

# How Generative Computer Systems can Mitigate Common Cognitive Problems of Creative Practice

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## Abstract

*Most art making can be described as a constructive process of incremental accretion and erasure. At a basic level, works are composed by the arrangement of granular elements like words, musical notes and brushstrokes etc. In the composition of an artwork, the addition, erasure and organisation of each of these elements represents the artist's decision about what goes where and/or when. In traditional art making, many of these creative decisions are instinctive and beyond the artist's conscious deliberation. These unconscious decisions are often based on learnt skill and techniques as well as formal heuristics that define an artist's signature style. However, unconscious decision making can also have a negative impact when, for example, cognitive 'sunk cost' bias leads to sub-optimal decisions. In generative computer practices, many of the granular decision heuristics required for the construction of a work become the purview of the system's automated decision-making processes. This can make a range of negative unconscious cognitive bias explicit and amenable to alleviation. This paper considers how this shift from human cognition to generative computer systems can mitigate common cognitive problems of creative practice and, how computers as creative partners can benefit the production of creative value.*

## Introduction

The recent rise of generative A.I suggests that human-computer co-creativity practices will become increasingly more widespread in the creative industries in the future. For many practitioners this will represent a significant paradigm shift to a fundamentally different way of working. The future extent of this shift will largely be driven by the creative benefits it can offer. However, relatively few studies have addressed the advantages for creative cognition that this transition may represent. This paper draws on my own experience as an artist to consider the possible creative benefits that such a shift might offer a broader range of practices and practitioners.

## Traditional and Generative Models of Process

This paper regularly refers to a 'Traditional Model of Process' and 'Generative Model of Process'. These terms first refer to my own development as an artist and second, as a distinction between [a] human-centric and [b] human-computer co-creativity practices. My transition from one

paradigm of art making to another was characterized by three distinct stages of my career as an artist.

**1. The Traditional Model.** In my traditional, pre-digital practice I would construct artworks piece-by-piece and step-by-step as a sequence of discrete acts over time. For example, in my photo-collage work, the sequential acts are defined in terms of selecting, cutting out and arranging printed photographic elements into a visual composition.

**2. The Traditional Model in a Digital Medium.** When I first began using digital media tools, the skilled artisanship required of traditional mediums and tools was replaced by the inbuilt virtuosity of software code. However, the traditional and digital modes of process remained unchanged from the perspective that artworks were still constructed piece-by-piece and step-by-step over time.

**3. The Generative Model.** The generative processes that have been the focus of my practice for the last two decades eschew manual step-by-step construction in favour of a software system that composes my visual imagery and animation artworks automatically and independently of my direct conscious engagement.<sup>1</sup> The focus of my creative process shifted to the design of generative systems and this has aligned my practice with a category commonly described as generative art by Boden and Edmonds (2009).

## Incremental Accretion

A second common term used in this paper is 'incremental accretion'. This term is used to describe the process of building an artwork via the piece-by-piece and step-by-step arrangement of its basic elemental parts. This is via human agency in the Traditional Model and, alternatively, via computational agency in the Generative Model.

It is proposed that the granular decision-making required of incremental accretion in the Traditional Model is responsible for a significant range of problems in creative practice and that these issues can be ameliorated via the Generative Model. In the following section I will establish that incremental accretion is a phenomenon of almost all creative practices. Consequently, human-computer co-creation may play a significant role in overcoming traditional problems of creativity across a broad spectrum of practices.

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<sup>1</sup> An overview of the author's generative art practice can be accessed online via: <https://talking-pictures.net.au/2021/01/30/murray-mckeich-the-imagination-machine/>

## Art and Increment

To identify the similarities and differences between my Generative and Traditional models of process, it is unavoidable that I begin with an adequate description of what I will henceforth regularly refer to as 'most art'. Although no widely accepted definition of art exists within contemporary theory, a simple and highly extensible account of art making is nonetheless possible if we approach it from a very basic level as a compositional process.

Most art works are perceptible artefacts or performances constructed via the artist's incremental accretion and organization of a vehicular medium. This approach describes most art as something constructed piece-by-piece and step-by-step by the skill and imagination of an artist so that its creative value is perceivable by someone else. This description of art does not provide any prescription for defining what is creatively valuable or significant in a work. It does, however, define that any work that is claimed to have creative value or significance is almost always made in the same way; piece-by-piece and step-by-step.

