, less fear-ridden."*

from George Orwell, "1984" (1949/1983:434).

Creativity often surprises us by cleverly re-packaging what we already know. So a computer can use its knowledge of the world to reason about the obvious consequences of those facts and rules, and still produce utterances of creative value, if it can crystalize these consequences in words that make apparent what the reader already knows but does not (yet) consider salient, or perhaps does not yet know how to clearly express for themselves. Our computers can assume the role of a "*mind similar to [one's] own*" (in the way it models the world), which is "*enormously more powerful*" (in its ability to retrieve and pull together relevant facts), "*more systematic*" (in its use of these facts), and "*less fear-ridden*" (insofar as it lacks any concern about social etiquette or fear for its own reputation). Machines may lack feelings, but they can express the possibilities of a situation in concrete ways that help to crystalize our own "*scattered thoughts*" and feelings.

To do this well, a machine must avoid two equally seductive poles that may be considered the Scylla and Charybdis of Computational Creativity. For one, it must avoid *mere generation*, the production of well-formed outputs that become the responsibility of someone else, typically the end user, to critique and filter. The cut-technique on its own is a technique for the mere generation of random splicings of text. It falls to the owner of the scissors to sort through the space of possibilities and select those with creative value, such as those that exhibit initially jarring but resolvable semantic tensions (Veale, 2014). Indeed, mere generation is so ingrained in the cut-up technique that Burroughs saw no real value in computers over typewriters, as the outputs of the technique would, in any case, still have to be filtered through his uniquely artistic sensibility. The second pole is *pastiche*, a problem that plagues human art as much as any machine. Creators can produce outputs that are sensible, meaningful and superficially novel by following too closely in a master's footsteps. One could, for instance, ape the style of Magritte and paint trivially novel pictures of bureaucrats whose faces are obscured with fruits other than apples, or of mantle pieces from which vehicles other than locomotives appear to burst out, just as a



computer might be trained to spatter a canvas with paint in much the same style as Jackson Pollack. Though one may hone an ability for pastiche to virtuoso levels, as in the case of the master Vermeer forger Han van Meegeren, the best one can aim for is to be considered an ingenious fraud, and not a true creator. Cut-ups and other recombinant production techniques flirt dangerously with pastiche and mere generation, but a true CC system must know enough to knowingly steer between these two polar extremes.

### COMPUTATIONAL LINGUISTIC CREATIVITY

The notion that creativity and insight might arise from searching a space of possible solutions is deeply entrenched in the language of problem-solving. We speak of “*searching for a solution*”, “*hitting a dead-end*”, “*taking the path less traveled*” and of being “*forced to back-track*” or to “*go back to square one.*” This search metaphor is, unsurprisingly, also key to the AI approach to problem-solving, most famously articulated by AI researchers Alan Newell, Cliff Shaw and Herbert Simon (1963). Though intelligence-as-search is now often ridiculed with the label GOFAI (for “*good-old fashioned AI*”; see Veale, 2012), it also forms the basis of Margaret Boden’s (1990/2004, 1999) conceptual spaces theory of creativity. In Boden’s view, creators explore an abstract space of possibilities, looking for areas of as-yet-untapped value. An explorer may use combinatorial means to traverse a space by combining aspects of past successes, or may, in rare cases, succeed in going outside the space itself, by changing the parameters that define the space to obtain a truly transformational result. Wiggins (2006) offers a formal CC treatment of Boden’s model, showing how transformational creativity is just exploratory creativity taken to the level of whole spaces, so that a radical creator searches through a *space of spaces*, looking for the right settings.

The geography of an abstract space does not afford its mental explorers the same abilities to grasp, follow and peer into the far distance as a physical terrain. The abstract terrain and its map are one, and afford a limited view of the search space as a whole. So it was apt of Gibson to describe Burroughs’ method as one of “*interrogating the universe with scissors and a paste pot.*” Abstract explorers must likewise interrogate a space – their universe of possibilities – by generating new

states (tentative solutions or way-points), by testing whether these states are viable, and by asking whether they take one closer to a desired goal state. To the extent that such actions are performed *blind*, in the absence of knowledge, any output from such a system must be a product of mere generation. Systems can negotiate a space using decomposition operators to pick apart the current state (Burroughs' *scissors*) and recombination operators to put its parts back together in random ways (the AI equivalent of Burroughs' *paste pot*) to generate new states, but any appreciation of these new states must employ some form of knowledge. Getting such knowledge into a computer is the bottleneck that most hinders the development of creative AI systems, and so AI/CC systems take their knowledge wherever they can find it. Naturally, the more superficial the knowledge, the more superficial the creativity that it affords to an AI/CC system.