This account recognises 'art' as creative activity, more consistently recognisable as a kind of *process* than as a kind of *product*. Such a characterisation of art is not without precedent. For most of Western history, art was a term that described a type of activity or a way of doing something. It was only during the modernist era that theories of art shifted their primary focus to the aesthetic properties and experience of an artwork as an artefact or performance. When artists' intentions became less explicit, or arguably less important (Beardsley and Wimsatt Jr 1946), during the early 20th century, theories of art became focussed on the artefact. For example, in the earliest formalist theories of art, the organising agency of the artist was ancillary rather than central:

These relations and combinations of lines and colours, these aesthetically moving forms, I call 'Significant Form'; and 'Significant Form' is the one quality common to all works of visual art (Bell 1934).

Bell's account defines art primarily as a form imbued with special aesthetic properties or 'Significant Form'. However, within this description he obliquely outlines a model of creative process 'common to all works of visual art'. In the above quotation we can discern that 'Significant Form' is a collective property of multiple and more basic non-aesthetic forms 'lines and colours' arranged via multiple creative acts 'combinations'. If we accept this prescription, then the construction of art is characterised as the arrangement of elements into configurations that exhibit creative value. The following anecdote from the poet Paul Valéry (1954) is remarkable, not only for its array of creative protagonists, but also for its fundamental insight into making art:

The great painter Degas often repeated to me a very true and simple remark by Mallarmé. Degas occasionally wrote verses, and some of those he left were delightful.

But he often found great difficulty in this work accessory to his painting. One day he said to Mallarmé: "Yours is a hellish craft. I can't manage to say what I want, and yet I'm full of ideas..." And Mallarmé answered: "My dear Degas, one does not make poetry with ideas, but with words".

No-one could argue that ideas don't play an important part of both the making and experiencing of art. However, Mallarmé's rejoinder to Degas reveals a fundamental problem of making art. The way an artwork is often conceived, and almost always experienced, is at odds with the way it is made. The idea of an artwork is often said to begin with a holistic moment of inspiration or illumination. Similarly, we experience a completed artwork with relative immediacy, fluency and, if it is well formed, as an 'inclusive and fulfilling' whole' (Dewey 1958). In both cases the *parts* of a work are subsumed within its experience as a *whole*.

By contrast, most artworks are made by the incremental arrangement of many small parts over protracted and punctuated periods of time, deliberation and labour. The ubiquitous elementary particles of art are single brushstrokes, words and, as is the case of my digital practice, mouse clicks etc. The artist adds and subtracts elements one at a time and an artwork only emerges piece-by-piece and step-by-step. When we experience great art, it is hard to equate its singularity—its cohesive synthesis of form and/or content—with the pedestrian anonymity of its constituent parts; common words or daubs of paint. It is easy to lose sight of the fact that these simple raw elements are the only tangible things that artists ever have to work with. It could be claimed that an artwork's essential value is always greater than the sum of its parts.

We commonly value art for its ability to transcend the relative ubiquity of its raw ingredients. Mallarmé reminds us that these simple parts are the only concrete things from which the sum of art emerges. In similar terms, Jean Cocteau (1954) articulates the gulf between inspiration and realization: 'To write, to conquer ink and paper, accumulate letters and paragraphs, divide them with periods and commas, is a different matter from carrying around the dream of a play or a book.'

The relationship between the 'sum' and 'parts' of an artwork was addressed within the Russian modernist painter Wassily Kandinsky's (1977) extensive writing on art. He concisely articulated the part-to-whole relationship of art as both fundamental to the artwork and the process of its creation:

Pure artistic composition has two elements:

- 1, the composition of the whole picture
- 2, the creation of the various forms which, by standing in different relationships to each other, decide the composition of the whole. Many objects have to be considered in the light of the whole, and so ordered to suit this whole. Singly they will have little meaning, being of importance only in so far as they help the general effect.

## Aesthetic and Non-aesthetic

In a similar articulation of this part-to-whole relation, the aesthetic theorist Frank Sibley claimed that the aesthetic properties of an artwork were always a collective property of its non-aesthetic formal elements. Sibley (1965) offers the example that aesthetic properties such as 'balance' and 'unity' can only exist in 'something consisting of parts in relation.' Sibley's distinction between the aesthetic and non-aesthetic has had its detractors but his basic premise is endorsed by a rare consensus in aesthetic philosophy that higher perceptual properties are dependent on lower ones (Levinson 2005). Nick Zangwill (2007) has maintained a strong contemporary defence of Sibley's distinction:

We cannot just judge that something is beautiful; we must judge that it is beautiful in virtue of its non-aesthetic properties. In fact, we pretty much always do so, and not to do so would be bizarre. Of course, we might not have in mind every single non-aesthetic property of the thing, nor exactly how the non-aesthetic properties produced their aesthetic effect. But we think that certain non-aesthetic properties are *responsible* for the aesthetic properties and that without those non-aesthetic properties, the aesthetic properties would not have been instantiated.

Zangwill (2009) explicates the non-aesthetic nature of art's basic units of construction via the example of language: 'a word has meaning only in the context of a sentence, and similarly most aestheticians would assert that the elements of a work have significance only in the context of the whole work. The basic formal elements of an artwork are almost always drawn from the vehicular medium's pre-existing and culturally shared lexicon of value. For example, most films are an arrangement of standard film shots that include close-ups, tracking shots and establishing shots. The tools and materials of the plastic arts are relatively identical for all artists in the same way that that a common language is shared by many authors. Aesthetic value is an emergent property of the incremental accretion and organization non-aesthetic elements.

In this characterisation, we can discern a fundamental challenge at the heart of most art making. The late modernist painter Frank Stella (1996) attests to this in an account of his creative development:

The painterly problems of what to put here and there – and how to make it go with what was already there – became more and more difficult and the solutions more and more unsatisfactory. Until finally it became obvious that there had to be a better way.

The problems that Degas and Stella cite are common in artists' accounts of practice and it is not difficult to find similar and related examples from across all eras of western art. 'What to put here and there - and how to make it go with what is already there' is perhaps the most fundamental questions that an artist must continually answer in the process of making art.

## Exceptions

The ubiquity of incremental accretion in art making is perhaps best illustrated by the relatively few art forms that can be intuitively excluded from this category. In general terms these are 'straight' [un-manipulated] photography and 'ready-mades'. In both cases these artistic mediums can be said to capture, frame or re-contextualize an existing scene, artefact or configuration of properties. Rosalind Krauss (1977) noted the distinctive relationship shared by these two forms:

The ready-made's parallel with the photograph is established by its process of production. It is about the physical transposition of an object from the continuum of reality into the fixed condition of the art-image by a moment of isolation or selection.

Although in qualitative terms these mediums are highly significant to contemporary art and culture, they represent a minor quantitative fraction in a pan historical and cultural account of art making. The balance of art making is via 'the incremental accretion and organization of a vehicular medium'.

## Process Theories of Art

Considering the pervasiveness of incremental accretion as a process in art, it is not surprising that some theorists have discerned the possibility of forming a universally extensible theory of art based on the *processes* rather than the *products* of art. Gregory Currie (2004) has proposed the thesis that all artworks are action-types. David Davies (2004) has argued for 'process-centred' ontology of art as an alternative to standard 'product-centred' accounts. Zangwill (1995) has proposed a 'Creative Theory of Art' that foregrounds art as a process. Zangwill's account in particular represents the shift from a product to a process orientated account of art in the ongoing development of formalist theories. As previously noted, the earliest formalist accounts describe art in terms of artefacts that possess formal qualities appropriate to aesthetic experience. In a later formalist account articulated by Monroe Beardsley (1981), the balance between product and process becomes more evenly poised:

An artwork is either an arrangement of conditions intended to be capable of affording an aesthetic experience valuable for its marked aesthetic character, or [incidentally] an arrangement belonging to a class or type of arrangement that is typically intended to have this capacity.

This highlights Beardsley's ontological commitment to an account of art-as-experience, but with the phrase 'an arrangement of conditions' he manages to conflate both product and process within a single, empirically neutral concept. Stephan Davis (2005) notes that in the more recent version of Beardsley's account by Zangwill, a further change of emphasis has highlighted the process over the product in formalism. Zangwill (1995) describes art as the generation of aesthetic properties as a result of

the artist's insight that this could be achieved via the organization of certain non-aesthetic properties.