Consider the development of CC systems adept at punning humour. Punning is often ranked bottom of the pile when it comes to wit, and this intuitive ranking is reflected in the level of sophistication and knowledge-engineering needed to build the computational equivalent of a human punster. Yet computer systems have proven quite successful at entertaining the target audience of most puns – children – and so this is no mean feat in itself. The JAPE system of Binsted and Ritchie (1997) generates punning riddles with a version of Burroughs' cut-up method: familiar phrases, or dictionary definitions of familiar words, are cut-up and recombined so that key elements are replaced with (nearly) homophonous alternatives. Thus, for instance, "*serial killer*" becomes "*cereal killer*", affording the punning riddle "*What kind of killer has fibre? A cereal killer*". Because children form the largest constituency for weak puns, a subsequent evolution of JAPE, called STANDUP (Ritchie *et al.* 2006), has proven useful for interacting with children with special learning needs. To these children, it matters not that JAPE and STANDUP rely on simple knowledge-sources (such as a phonetic dictionary) since they exhibit precisely the right kind, and just the right amount, of linguistic creativity to engage their audience. Puns remain an active area of CC research (e.g. see Hempelmann, 2008), not least because more can be done to generate outputs that hit the trifecta of sound similarity, semantic opposition (to yield a striking but meaningful incongruity) and pragmatic resonance.

That successful puns can be generated without insight into their meaning or as to why an audience might find them funny makes most CC pun creation an act of mere generation. Pun generation might also be considered a form of pastiche, insofar as it characterizes a CC system that skates on the surface of language, that relies too heavily of an existing stock of familiar phrases and idioms, and that lacks the wit to venture into the unknown territories of novel conceptual humor. This is a graded rather than binary distinction, for some CC systems may venture further away from familiar shores than others. Consider the *HAHAcronym* system of Stock and Strapparava (2006), which invents new expansions and meanings for familiar acronyms. Such humor combines punning with a degree of meaning invention, as found on T-shirts that proclaim their “FBI” wearers to be “*Female Body Inspectors*” or “*Full-Blooded Italians*”. *HAHAcronym* uses the lexical resource WordNet (a dictionary/thesaurus whose senses are organized taxonomically; see Fellbaum [1998] for an introduction and a range of its uses), as well as additional resources that indicate the general domain of a word sense (e.g. that *theology* is in the *religion* domain) and that indicate which senses exhibit a strong semantic or pragmatic opposition (e.g. *religion* and *science*). This knowledge allows *HAHAcronym* to re-invent meanings for familiar acronyms like MIT (“*Mythical Institute of Theology*”) that are superficially apt but which exhibit a deep incongruity (as e.g. MIT is strongly associated with technology). *HAHAcronym* uses more semantic insight than JAPE or STANDUP, yet its outputs are more constrained and this makes them seem more formulaic. *HAHAcronym* is noteworthy for another reason, however: it is the fruit of the first CC humour project to be directly and knowingly funded by the European Commission.

To what extent to existing CC systems, which wear their limitations openly, define the scope of future CC implementations? Each CC system may be seen as the patriarch of a family of yet-unborn systems that rely on the same techniques. The LIBJOG (LightBulb Joke Generator) system of Victor Raskin and Salvatore Attardo (1994) is the patriarch of CC systems that over-rely on templates that come complete with a convenient stock of fillers. As Raskin and Attardo note, LIBJOG is capable of generating light bulb jokes about members of various ethnic groups (such as “*Q: How many X-men does it take to change a lightbulb? A: It takes Y. One to hold the bulb and Y-1 to spin the room around.*”) only because the

desired jokes are effectively *baked into* the templates. Hempelmann (2008:338) argues that this failure of creativity is precisely the goal of LIBJOG: to expose the inherent limitations of systems that use templates without adequate knowledge. In this view, LIBJOG is not so much a CC system as a Duchampian prank, a trap into which subsequent humour systems like JAPE and STANDUP unwittingly fall.