As I noted earlier, this paper is not concerned with defending any theory of art. Nor am I concerned with supporting an ontological distinction of art as process. I am however suggesting a common account of constructive process in art making. I have cited the process-based theories proposed by Currie, Davies and Zangwill because, although they may differ in their approach, they all foreground process as a means of finding common ground in art.

### **Art After Increment**

In the preceding sections I have made a case to establish incremental accretion as defining aspect of the Traditional Model of process in art making. It was not until I adopted a Generative [non-incremental] Model of process that I realised the degree of determinacy that incremental accretion exerted on key aspects of my art and the extent to which it fomented the most challenging problems in my practice. By examining incremental accretion in the knowledge that it is becoming possible to move beyond it, we can begin to imagine the scope and potential that lies in alternative paradigms like generative computation. In the following I review the benefits my practice has since achieved by adopting a Generative Model of artwork production and suggest that similar models of human-computer co-creativity can extend these advantages to a wide range of creative practices.

### **Productivity and Aspiration**

The Generative Model's most obvious benefit is the sheer productive potential of computational automation. However, quantity does not always equate to quality in a western conception of creative value. Despite this, we should not dismiss productive capacity too quickly. We may not judge the creativity of artists from the quantity of work they produce but the quantity of work they produce often plays a role in improving their creative quality. James A. McNeil Whistler declared that 'industry in art is a necessity — not a virtue' (Bowdoin 1901) and historiometric studies have shown that artists' productivity and their level of eminence are often isomorphically symmetrical (Simonton 1984).

Creative quality equates to productive quantity via the process of developing, exploring and testing the potential of novel techniques and artwork configurations. My own experience as an artist confirms this. My initial exploration of generative process was instigated by a lack of time. I believe that over the period I have been using generative processes I have advanced the creative quality of my work at a far greater pace than I did in my traditional practice. This was achieved with less average daily time than my pre-generative practice.

In the Traditional Model of process, the pace at which an artist can produce artworks is defined first, by the physiological speed limit of the human hand in accord with working memory, and second by the waking hours

available for practice. Limited time resources are barriers to creativity and according to Ericsson et al (2007) very few experts, including novelists and musicians, can engage in more than four or five hours of high concentration and deliberate practice at a time. Computers by comparison can operate interminably at accelerated speeds.

The constructive/synthesising potential of digital computers is not restrained by human physiology. Human action is single and serial, computation, like the human unconscious, is multiple and parallel. Donna Haraway (1991) writes, 'Our machines are disturbingly lively and we ourselves frighteningly inert.' In a Generative Model of practice, the pace of exploratory productivity can be performed at the vastly accelerated speeds of digital computation. The only physiological limit to creative capacity becomes the pace at which I can review and evaluate the discrete works produced by the system. The enhanced productivity of generative process can narrow the gap between aspiration and available resources.

### **Habit and Formula**

Davis (1999) lists six categories of barriers to creativity and first among them is 'learning and habits, which lead to stereotypic ways of thought and action.' The psychologist William James (1908) described habit in the following way:

The force of habit, the grip of convention, hold us down on the Trivial Plane; we are unaware of our bondage because the bonds are invisible, their restraints acting below the level of awareness.

New artisanal and conceptual skills begin as novel behaviours, learnt and refined via conscious and unconscious decision-making processes in relation to intentions. Subsequently, the use and refinement of these behaviours becomes steadily more 'skilled' [reflexive, unconscious and habitual] with repetition. There is evidence to suggest that skilled-based schema not only retain physical and conceptual values associated with their conscious development, but they also retain the evaluative criteria long after the initial conditions have expired.

A universal value within creativity is the production of novelty. However, the traditional model of process is based on the highly repetitive use skilled-based schema. Through largely tacit processes of cognitive efficiency, they become the formalised building blocks with which higher orders of conceptual organization act. In human cognition these schematic 'skills' are formed and habitually deployed at a level below conscious awareness. Reber (2003) notes that: 'The operations of implicit learning are shown to take place independently of consciousness; their mental products have been demonstrated to be held tacitly; their functional controlling properties have been shown to operate largely outside of awareness.' In short, they enshrine conceptual and evaluative values from past decisions that are enacted reflexively with all subsequent actions. They are mutable only by constant recourse to focused conscious re-evaluation and modification.