Yet even humans obtain good mileage from templates and other rules and tricks for linguistic creativity. Consider what Matthew McGlone and Jessica Tofighbakhsh (1999) call the *Keats heuristic*, an insight about creative language that owes as much to Nietzsche (“*we sometimes consider an idea truer simply because it has a metrical form and presents itself with a divine skip and jump*”) as to John Keats (“*Beauty is truth, truth beauty*”). McGlone and Tofighbakhsh (2000) demonstrated that when presented with uncommon proverbs with internal rhyme (e.g. “*woes unite foes*”), subjects tend to view these as more insightful about the world than the equivalent paraphrases with no rhyme at all (e.g. “*troubles unite enemies*”). If the Keats heuristic is not exactly a license to pun, it is a license to rhyme, and to give as much weight (or more still) to the superficial aspects of linguistic generation as to the underlying semantics and pragmatics of poetry generation. As such, the Keats heuristic is implicitly key to the operation of almost every CC system to date for generating poetry (see e.g. Chamberlain and Etter, 1983; Gervás, 2000; Manurung *et al.*, 2012). If good human poets ask questions first and rhyme later, CC systems typically rhyme first and ask questions later, if at all. For if the human jury in the O.J. Simpson trial could be turned against bald facts with a Keatsian “*if the glove don’t fit you must acquit*”, readers of computer-generated poetry can be likewise persuaded to see meaning and deliberate resonance in any CC output that has a “*divine skip and jump.*”

For example, the Full-FACE poetry generator of Colton *et al.* (2012) uses a template-guided version of the cut-up method to mash together semantically-coherent text fragments in a way that meets certain over-arching constraints on metre and rhyme. The text fragments in question come from a variety of sources, such as from online news articles, from short social media messages (*tweets*), or from a large stock of stereotype-laden proverbial similes. News stories are a rich source of phrases that convey resonant images, and these can be clipped from a

news text using standard natural-language processing techniques. Likewise, tweets that use affective language to express strong emotional viewpoints can be extracted automatically using standard *sentiment analysis* lexicons and tools. Most interestingly, perhaps, a large stock of resonant similes, such as “*as blue as a blueberry*” or “*as hot as a sauna*” can be extracted from the texts of the World Wide Web using a search engine like *Google* (see Veale, 2012:61-86), since the simile frame “*as X as Y*” is specific enough to query for, yet promiscuous enough to allow a bountiful diversity of possible X:Y mappings. Such mappings can also be recast in a variety of poetic forms to make their clichéd offerings seem new again, as in “*Blueberry-blue overalls*” or “*sauna-hot jungle*.” Indeed, the very act of combining clichés can itself be a creative act, as evidenced both by the success of the cut-up method in general, and the success of specific cut-ups in specific. Consider William Empson’s withering analysis of the persnickety, cliché-hating George Orwell, whom Empson called “*the eagle eye with the flat feet*” (quoted in Ricks [1995:356], who admires Empson’s “*audacious compacting of clichés*”). The Full-FACE system is just one of many CC poetry systems that use an autonomous variant of Burroughs’ cut-up method, building tight constraints on form and loose constraints on meaning directly into Burroughs’ “*scissors and paste pot*”.

### LINGUISTIC CREATIVITY AS A SERVICE

Despite the radical shift initiated by Duchamp in 1917, who licensed artists to outsource key creation tasks to 3<sup>rd</sup>-party artisans, and by Burroughs and Gysin in the 1960s, who showed how artists might randomly but meaningfully mash-up the creative outputs of 3<sup>rd</sup>-party creators like so much *papier-mâché*, the popular imagination still sees the artist as a complete creator, one who does everything. In contrast, we accept that large companies will outsource many of their creative needs to external agencies with niche specialties and proven track records. Even *Apple*, a technology company with as much hipster appeal and artistic credibility as many highly-regarded human artists, has been known to reuse old ideas and to out-source creative tasks to outside agencies. Steve Jobs conceded a spiritual debt to Pablo Picasso, but built his legacy on following Marcel Duchamp and by elevating existing electronic commodities into desirable works of artistic design.