Bargh and Chartrand (1999) claim that: 'The necessary and sufficient ingredients for automation are frequency and consistency of use of the same set of component mental processes under the same circumstance.' The Traditional Model is based on incremental accretion and is thus highly susceptible to automaticity. Most artworks are comprised of at least hundreds, and more typically thousands, of discrete acts of construction. The average novel has between 80,000 and 120,000 words. Beethoven's ninth symphony has something close to 166,000 individual notes. The average Hollywood feature movie has between 1,100 and 1,200 individual 'shots' and modern action movies have considerably more (Bordwell 2006). Considering that most creative works require multiple revisions and alterations, the perceivable elements of a work represent a fraction of the total required in its construction. As Paisley Livingston (2005) has noted, the 'micro-plans' of accretive authorship are so many and constant that they often escape the conscious deliberation and awareness of the artist.

All creative processes that are incremental require the highly repetitive, and thus, largely automatic use of cognitive mechanisms that are formed and utilised beyond conscious scrutiny and control. Expertise is defined by the depth and complexity of these cognitive mechanisms, but their automaticity requires constant policing to maintain creative flexibility and development. Self-evaluation and regulation, or the intentional monitoring and guiding of one's own behavior are necessary for human performance in general and for creative thinking in particular [(Kitchner 1983), (Jausovec 1994)]. Experts need to use meta-cognitive schemes [thoughts about thinking] to counteract automaticity and bias but these are cognitively costly and one can never be sure that one is aware of negative bias. The conscious intention not to follow habit is compromised by the automatic behaviour that a goal will trigger (Hay and Jacoby 1996). Cognitively efficient heuristics are the basis of skilled expertise. However, the price paid for this skilled efficiency is a formulaic determinism that is often at odds with the values of creativity.

The ability to overcome the negative habits of practice is anticipated in certain Traditional practices by the strategic use of trained assistants. For example, the British Op Art painter Bridget Riley began a career-long practice of employing assistants to manufacture her paintings from the early 1960s onwards. According to Riley, this was not strictly for any advantage of increased production but responded to the need to distance herself from brush and paint in order not to fall into the trap of formula (Hill 2005). I could easily use Riley's words to explain my own decision to adopt generative software in my practice. Riley's example demonstrates the degree in which the work under construction can activate habitual responses and thus negatively impact on creativity. Her strategy of subordinating authorial agency to trained assistants is synonymous with my Generative Model of process.

## Reduction and Convergence

Although it has now been some years since I have made works via a traditional process of incremental accretion, I can still recall what the process was like. The blank page that preceded a new work seemed to represent an infinite potential. However, barring erasure and revision, this potentiality would steadily shrink with each incremental adjustment. The more elements that accumulated in a work the greater they pre-determined the compass of those that could follow. As an assemblage became more complex, the balance between elements became more delicate and less amenable to change. The emergent order of a work planned or otherwise, would determine an ever-narrowing path by which it could move forward. With less room to manoeuvre, the final stages of production could often become the most protracted and arduous.

Other artists experience this phenomenon of creative process. Gerhardt Richter noted that bringing a painting's elements into relation 'becomes more and more difficult the further a picture has progressed (Siegel 1988).' The gradual ossification of creative activity seems to occur in a range of mediums and practices. An Australian study of creative process among professional installation artists, painters, photographers, printmakers and sculptors noted the following common phenomenon:

Although at the beginning of making the work there may have been large increments of change, these adjustments get smaller and smaller as the artwork concept is defined and nears completion (Mace and Ward 2002).

Creative activity in the Traditional Model of process converges towards a single possible outcome via a single linear sequence of acts. The ability of the work to branch off and explore multiple alternative end states is confined by human limits on multi-tasking and the expenditure of time this requires via incremental accretion.

In my Generative Model of process, a large range of possible configurations is produced in parallel. The number of variations produced is not constrained by my physiological limits. Instead, it is my capacity to review and evaluate works that defines the size of the population of works produced. For example, in the case of still images I have found that 1200 can be usefully reviewed and final selections made within a short working day.

## Conservation Bias

Human decisions are based on the calculation of reward in relation to risk. In a Traditional Model of process, the cost of time in the creation of an artwork is considerable. Although artists have a higher-than-average aversion to risk (Lubart and Sternberg 1995), the conservation of effort is a strong cognitive impulse that influences any heavy investment of a limited resource such as time. It is for this reason that artists often persist with a work, an idea or a part thereof for a long time before they reluctantly admit defeat and set aside the work permanently or temporarily or erase and revise a part of it.