CC systems that aim for human-comparable outputs are often modeled on the idea of the lone artistic creator, yet a better model for CC systems is the company that is not afraid to out-source its creative needs whenever an external agency offers a superior service. Comparative advantage is as real a factor in the design of large CC systems as it is in the running of a large economies, especially when deep knowledge, or the flexible representation of such on a machine, is so hard to acquire, organize and robustly exploit in a computational system. It makes sense then that CC systems that possess certain kinds of knowledge, and that know best how to exploit it, offer themselves as specialist services that can shoulder some of the creative responsibilities of other CC systems. For instance, a CC system that has been carefully crafted to create metaphors on demand, or conceptual blends, or puns, or poetic couplets, and that has marshaled all of the necessary knowledge and lexical resources to fulfill this goal with aplomb, can offer its outputs to other systems that need metaphors or puns or blends. If multiple services later compete to offer metaphors on demand, then 3<sup>rd</sup>-party systems can shop around and choose whichever service works best for them.

Technologically, Web services are best-positioned to support this emerging marketplace of creative services (see Erl [2008] for a discussion of what constitutes a service-oriented Web architecture). The World-Wide-Web is a well to which human creators frequently return, and CC services can be established on the Web to invite both human and machine visitors to take up their offerings. Consider one such service – actually a suite of related services – called *Metaphor Magnet* (Veale, 2013a). *Metaphor Magnet* provides metaphors on demand for a given target, or a given pairing of target and source domains (readers may visit this service on the Web at: <http://boundinanutshell.com/metaphor-magnet-acl>). For instance, given the target *religion*, *Metaphor Magnet* will scour a large database of Web snippets (called the Google n-grams; see Brants and Franz [2006]) to find copula metaphors of the form “*religion is a Y*”. The values it retrieves for Y will vary from *comfort* to *myth* to *philosophy* to *virtue*. One can ask for just the negative metaphors by prefixing *religion* with a minus sign (*-religion*; for positive metaphors, *+* is used), spurring *Metaphor Magnet* to retrieve *sham*, *lie*, *cult*, *virus*, *scourge*, *delusion* and *fallacy*. Or one can ask for specific metaphors to elaborate on the general conceit that “*science is a -religion*”, prompting

*Metaphor Magnet* to view its negative metaphors for *-religion* through its knowledge of *science*, to offer views of science as a *complicated bureaucracy*, a *predetermined dogma*, a *troubling mystery* and an *irrational child*. The system acquires its stereotypes of children, dogmas, mysteries and bureaucracies largely from its large inventory of common similes, themselves harvested automatically from the Web (as described in Veale [2012]). These are the same similes exploited in Colton *et al.*'s Full-FACE system, and *Metaphor Magnet* can also be viewed as a knowledge-driven embodiment of the cut-up technique. Indeed, if ever there was a vast textual resource that was ideally suited to the autonomous generation of creative cut-ups, it is Google's Web n-gram database.

*Metaphor Magnet* provides a range of follow-up services for its metaphors. For instance, one might ask about the emotional resonances of a metaphor – how is an audience likely to feel about a given source concept? – and receive, in reply, a description of likely emotions, such as that troubling mysteries make one feel *troubled* (naturally), *confused*, *threatened*, *intimidated*, *perplexed* and *exhausted*. These feelings are suggested by corpus analysis, which observes how the typical properties of mysteries (*challenging*, *weird*, *engrossing*, etc.) are commonly coordinated with properties that convey feelings (*confusing*, *perplexing*, etc.). In addition, one might ask for a deeper, conceptual blending analysis of a metaphor (as defined in Fauconnier and Turner [2002]), to identify the specific emergent properties that arise from its pairing of ideas. For instance, when *science* is viewed as a *religion* it can be seen to possess an *analytical grip* (“analytical” from *science*, “gripping” from *mystery*), *complicated twists*, a *spellbinding fascination*, a *defined magic* and a *scholarly allure*. These bridging phrases are extracted from the Google n-grams database so as to marry a property of the source domain to one of the target domain, and thus suggest a nuanced blend-property that emerges from the integration of both domains. Bridging phrases are often poetic, and insofar as they originate in other literary works whose snippets are captured within the Google n-grams, they may be viewed as *linguistic readymades* that are ready to do service in newer literary contexts (the conceit of a linguistic readymade is developed at length in Veale (2012, 2013b)).