A curious phenomenon of cognitive efficiency is that novel solutions are actively inhibited. Inhibitory processes

suppress alternative means to the same end. An aspect of cognitive efficiency that inhibits the exploration of creative alternatives is the 'goal looms larger effect'. In this cognitive phenomenon, the unconscious motivation to complete a goal automatically grows stronger as one gets closer to its attainment (Shah 2005). As the achievement of a goal draws nearer, an automatic inhibitory process protects the sunk cost of effort by suppressing the consideration of alternative goals.

This instinct to protect the expenditure of spent energy reduces the potential for risk-taking as the volume of increments grows. Incremental construction can tend towards the maintenance of equilibrium at each incremental stage. However, it is possible that some unproductive addition to the work at one stage may, by virtue of later additions, prove valuable in the long term. For this reason, the 'Deferral of Judgement' has proved to be a key strategy of creativity. The painter Chuck Close (1992) notes 'I keep working so that I never have to take a break, look at the work, and be critical of it.'

Gerhard Richter (1995) similarly states that 'like everyone else, I am constantly critical of countless kinds of things but not when I am painting.' The 'deferral of judgment' is a key strategy in the process of 'brainstorming', a group creativity technique designed to generate a large number of ideas for the solution to a problem (Osborn 1948). By deferring judgment, a solution that proves inadequate at an early stage proves adequate at a later stage of development. The creative benefits of deferring judgment relate to other concepts associated with enhanced creativity:

**[a] Limited Commitment Mode** has been noted as a key strategy in large-scale design projects (Goel 1995). As the term suggests, experienced designers solve problems by remaining uncommitted to specific solutions for as long as practicably possible in the early periods of the design process. This means thinking in broad abstractions as opposed to particulars. Experienced designers are more likely than novices to use Limited Commitment Mode (Kim et al. 2007).

**[b] Resistance to premature closure** is one of the assessment criteria in the Torrance Tests of Creative Thinking [TTCT] (Torrance 1966). By keeping one's mind open and delaying closure, more possibilities can be considered, and more impressive and original images can be made.

**[c] Tolerance of ambiguity.** Torrance's (1974) early creativity tests also identified the tolerance of ambiguity as a key personality trait of creative individuals. The ability to tolerate unresolved or contradictory events or situations was acknowledged by Guilford (1950) as a common personality trait of creative practitioners as have many subsequent lists including Sternberg and Lubart's (1995) 'five attributes' and Davis's (1975) 'sixteen traits'. The tolerance of ambiguity features in accounts of creativity from Barron (1968), Torrance (1979) and Kirton (2004). Martindale (1990) identifies

an even earlier recognition of this trait in Samuel Taylor Coleridge's claim that 'creativity required the ability to "exist in ambiguity" or to tolerate disorder'.

As I have noted, the principal of cognitive economy exerts a powerful tacit influence on behavior and the instinct to protect an investment of energy and time. When building an artwork via incremental accretion, there can be a reflex to protect the 'sunk cost' of effort by preserving the existing configurations and values in a work. However, this instinct must be balanced against the possible creative benefits offered by deferring judgement and tolerating 'mistakes'.

In a Generative Model, the conservation of spent time is irrelevant to the relatively endless productive capacity of the computer. 'Ambiguity' is tolerated, 'premature closure' can be resisted, and aesthetic judgement is deferred to a completed works final versions and not its constituent parts in isolation of a completed whole.

## Objectivity and subjectivity

Judgement can be deferred only for so long. At some stage the artist must make one last set of decisions. Is the work good enough and is it finished? Central to any socialised or professional practice is the artist's ability to objectively evaluate their work in relation to the cultural milieu to which they are contributing. To have this evaluation wrong can result in professional failure, either commercial or critical. Most art making requires, as a critical necessity, that the artist have some capacity to imagine the experience of their work as an audience would.

This can be a difficult skill. Paul Gauguin wrote 'It is true that one is not a good judge of one's own work...'. (Chipp 1968). Gauguin did not lack self-confidence, and, in fact, he generally thought himself a very good judge of his own work. Such self-belief is often a necessity when artists are exploring new ground. However, when Gauguin questions an artist's ability to be objective, he acknowledges a commonly recognised problem of practice. Studies of creative process in a variety of mediums confirm the anecdotal evidence that artists often have difficulty determining whether a work is finished, and it has been suggested that this may reflect the difficulty of making objective evaluations while still emotionally engaged with the work (Mace and Ward 2002).

Critical objectivity may be difficult for several reasons. First, during the work's intermediate states of construction, the artist must imagine how incremental decisions will impact on a work well in advance of its completion. Second, incremental accretion over extended periods of time inevitably results in a great deal of reflective attention and speculation. Just as an oft-repeated word loses its immediate and sensible meaning [a phenomenon known by the terms 'semantic satiation' or 'semantic saturation'], the artist's long intimacy with the work is desensitising. By contrast, an audience comes to a work innocent of this process. They encounter the work as a completed whole

and, in psychological terms, they experience it via immediate and non-reflective primary processes. The artist, intimate with the work's details, particulars and history of construction, can never hope to completely share or anticipate the audience's experience.

Artists often develop techniques to gain objective insights on a work. The most common is to simply set the work aside for some period before regarding it later with fresh eyes. The Baroque artist Gian Lorenzo Bernini offered the following advice:

There are two devices which sculptors can use to judge of his work: one is not to see it for a while; the other – whenever he does not have leisure for the former – is to look through spectacles which will change its colour and magnify or diminish it, so as to disguise it somehow to his eye, and make it look as though it were the work of another, removing by this means the delusions caused by *amour-propre* [French: self-love] (Goldwater and Treves 1987).

Making art via incremental accretion requires a balance of subjective engagement and objective distance. The psychologist Mary Henle (1962) argued that creative activity is conducted with detached devotion. This describes a psychological state in which an artist's passionate commitment and interest in an activity is combined with a critical detachment. Henle's account suggests a bifurcated cognitive agency of *worker* and *watcher*. This accords with artists' accounts of being an audience to their own activity in periods of 'flow-like' experience.

An important benefit my practice has gained from the Generative Model of process is that I never experience an artwork during its intermediate steps of construction. My first direct experience of a work is only ever as a complete and finished whole, as it would be for someone seeing the work for the first time. Although I naturally anticipate certain kinds of formal and thematic outcomes during the incremental construction and design of the generative system, this is only at a highly abstracted level. Because my decisions cannot anticipate any specific outcomes, my decisions are orientated towards maximizing surprise. Invariably, when I review a population of constructed works, it is the totally unanticipated configurations that I select as final outcomes.

In the traditional model of incremental accretion, the extended construction time is always in excess of the affective experience of viewing a completed work. A phenomenon akin to image fatigue or semantic saturation alienates the artist from an ability to view a work objectively or with the innocent eye of an audience. In a Generative Model of process, I come as close as possible to being an innocent audience to my own art.

## Authorial Distance and Intimacy

The values of expression and representation in art often depends on the artist disappearing from his or her work in some way (Eliot 1928). Barring works of explicit and deliberate self-expression [if such a thing is even possible], the sublimation of authorial identity and agency is commonly integral to both the artist's experience of making a work and an audience's experience of perceiving it.

From the artist's perspective, creative spontaneity via the sublimation of conscious artifice has often been associated with the expressive authenticity. From the audience's perspective, a work of mimetic representation or fiction requires what Samuel Taylor Coleridge (2008) described as their 'willing suspension of disbelief.' Such works suffer when any obvious traces of the artist's labour and premeditation disrupt the smooth illusion of a reality. Creating form from incremental steps requires 'hiding' the authorial trace of incremental granularity and its inherent artifice.

In the traditional model of creative process, considerable levels of pre-meditated artifice are required to organise unformed matter into seamless aesthetic unities. Incremental construction in small steps demands a high level of intimacy between artist and work. In a Generative Model of practice, authorial sublimation is via computational agency. For the artist this approaches a near-absolute degree of spontaneous creative efficacy by circumscribing the sustained engagement required of incremental accretion. The unpredictability of computational randomness can obscure the artifice of considered composition.

## Inspiration and Realisation

Wrestling with recalcitrant ideas is a common source of creative toil and despair and much of the effort in art making is expended via erasure and revision (Hayes 1989). The final area of creative benefit I suggest is counter intuitive. In at least one regard, computational co-creative systems could be considered as making art making more human. The phenomenon of incremental accretion and its fine-grained division of labour and cognition across extended periods of time is at odds with the holism of the inception and experience of art. Computational co-creative systems can potentially negate this incongruity.