*Metaphor Magnet* will generate poems on demand for any of these blends, by

sampling the space of properties (both simple and blended) that emerge from each metaphor or blend, and by using linguistic readymades and familiar tropes – such as simile, superlative, rhetorical questioning, chiasmus, alliteration – to package each sampled property into its own poetic line (see Veale [2013c] for the technical details). One such poem, for *science as troubling mystery*, begins “*My science is an exhilarating mystery, sacred gods of rigorous description do sciences enshroud*” and ends “*Oh Science, you shock me with your impenetrable confusion.*” The key point here is not the quality of the text as poetry (like most CC poetry systems, *Metaphor Magnet* still has a long way to go), but its use of deliberate metaphors to bridge the worlds of *science*, *religion* and *mystery*. Of course, if any poem fails to please, another can quickly be generated to take its place.

### **BOT POETS AND THE TWEET GENERATION**

To see all that is good and bad about humanity we need only look at Twitter. Some users rise to the challenge of its 140-character message limitation, to craft aphoristic tweets with wit, allusion and high re-use value. Others brush-off the challenge and fill their tweets with prattle and bile. To see all that is good and bad about Computational Creativity, one should also look to Twitter. *Twitterbots* (where ‘*bot*’ is a common term for an autonomous software robot) are systems that generate their own tweets for the knowing enjoyment of human followers. No attempt is made to hide the software basis of most bots from their followers, though the converse is not always true, as in the case of the now infamous *@Horse\_eBooks* bot. This Twitterbot began as a simple application of the cut-up method, tweeting enigmatic but largely random gobbets of online books that were viewed by many as oddly poetic. Having attracted over 200,000 followers at its prime, the bot was sold to an artist/marketer who exploited its popularity, but comprised its autonomy, to distribute hand-crafted marketing materials. The outrage that ensued shows that modern Web users still appreciate the outputs of autonomous systems in a very different way to those generated by humans. The mechanical provenance of the creative output is a key part of its appeal, and an important dimension in its evaluation. One is reminded of Samuel Johnson’s quip about dogs who can stand on their hind legs: “*It is not done well; but you are*



*surprised to find it done at all.*" It is worth noting that Johnson addressed his quip to the topic of "*a woman's preaching*", a topic that now raises no eyebrows at all. Perhaps the same will be said of the "preaching" of CC bots in years to come.

This is not to say that most Twitterbots are CC Twitterbots, as most fall into the traps of mere generation or pastiche. Almost all employ the cut-up method in a non-reflective mode, to generate tweets that meet some formal constraints but about whose meaning or contextual aptness the system has no real insight. Bot designer Darius Kazemi (@*tinysubversions*) describes bots as *tiny subversions*, playful software systems that exist somewhere on the spectrum from Dadaist joke to conceptual art. Consider @*everyword*, a bot designed by Adam Parrish that tweets a single word every half hour. Though @*everyword* simply doles out successive entries from a large alphabetized word list, its many followers see it as a regular reminder of the importance of words in our lives, and retweet individual words when they seem to capture the current mood of the follower or of the news cycle. For instance, as reported by Dewey (2014) in the Washington Post, the @*everyword* tweet "*woman*" was retweeted thousands of times when its appearance coincided with the firing of the New York Times' female executive editor Jill Abramson (Dewey goes on to argue that the Twitterbot is quickly becoming a new modality of conceptual art). A bot named @*sandwiches\_bot* tweets a novel cut-up recipe for a different sandwich every lunch time, as in "*The Consultant: A fried or scrambled egg, brie and corned beef served on a buttered sesame bun.*" Yet it is a bot named @*twoheadlines* that comes closest to the spirit of Burroughs' and Gysin's use of the cut-up. This bot chooses two random headlines from an online news service, and splices them into a novel, well-formed, fantastical whole by clipping and swapping their named entities. Thus, a headline about Samsung releasing Q3 financial results becomes a headline about NSA whistleblower Edward Snowden releasing (*leaking?*) those results. When this bot works well it works very well indeed. Unfortunately, it lacks knowledge of the world to tell it which cut-ups will thrive and which will die on the page.

This lack of knowledge and linguistic know-how in merely generative bots is where creative Web services can turn unreflective bots into reflective CC bots. These CC bots can still be rapidly prototyped as lightweight *tiny subversions*, yet

marshal all the resources of a large, complex knowledge-based creative system. Consider a bot named *@AppreciationBot*, which feeds off the outputs of another bot called *@MuseumBot*. The latter demonstrates the power of simplicity by tweeting a new catalogue entry (photo & caption) from New York's *Metropolitan Museum of Art* four times a day. Its followers thus receive a regular jolt of art and culture in their daily Twitter feed. *@AppreciationBot* responds to each tweet by *@MuseumBot* with an apt metaphor, cast in the form of a critical appraisal. For instance, in response to the tweet "*Saint Simon*" (with a photo of the Met's statue of Saint Simon attached), *@AppreciationBot* tweets ".*@MuseumBot* A reigning tyrant. Interesting representation of a saint. Who would like this?". Critical adlibs (e.g., "*Who would like this?*") are chosen randomly from a list, but the metaphor in each case is sourced in real time from a Web service: *Metaphor Magnet*.

*@AppreciationBot* is a 3<sup>rd</sup>-party bot that shows the utility of Web services as reusable bricks in new CC systems. But it is the bot *@MetaphorMagnet* that is the full and official Twitter incarnation of the *MetaphorMagnet* service. It is instructive to compare this CC bot to the merely generative *@metaphorminute*, which playfully tweets a random metaphor every two minutes by filling a generic template – such as "*A T is an S: A, B and C*", where T denotes the target of the metaphor, S denotes its source, and A and B denote shared properties that are projected from S to T – with related words from the 3<sup>rd</sup>-party Web service *Wordnik*. This bot is an enigmatic yet mostly random user of words, generating tweets such as "*a separation is a stroma: blurred and transhuman*". In contrast, *@MetaphorMagnet* calls on its underlying service to squeeze metaphors, blends and emotions into poetic tropes and craft aphoristic tweets that exploit the Keats heuristic to the fullest. Examples include "*What is a monarch but an unelected senator? What is a senator but an elected monarch? #MonarchOrSenator?*" and "*#Irony: When some rulers appoint 'leading' governors the way bosses appoint submissive lackeys. #RulerOrBoss #GovernorOrLackey*". The bot, like most CC bots, is a work in progress: a meta-creator that captures the voice of its creator yet which explores new ways to surprise us with what we already know.

## CONCLUDING REMARKS

Since the heyday of Burroughs' and Gysin's cut-up technique, computers have gone from being powerful alternatives to the typewriter to potentially credible alternatives to the person that uses the typewriter. Though the field of CC is still inchoate, recent developments in the sphere of social media suggest that it will grow quickly as people warm to the social dynamics of computational creativity (e.g. see again Dewey [2014]). Not only do meta-creators inspire other meta-creators, their bots provide the necessary conceptual and linguistic impetus for other bots to do their thing. One especially exciting dynamic can be seen in the trend for autonomous bots to interact with other autonomous bots. To take a small but illustrative example: the *@youarecarrying* bot taps into the tropes and texts of classic text-adventure games (which, incidentally, were created at much the same time as Burroughs and Gysin developed the cut-up method) and tweets random collections of the game items that players were expected to acquire in those games (maps, swords, lanterns, ticket stubs, etc.). A rival bot, *@\_The\_Thief*, was quickly developed to exploit the outputs of the former, with a twist: *@\_The\_Thief* re-uses the vivid textual descriptions of thieves from old adventure games, to offer crime reports on how the items "carried" by specific followers of *@youarecarrying* have just been stolen by a colorfully novel criminal. Though such interactions are still merely generative, they raise the possibility of true CC bots that use language to creatively riff with each other, bringing the linguistic equivalent of jazz improvisation to the Twittersphere.

For just as a sufficiently expressive medium can eventually become its own message, a sufficiently complex tool may eventually become its own user. Whether everyone agrees with this perspective is beside the point, as producers and consumers of all stripes continue to squabble, and will always squabble, about the creative status of certain human artists and their outputs. What matters is that, when judged purely on performance, our CC systems are seen to produce outputs that are both novel and useful, and to produce them with such variety and virtuosity that the apparent ingenuity on display cannot be attributed to any simple trick or reductive technique. Computational Creativity may eventually lead to insights into the mechanics of human creativity – humans

define what it means to be “creative”, after all, and to play in this rigged game a computer may well need to tap into the same structures that allow us to innovate –but it is just as likely to force another historical shift in our collective concept of creativity, leading us to discriminate between human and machine creativity. But conceding the idea that computers may be creative, even in a very different way to humans, will be a seismic shift in itself.

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