In psychological terms, the conception of an artwork [incept] is often akin its experience as a completed work. In both cases the artwork is perceived as a unitary whole, experienced with relative immediacy, oblivious to particulars and unmediated by the secondary processes of rational reflection. Art often begins in the imagination as a holistic singularity [(Croce 1953), (Arieti 1976)]. The following description of inspiration provided by Collingwood (1938) could serve equally as well to describe the initial experience of a finished artwork:

Thus, what I imagine, however complex it may be, is imagined as a single whole, where relation between the parts are present simply as qualities of the whole.

Collingwood believed that artworks are conceived in the imagination as singularities but to create art in its particulars required a secondary process of 'analytical thought'. Collingwood viewed the challenge of art making as the problem of dividing the indivisible: 'an indivisible unity it becomes a manifold, a network of things with relations between them'.

Ideas that seem so perfectly formed and feasible in the imagination have a habit of evaporating when subjected to the reality of construction. The gulf that separates an artist's inspiration from its realization in form is articulated in these words from the American composer Aaron Copland (1980):

The inspired moment may sometimes be described as a kind of hallucinatory state of mind: one half of the personality emotes and dictates while the other half listens and notates. The half that listens had better look the other way, had better simulate a half attention only, for the half that dictates is easily disgruntled and avenges itself for too close inspection by fading entirely away.

In the Traditional Model of process, the path between conception and realisation requires the artist to move through an extended period of incremental construction. In contrast, the Generative Model of process largely sidesteps this source of frustration by quarantining the artist from these alienating particulars of construction. Creative process maintains an ontological consistency between the conception and experience of an artwork and bypasses the notion of translating imagined singularities into externalised particulars or, in Collingwood's words, 'dividing the indivisible'.

## Objections

We can summarize the discussed benefits of the Generative Model in the following generalized terms. The cognitive processes of the Traditional Model are largely tacit, and often beyond conscious awareness and redress. If we consider the design of processes in a Generative Model as the creative *medium* in which an artist is working—and that these processes are equivalent to, and a replacement for, human heuristics and bias—then the computer-based processes are beneficial by virtue of being explicit and instrumentally adjustable.

However, it could be argued that building generative systems simply shifts the problems of incremental agency from one medium to another. My generative systems can autonomously make artworks, but I still need to make the systems and I can only build such a structure via a linear sequence of incremental steps through time. The potential problems associated with incremental accretion (habit and convergence etc.) may have been ameliorated from the

level of an individual art-works construction, but they remain entrenched at the level of incremental system building.

For example, we can consider the negative inhibitory aspects of conservation bias discussed earlier. When constructing an artwork via a Generative Model, the sunk cost of computational time is of little consequence and high-risk heuristics can be maintained, insulated from bias, throughout an accretive process that is human-independent. Nevertheless, conservation bias is not totally alleviated from a practice. Designing and calibrating a generative software system can be a cognitively demanding and time-consuming. It is a process that requires its own type of repetitive decision making and is heir to the subsequent pitfalls of 'sunk cost' and conservation bias. This tier of practice represents its own set of problems for a practitioner and a point at which the extent of our proposed benefits terminate. The benefits I'm suggesting accrue from the creative value of the art works produced as opposed to the specific systems that build them. To avoid circularity, this study avoids any suggestion its proposed benefits may extend to systems that can design systems.

## Conclusion

This study has examined the ubiquity of incremental accretion as a common phenomenon of most art making. We've also established the high level of determinacy that this exerts on key aspects of practice and the extent to which this can foment challenging problems for practitioners. We conclude that the reduction of granular human cognitive processes via human-computer co-creativity may have the potential to benefit most art practices. Human-computer co-creative systems may not only ameliorate the creative limitations of the human mind and body, but they may also have the potential to form a more seamless, spontaneous and ontologically consistent path between the conception, construction and experience of the art object.

Although the ideas offered in this paper are based largely on observations and outcomes of my own experience as an artist, there is a growing opportunity to build on this via wider study. The rapid rise of generative A.I. and its integration into a widespread range of creative industry practices is producing a cohort of practitioners that have, like me, transitioned from a Traditional to a Generative Model of practice. This offers the opportunity for further quantitative and qualitative study of how generative computer systems can mitigate common cognitive problems of creative practice.



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